INTERNATIONAL CONFERENCE ON "EMERGING STRATEGIES IN NUTRITION, FOOD & LIFESTYLE FOR HEALTH MANAGEMENT (ICESN'24)"

VOLUME - I

Editors

Dr. M. V. Alli, Lt. Dr. S. Ithayamalar

Dr. L. Jayaprada, Dr. R. Sakthi






Department of Nutrition and Dietetics

Seethalakshmi Ramaswami College

Autonomous

Affiliated to Bharathidasan University

Tiruchirappalli, Tamil Nadu, India.

INTERNATIONAL CONFERENCE ON "EMERGING STRATEGIES IN NUTRITION, FOOD & LIFESTYLE FOR HEALTH MANAGEMENT (ICESN'24)"

VOLUME -I

Editors

Dr. M. V. Alli
Lt.Dr. S. Ithayamalar
Dr. L. Jayaprada
Dr. R. Sakthi

Department of Nutrition and Dietetics
Seethalakshmi Ramaswami College
(Autonomous)
Affiliated to Bharathidasan University
Tiruchirappalli
Tamil Nadu, India

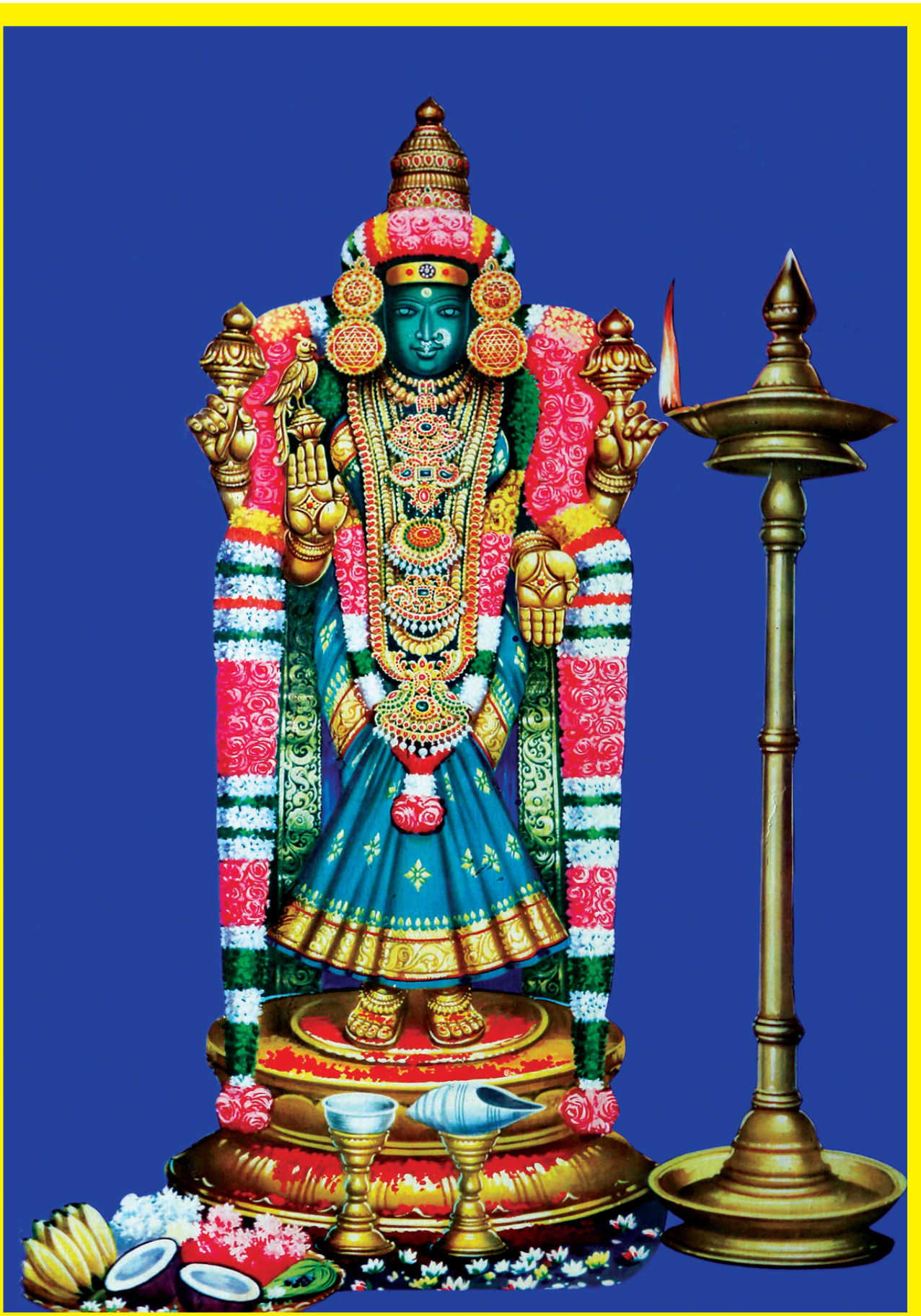
INTERNATIONAL CONFERENCE ON EMERGING STRATEGIES IN NUTRITION, FOOD & LIFESTYLE FOR HEALTH MANAGEMENT (ICESN'24) – VOLUME I

First Edition: **2024**

Publisher

Thanuj International Publishers,

Tamil Nadu, India



The light that guides us all...
To them we owe all our achievements

Our Revered Founder

Padma Bhushan **Sri N. Ramaswami Ayyar**

Srimathi Alamelu Seethalakshmi Ammal

Titles Conferred on our Founder

'Rao Sahib' **by the British Government**

'Rao Bahadur' **by the British Government**

'Diwan Bahadur' **by the British Government**

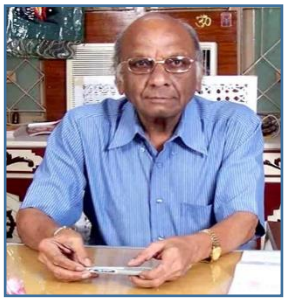
'Padma Sri' **by the Government of India**

'Padma Bhushan' **by the Government of India**

Dedicated to
The Inspiring Mother of our Institution

Smt. Vasantha Panchapakesan
(1943 - 2020)
Co-ordinator
Padmabhushan Sri N. Ramaswami Ayyar Educational Complex

MESSAGE



SRI.R. PANCHAPAKESAN,
Managing Trustee
Sri.N.Ramaswami Ayyar Educational Complex
Tiruchirappalli
Tamil Nadu

The International Conference on *Emerging Strategies in Nutrition, Food & Lifestyle for Health Management*, is the fruition of the efforts of the members of the Department of Nutrition & Dietetics. I am happy that the earnestness of the Head and faculty members has culminated in the success of the seminar.

The theme of the conference has a strong contemporary relevance and has enjoyed a wide reception among the National and International scholars and students. The overwhelming response for the conference can be owed to the academic expertise shared by the experts across the globe, who have opened up the frontiers available in the discipline for future study and research. They have equipped the participants with the recent trends and encouraged the scholarly brains to work with focus and to walk on the path of their choice of career.

The research articles aim at the convergence of the diverse ideas in the field of Nutrition and Dietetics. I congratulate the Department for showing a keen interest in exploring innovative methodologies and techniques in teaching and research. This International Conference marks yet another milestone for the Department.

I wish the Department success in its future endeavours!

MESSAGE

DR. M. VASUKI
Principal
Seethalakshmi Ramaswami College
Tiruchirappalli
Tamil Nadu

I feel elated to greet the Department of Nutrition and Dietetics for organizing a two day Virtual International Conference on “Emerging strategies in Nutrition, Food and Lifestyle for Health Management”. This conference has served as a platform for the confluence of intellectual ideas and expert academicians.

In today’s scenario, when health management awareness is low, especially, among the students and youngsters, this conference would serve as an eye-opener for their healthy future. It is important for people to know that a person who is sound in the body will naturally be sound in the mind, turning out to be more confident, self-assured, sociable, energetic and have the capacity to view things calmly and without prejudice. It is high time that youngsters understand this and start taking positive steps to lead a healthy way of life. I am happy that the conference has paved way for understanding and reiterating this idea.

I whole heartedly congratulate the Department of Nutrition and Dietetics for organizing a conference for the benefit of the society. My best wishes for their future endeavours.

I thank our revered Managing Trustee and our dynamic Director Academics for their guidance, support and encouragement for enhancing the quality of education offered in our prestigious institution.

I offer my sincere pranams to our Revered Founder Padmabhushan Sri N. Ramaswami Ayyar, a man who envisioned empowerment of women through education and our respected Madam Co-ordinator, Shrimathi Vasantha Panchapakesan, the motherly figure of the complex and to the golden feet of Goddess Akilandeshwari.

MESSAGE

DR.S.KALA
Dean of Quality & Research
Associate Professor of Botany
Seeethalakshmi Ramaswami College
Tiruchirappalli

I feel extremely delighted that the Department of Nutrition and Dietetics is making concerted efforts to achieve the National goal of "Health for All" through its academic and societal outreach activities. Since its inception the department has organized several nutrition and health oriented activities such as seminars and conferences for the benefit of the students and academic peers. This Virtual International Conference on "Emerging Strategies in Nutrition, Food and Lifestyle for Health Management" is yet another milestone. Congratulations for going above and beyond consistently raising the bar.

I wish to congratulate the Head and the Faculty members of the Department of Nutrition and Dietetics for organizing this Virtual International Conference and publishing two ISBN Books with 130 articles as Volume I and Volume II which have included excellent papers presented by the distinguished participants of this Conference.

I strongly desire that Founder's great vision of creating a society with knowledge, skill and values could be reached by this programme. With great pleasure I would like to recognize the incredible work done by the Head and Faculty members of the Department. Congratulations on reaching this milestone! Your dedication and hard work have brought you this far, and I look forward to many more successful achievements in the future.

"Thank you for always putting your best foot forward! Your performance is always top-notch, even when you take on more work. Keep up the amazing work."

S. Kala.

(Dr.S.KALA)

	CONTENTS	
S. No.	**Title with Author(s)**	**Page No.**

NUTRITION FOR ATHLETES - AN OVERVIEW

Hemalatha. M

Associate Professor, Department of Botany,

Seethalakshmi Ramaswami College, Tiruchirappalli, Tamil Nadu, India

Email:hemaravvy@gmail.com

Abstract

Sports nutrition is the study and application of how to use nutrition to support all areas of athletic performance. This includes providing education on the proper foods, nutrients, hydration protocols, and supplements to help you succeed in your sport. The fundamental component to optimizing training and performance through nutrition is to ensure that athletes consume the proper amounts of carbohydrate, protein and fat in their diet. Oxidation damage and muscle tissue breakdown happens during endurance running so athletes need to eat foods high in protein in order to repair these muscle tissues. It is important for female endurance runners to consume proper nutrients in their diet that will repair, fuel, and minimize fatigue and injury. Good nutrition can help enhance athletic performance. An active lifestyle and exercise routine, along with eating well, is the best way to stay healthy. Eating a good diet can help provide the energy you need to finish a race, or just enjoy a casual sport or activity. You are more likely to be tired and perform poorly during sports when you do not get enough: calories, carbohydrates, fluids, iron, vitamins, protein and other minerals. Hence the present study reveals the required nutrition for sports personnel.

Key words: *Nutrition, carbohydrates, fluids, iron, vitamins, protein, minerals*

Introduction

A diet rich in carbohydrates increases both endurance and intermittent high-intensity performance because of the extra store of carbohydrates in the muscles and liver, called glycogen. It is well documented that athletes need to replenish carbohydrate stores in the body, especially during periods of intense training or competition. Consuming carbohydrates during workouts lasting over one hour can also benefit performance and delay onset of fatigue. This is not surprising since it is well-known that carbohydrates, when compared to protein and dietary fat, are the most efficiently broken down and metabolized form of energy for the body**.**

Depending upon the training routine, athletes should consume anywhere from 3-12 grams of carbohydrates per kilogram of bodyweight throughout the day. Athletes can obtain the required carbohydrate intake by consuming simple sugars that are low fat, low protein, and low fibre. It can be from solid foods (energy or cereal bars, soft bake bars, and white bread with jam, jelly sweets, rice cakes, or soreen), carbohydrate chews, gels, or drinks.

Vitamins and minerals, also known as micronutrients, are crucial for a variety of activities in the body such as turning food into energy and keeping bones healthy. They also may affect how well the body performs. Although some research suggests high activity levels in athletes may increase their vitamin and mineral needs, there are no official guidelines for micronutrient recommendations specific to athletes at this time, so individualized guidance is needed. A variety of vitamins are needed in metabolism. These vitamins help to break down food from bigger nutrients, such as carbohydrates and fatty acids, into smaller units that the body can use to turn food into fuel.

Athletes fall into a slightly different category than the typical non-exerciser. An athlete uses protein primarily to repair and rebuild muscle that is broken down during exercise and to help optimizes carbohydrate storage in the form of glycogen. Protein isn't an ideal source of fuel for exercise but can be used when the diet lacks adequate carbohydrates. This is detrimental, though, because if used for fuel, there isn't enough available to repair and rebuild body tissues, including muscle.

Carbohydrate need for Athletes

Carbohydrates are the primary energy source for exercise, so to fuel the high volume of training that athletes do, carbohydrates are needed to support it and maximize their performances. Carbohydrates are the best source of energy for training. Fats are also an important energy source. However, they are only effective at the low-moderate intensity and are switched off at maximal intensities. Low carbohydrate diets can therefore impair training performance in athletes. Fruit, vegetables, whole grains, and starches are the most nutrient-dense carbohydrate sources for athletes and make up most of their diet. In addition, simple carbohydrates used in carbohydrate-electrolyte drinks, gels, and energy bars effectively consume the energy they need during training without causing any gastrointestinal discomfort. Excessive

intakes of processed, sugary carbohydrates such as sugary drinks, sweets, and foods with added sugars are not advised for athletes. Rice is a high-quality carbohydrate staple in Asian cooking. Brown, basmati, and wild rice are excellent choices with a lower glycemic index and higher nutrient and fibre content. It is also gluten-free. Consuming carbohydrates after exercise help to replenish muscle and liver glycogen stores to support subsequent training sessions. Athletes should eat complex carbohydrates as part of their diet. It provides a controlled release of energy throughout the day, which is essential for athletic performance.

It is recommended that athletes consume 3-12 grams of carbohydrates per kilogram of body weight throughout the day, depending on their training routine. The daily carbohydrate recommendations for athletes vary depending on the training routine, type of activity, and individual factors. For exercise lasting 1-2 hours, consuming 30-60 grams of carbohydrates per hour is recommended to improve performance. For up to 3 hours an athlete should aim for 60-90g carbohydrates per hour, but for events >3 hours, the body can effectively use up to 120g/hour. Finding the balance between carbohydrate intake and exercise duration is essential to optimize performance and energy balance.

Vitamins and minerals needs for athletes

Thiamin is important to several metabolic pathways, such as the breakdown of carbohydrates and branched-chain amino acids. Good sources of thiamin are: Whole or fortified grain products, pork and black beans. Having too little or too much niacin can result in unpleasant and even dangerous side effects such as diarrhea, dementia, rashes and liver damage. Good sources of niacin: Poultry, peanuts, fish, brown rice and enriched grains.

Vitamin B6:

It is essential to the breakdown of foods. Good sources of vitamins are: Poultry, pistachios, chickpeas, lentils, pork, bananas and tuna.

Vitamin B12:

B12 is found naturally in animal products, putting vegan and vegetarian athletes at risk for a deficiency. Fortified foods including breakfast cereals, nutritional yeast and plant-based meat alternatives provide vitamin B12. Taking a B12 supplement may also be needed but check

with a health care provider first. Good sources: Seafood, meats, milk and cheese, eggs and fortified breakfast cereals

Iron:

Iron is essential for oxygen transportation, traveling in blood throughout the body. Not having enough iron in the body may cause fatigue and impact physical performance. Exercise may cause some iron losses or decreased absorption. Good Sources: Oysters, turkey breast, fortified breakfast cereals, beef, beans and spinach

Vitamin A:

Well-known for its role in vision, vitamin A also may act as an antioxidant. Excess amounts from supplements can have toxic effects, though, so check with a health care provider before taking. Good Sources: Sweet potato, carrot, pumpkin, collard greens, spinach and some types of cheese.

Bone Health:

Running, jumping and acrobatics – intense physical activity puts stress on bones and joints. Some vitamins and minerals promote bone health, including vitamin D and calcium.

Vitamin D:

Vitamin D can be absorbed from exposure to sunlight; however, the season, time of day, cloud coverage, as well as an individual's geographic location and skin color all can affect how well vitamin D is absorbed from ultraviolet light. Good sources: Fortified milk and soymilk, cod-liver oil, fatty fish and mushrooms exposed to UV light

Calcium:

In addition to bone health, calcium is important for nerve function and the release of hormones. Good sources: Milk, cheese, fortified 100% fruit juices and soymilk, and collard greens.

Sodium and chloride are two essential minerals that often are found together as table salt. They also make a frequent appearance in sports drinks.

Protein for athletes

Proteins are often called the building blocks of the body. Protein consists of combinations of structures called amino acids that combine in various ways to make muscles, bone, tendons, skin, hair, and other tissues. They serve other functions as well including nutrient transportation and enzyme production. Adequate, regular protein intake for athletes and non-athletes alike is

essential because it isn't easily stored by the body. Various foods supply protein in varying amounts. The body needs 20 different types of amino acids to grow and function properly. However, of these 20 amino acids, nine of them are essential in the diet and can't be made in the body like the other 11 non-essential amino acids. Adequate, regular protein intake for athletes and non-athletes alike is essential because it isn't easily stored by the body. Various foods supply protein in varying amounts. The body needs 20 different types of amino acids to grow and function properly. These complete proteins contain amino acids histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Sources mostly include animal products such as: Eggs, fish and meat. Incomplete proteins contain low amounts of one or more essential amino acids. [1]. Beans (lacks methionine), Grains (lacks lysine, threonine), Nuts (lacks lysine), vegetables (lacks methionine), Corn (lacks trytophan, lysine).

Daily Intake of protein

The average adult needs 0.8 grams per kilogram (2.2lbs) of body weight per day to prevent protein deficiencies. Endurance athletes need about 1.2 to 1.4 grams per kilogram (2.2lbs) of body weight per day. [2].Strength training athletes need about 1.4 to 2.0 grams per kilogram (2.2lbs) of body weight per day. If weight loss is to be included while maintaining endurance and strength training, protein needs greater than 2.0 grams per kilogram of body weight may be needed. [3]

References

1. Mariotti F, Gardner CD. Dietary protein and amino acids in vegetarian diets—A review. Nutrients. 2019; 11(11):2661. doi:10.3390/nu11112661
2. Kato H, Suzuki K, Bannai M, Moore DR. Protein requirements are elevated in endurance athletes after exercise as determined by the indicator amino acid oxidation method. PLoS One. 2016;11(6):e0157406. 2016 Jun 20. doi:10.1371/journal.pone.0157406
3. Jäger, R., Kerksick, C.M., Campbell, B.I. et al. International Society of Sports Nutrition Position Stand: protein and exercise. J Int Soc Sports Nutr 14, 20 (2017). doi:10.1186/s12970-017-0177-8
4. https://www.usada.org/athletes/substances/nutrition/carbohydrates-the-master-fuel/ https://webber-nutrition.co.uk/carbohydrate-recommendations-for-athletes/#:~:text=Athletes%20can%20obtain%20the%20required,chews%2C%20gels%2C%20or%20drinks.

5. https://www.eatright.org/fitness/sports-and-athletic-performance/advanced/vitamin-needs-of-athletes.
6. https://www.verywellfit.com/sports-nutrition-protein-needs-for-athletes-3120669#citation-3

r, should carbohydrates, when compared to protein and dietary fat, are the most down and metabolized form of energy for the body.

FUNCTIONAL FOODS FOR BETTER HEALTH

Nisha lakshmi. C

Assistant Professor, Department of Nutrition and Dietetics

Aiman College of Arts and Science for Women

Tiruchirappalli, Tamil Nadu, India, Email: nishanajz@gmail.com

Abstract

The research aims to investigate the nutrient content such as carbohydrate, protein, fat and dietary fibre along with its antimicrobial and antioxidant activity of the prebiotic based novel food product which can benefit in the prevention of gastro intestinal disorder as well as its symptoms like acidity. High-fiber foods such as fruits, vegetables, and grains reduce acid reflux due primarily to Fiber qualities as a digestive aid. Fiber absorbs liquid in the digestive system, preventing the displacement of stomach acid. For this reason, sources of soluble fiber, such as sunflower seeds are used which is especially beneficial in reducing inflammation and other digestion related problems and on the other hand, the insoluble fiber present in flax seed can help relieve or prevent constipation and keep bowel movements regular. Lemon peel which is usually thought to be a waste, contain significant sources of naturally occurring health-intensifying components such as phenols and carotenoid which can be broadly used as functional compound in order to promote health benefits. It can help to hamper the acidity produced by GERD and acid reflux. Ginger helps in acid reflux, which is a great way to treat this condition naturally, without any medication. Furthermore, it also adds extra nutrition to your daily diet. Hence, the prebiotic based novel food product was developed in herb and different spice flavours. The flavoured novel food products can be used as Dry instant which can be generally added into water and consume. Luke warm water is preferred for the best result.

Keywords: *Sunflower seeds, Flax seed, GERD (Gastro-Oesophageal Reflux Disease), Dietary fibre*

Introduction

Prebiotic is described as "a non-digestible food ingredient that beneficially affects the host by selectively invigorating the growth and, or activity of one or a certain number of microorganisms in the colon and by improving the health of the host". Research on prebiotic dietary fiber has found that although changes in specific gastrointestinal (GI) taxa are often connected with health, this effect alone is not considered a direct health benefit under most

condition. Prebiotics can selectively impact gut microbiota, affecting intestinal functions, such as metabolism and integrity of the intestine. Moreover, they can suppress pathogens in healthy individuals through initiation of some immunomodulatory molecules with antagonist's effects against pathogens by lactic acid that is produced by Bifidobacterium and Lactobacillus genera (Shokari D. *et al*., 2018). The gut microbiota can even influence disease risk, including the risk of developing colon cancer, inflammatory bowel disease, and type 2 diabetes. Prebiotics are essential to a healthy microbiome. In simple terms, they're nutrients that get broken down by gut bacteria. Bacteria in the large intestine ferment prebiotics. This releases by-product called short-chain fatty acids. These by-products act as energy sources for the cells lining the colon, called colonocytes, and benefit health in many other ways. (Davani-Davari D. *et al.*, 2019). Nutritional ingredients (a collective term used herein to describe botanicals, including dietary fibers, and non-botanicals) have been employed throughout history for a myriad of GI (Gastrointestinal) conditions and symptoms due to their claimed anti-ulcer, carminative, spasmolytic, soothing, and laxative effects, to name a few. The acceptance of these products continues to increase, as evidenced by sales growth of 8.6% in 2019, the second largest percentage increase since 1998. (Schulz *et al*., 2022).

PREBIOTIC RAW MATERIALS

SUNFLOWER SEEDS

The seed and sprout of the sunflower seed contains valuable nutrients such as antioxidant, antimicrobial, anti-inflammatory, antihypertensive, wound-healing, and cardiovascular benefits found in its phenolic compounds, flavonoids, polyunsaturated fatty acids, and vitamins. It is also used in ethno medicine for treating various disease conditions such as heart disease, bronchial, laryngeal and pulmonary infections, coughs and colds and in whooping cough (Bashir T *et al*., 2021). These notable medicinal, nutritional, and culinary benefits have resulted in historical and growing popularity of the sunflower plant and its constituents world-wide.

FLAX SEEDS

The major bioactive compounds in flaxseed are alpha-linolenic acid (ALA), lignans and fiber. Four common types of flax seed are available for human utilization which includes whole flaxseed, ground flaxseed, flaxseed oil and partially defatted flaxseed meal (Parikh M *et al*., 2018). Generally, flax seeds are used to improve digestive health or relieve constipation. It can

also support the growth of beneficial bacteria and heal many gut problems. Hence, the control of the micro biome on human and animal health is receiving increasing attention from the research community (Ettinger G. *et al*., 2014).

LEMON PEEL

Lemon shows various characteristics, such as antimicrobial, antifungal, anti-inflammatory, anti-cancer, depurative, antiscorbutic, etc. The consumption of citric acid, encompass in lemon juice, may effectively improve indigestion and can maintain an optimal intestinal environment as it aids or assist in gastric acid function. (Tadayuki Iida *et al.*, 2021). Citrus peel (CP) generally forms around 40–50% of the total fruit mass, but it is usually thought to be a waste. However, it is significant source of naturally occurring health-intensifying compounds mainly phenolic compounds and carotenoids. Phenolic compounds in CP mainly comprised of phenolic acids (primarily caffeic, p-coumaric, ferulic and sinapic acid), flavanones (generally naringin and hesperidin) and polyethoxylated flavones (notably nobiletin and tangerine). Therefore, peels from citrus fruits can be broadly used as sources of functional compounds and preservatives for the development of novel food products, which are not only safe but can also have health-promoting benefits.

GINGER

It is believed that ginger acts directly on the gastrointestinal system to minimize nausea. It is also used to prevent nausea resulting from chemotherapy, motion sickness, and surgery. Ginger plays a vital role as a remedy for nausea during pregnancy. It is also used to treat different types of GI problems such as morning sickness, colic, upset stomach, gas, bloating, heartburn, flatulence, diarrhea, loss of appetite, and dyspepsia (discomfort after eating). Indian Ayurvedic medicinal system states that ginger is recommended to increase the process of digestion of food and has been proclaimed as a pain relief for arthritis, muscle soreness, chest pain, low back pain, stomach pain, and menstrual pain. Furthermore, it can also be used for treating upper respiratory tract infections, cough, and bronchitis. Active components of ginger are widely accepted as a laxative and antacid medication. It is also used to warm the body for uplifting circulation and lowering high blood pressure. Due of its warming effect, ginger acts as antiviral for treatment of cold and flu. (Alam.P, 2013).

Objectives

The present study was undertaken with the following goals

- Procurement and processing of prebiotic raw materials.

- ❖ Formulate and standardize dried, roasted sunflower and flax seeds incorporated value added natural ascorbic acid and natural alkaline product.
- ❖ Analyze the nutrient content of the raw material used in the development of prebiotic based novel food product.
- ❖ Study the shelf life and antimicrobial properties of the novel food product.

Methodology

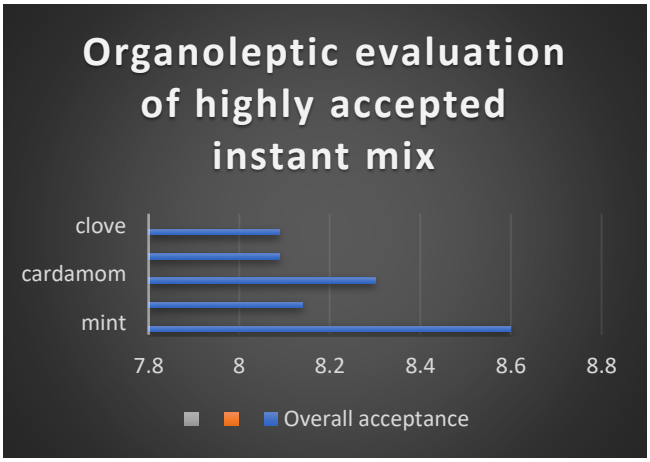
The quantitative study comprises of

i. Procurement of the raw materials namely sunflower seeds, flax seeds, lemon and ginger along with herbs and spices for the development of flavored prebiotic instant mix to combat Gastrointestinal Disorders.
ii. Development of flavored instant mix to combat Gastrointestinal Disorders and carry out, sensory evaluation of the developed novel food product, using 9-point Hedonic scale.
iii. Analyze the nutrient content such as Carbohydrate, Protein, Fat and Fibre of the raw material used in the development of prebiotic product.
iv. Analyze the Antioxidant and Antimicrobial activity of the raw material of developed prebiotic product.
v. Study the shelf life of the developed prebiotic based novel food product.

Results and Discussion:

1.Organoleptic evaluation of the highly accepted flavoured instant mix

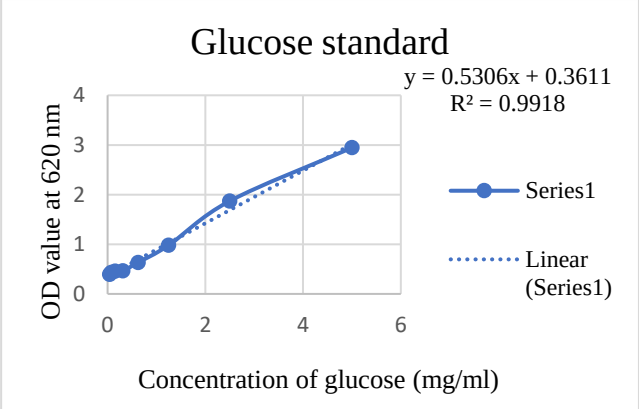
Characteristics such as colour, flavour, taste were studied by the Students and Professors of the Nutrition and Dietetics Department of Jamal Mohamed College, Tiruchirappalli. For this 9-point Hedonic scale was used where it resulted that, Mint flavoured instant mix has high level of acceptance compared to other flavoured instant mix.



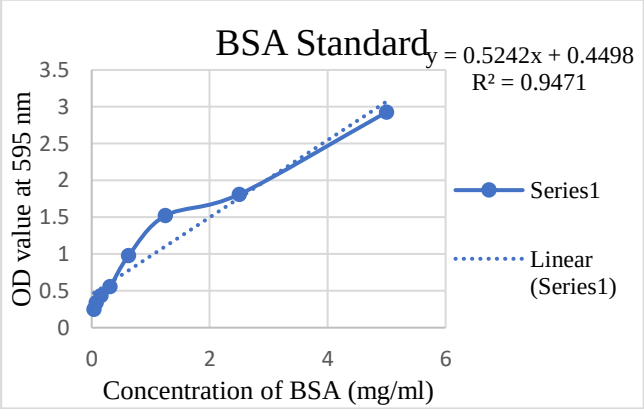
2.Nutrient content of the prebiotic based raw material used in the development of novel food product

Healthy food refers to the food that contains the right amount of nutrients to keep our body healthy. Hence, the nutrient content such as Carbohydrate, Protein, Fat, Fibre content were studied for the raw material and it resulted in good amount of nutritional value to keep away long-term illness and get rid of all harmful things.

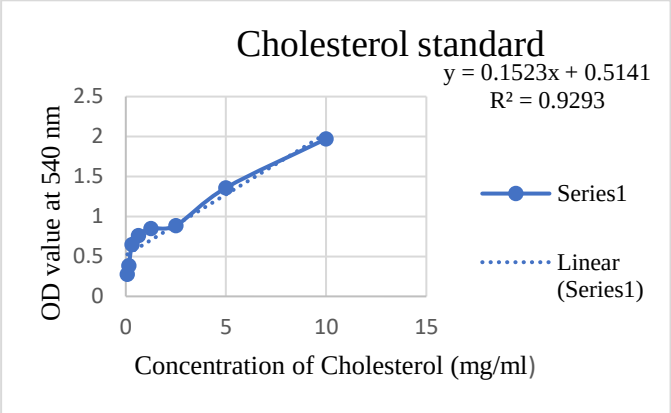
i. Carbohydrate content was estimated using Anthrone Method.



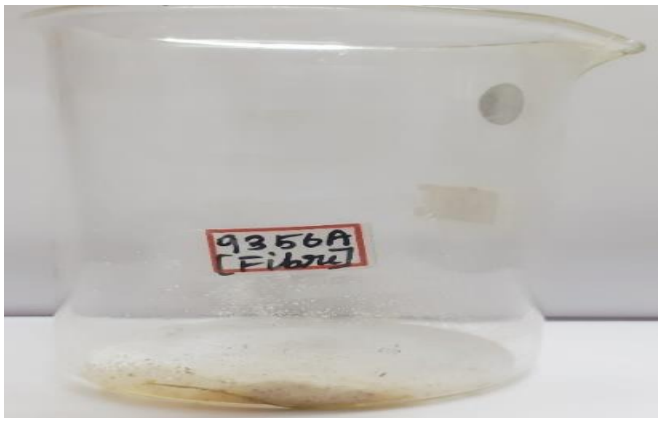
ii. Protein content was estimated using Bradford's Method.



iii. Fat content was estimated using Vanillin Method.



iv. Fibre content was estimated using Crude fibre Method.



Crude fibre = 50%

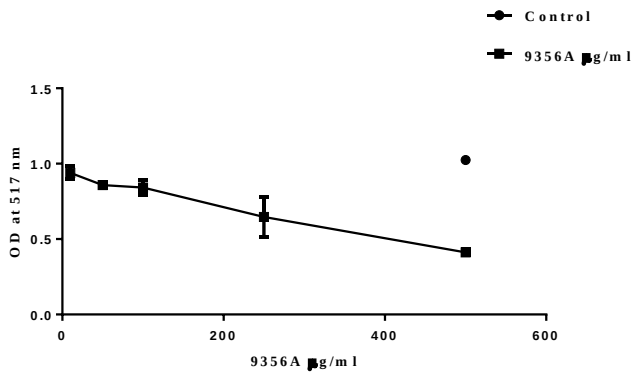
3.Anti-oxidant activity of the prebiotic-based raw material used in the development of novel food product

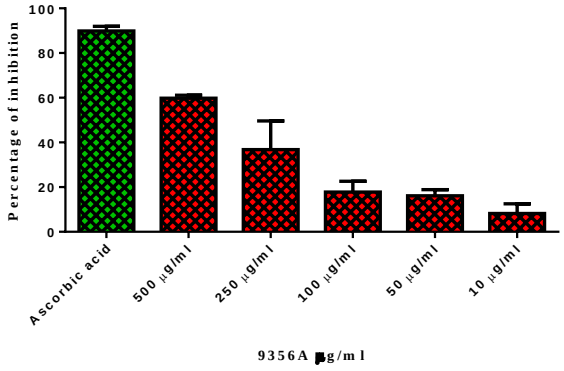
The DPPH assay is popular in natural product antioxidant studies. Hence, this method was used to study the Antioxidant activity of the prebiotic based raw material used in the Development of novel food product. It is apparent that the product shows excellent antioxidant activity as sunflower seeds are incredibly high in vitamin E and selenium, flax seeds are rich in antioxidant compounds such as phenols and vitamin E, lemon peel is high in D-limonene and vitamin C, Ginger is high in phenolic groups of gingerol component which possess excellent antioxidant activity.

Antioxidant activity (OD value at 517nm)

- The absorbance has been measured at 517 nm using a UV-VIS spectrophotometer. (Ascorbic acid can be used as the reference).

- Lower absorbance values of the reaction mixture indicate higher free radical scavenging activity.

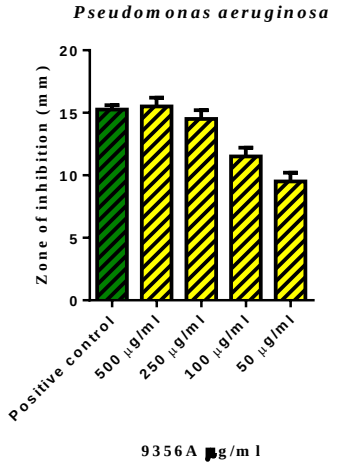




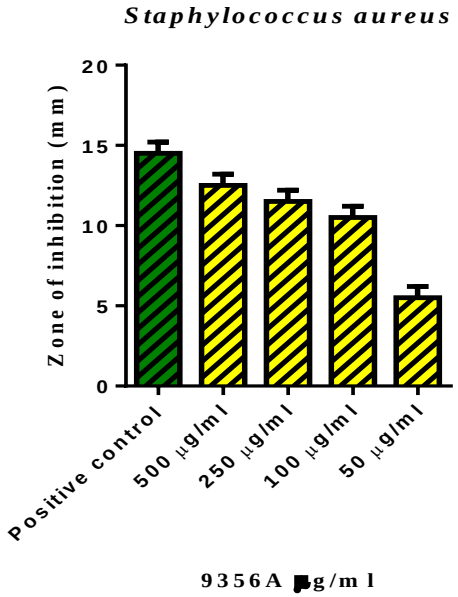
4.Anti-microbial activity of the prebiotic-based raw material of the developed novel food product

Agar well diffusion method was preferred to study the anti-microbial activity of the raw material used in the development of the novel food product. Sunflower seeds contain a wide range of phenols, flavonoids, tannins, alkaloids, saponins, and fatty acids which helps to maintain better gut health; Flax seeds possess antimicrobial activity mainly due to phenolic acid, flavonoids, and lignans; Lemon peels are an excellent source of biological active compounds known as flavanones, Ginger contains monoterpenoids, sesquiterpenoids, phenolic compounds, and its derivatives, aldehydes, ketones, alcohols, esters which provide a broad antimicrobial spectrum against different microorganisms.

❖ **Effect of sample 9356A against *Pseudomonas aeruginosa***



❖ **Effect of sample 9356A against *Staphylococcus aureus***



5.The shelf life of the developed novel food product

The shelf life of a food product is the period during which the food retains an acceptable quality from a safety, and organoleptic point of view and it depends upon four main factors such as formulation, processing, packaging, and storage conditions. The shelf life of the product was studied by the Enumeration of microorganism (CFU) method. The samples had low microbial population (bacteria, yeast) and hence were fit for consumption till 15th day of storage.

Conclusion

High-fiber foods such as fruits, vegetables, and grains reduce acid reflux due primarily to fiber qualities as a digestive aid. Fiber among other things, absorbs liquid in the digestive system, which prevents the displacement of stomach acid. For this reason, sources of soluble fiber, such as sunflower seeds are especially beneficial reducing inflammation and other digestion related problems and on the other hand, the insoluble fiber present in flax seed can help relieve or prevent constipation and keep your bowel movements regular. Small amounts of lemon when added to water can have an alkalizing effect on the digestive tract. This is helpful because it can help to counteract the acidity that is produced by GERD and acid reflux. Using ginger for acid reflux is a great way to treat this condition naturally, without any strong medication. Furthermore, it also adds extra nutrition to your daily diet.

References

1. Shokri, D., Khorasgani, M. R., Mohkam, M., Fatemi, S. M., Ghasemi, Y., & Taheri-Kafrani, A. (2018). The inhibition effect of lactobacilli against growth and biofilm formation of Pseudomonas aeruginosa. *Probiotics and antimicrobial proteins*, *10*(1), 34-42.
2. Davani-Davari, D., Negahdaripour, M., Karimzadeh, I., Seifan, M., Mohkam, M., Masoumi, S. J., & Ghasemi, Y. (2019). Prebiotics: definition, types, sources, mechanisms, and clinical applications. *Foods*, *8*(3), 92.
3. Schulz, R. M., Ahuja, N. K., & Slavin, J. L. (2022). Effectiveness of Nutritional Ingredients on Upper Gastrointestinal Conditions and Symptoms: A Narrative Review. *Nutrients*, *14*(3), 672.
4. Bashir, T., Zia-Ur-Rehman Mashwani, K. Z., Haider, S., & Shaista Tabassum, M. (2021). 02. Chemistry, pharmacology and ethnomedicinal uses of Helianthus annuus (Sunflower): A Review. *Pure and Applied Biology (PAB)*, *4*(2), 226-235.
5. Parikh, M., Netticadan, T., & Pierce, G. N. Mining Natural Products for Cardiovascular Benefits Flaxseed: its bioactive components and their cardiovascular benefits.
6. Ettinger, G., MacDonald, K., Reid, G., & Burton, J. P. (2014). The influence of the human micro biome and probiotics on cardiovascular health. *Gut microbes*, *5*(6), 719-728.
7. Tadayuki Iida; Sari Ishigami; Masafumi Kunishige; Satona Sasagawa; Hiromi Ikeda; Satomi Aoi; Toshihide Harada.(Dec2021). *International Medical Journal.* Vol. 28 Issue 6, p625-628. 4p.
8. Alam, P. (2013). Densitometric HPTLC analysis of 8–gingerol in Zingiber officinale extract and ginger–containing dietary supplements, teas and commercial creams. *Asian Pacific Journal of tropical biomedicine*, *3*(8), 634-638.

A STUDY ON INSTANT ELECTROLYTES INCORPORATED EDIBLE WATER BALLS FOR ATHLETES

Indhumathi. S

Assistant Professor, PG Department of Food Service Management and Dietetics,

AIMAN College of Arts and Science for Women, Tiruchirappalli, Tamil Nadu, India.

indhumathiselvam2320@gmail.com

Abstract

This study aimed at developing an easy-to-carry instant electrolyte specially made for athletes in edible packaging which can prevent plastic pollution to some extent. Athletes use instant electrolyte supplementation to replenish electrolytes lost during their activity. The main ingredient of these edible balls is Beta vulgaris root extract which can raise nitric oxide (NO) levels in the body. Nitric oxide helps to increase blood flow, improve lung function and strengthen muscle contraction and mainly improves cardiorespiratory endurance and performance. And, other main ingredients used as edible packaging film are Sodium alginate and Calcium chloride ($CaCl_2$). Sodium alginate (a food product derived from brown algae or seaweed) is used in food industries as a thickening agent, gelling agent, emulsifier, stabilizer, and texture improver. Calcium chloride ($CaCl_2$) is used as a food additive as well as in food processing operations. It helps to extend the shelf life of various food products while maintaining desirable texture and flavour properties. The acceptance and electrolytes evaluation study was carried out for this edible balls among 20 athletes of our college.

Keywords: *instant electrolytes, plastic pollution, beta vulgaris root extract, nitric oxide, sodium alginate, calcium chloride, score card, shelf life analysis.*

Introduction

The term Athletes comes from the Greek word “Athlos”, which means “Achievement”. Athletes have commonly considered individuals with superior physical and psychological conditions the term refers to athletic excellence. The Person who is engaged in exercise and physical activity regularly of an individual is called Athletes (M. Sanz de la Garza and P.E Adami, 2021).

Athletes have special dietary needs. In a consensus statement on sports nutrition, the International Olympic Committee (IOC) stated that diet influences performance capacity and advised athletes to apply dietary strategies adapted to individual needs during and after training and competitions to maximize their physical and mental performance (Maughan RJ, Shirreffs SM, 2010). Athletes expend greater amounts of energy as a result of their training. However, these amounts vary during the competition and are influenced by such factors as the training period and intensity. Numerous factors influence energy and nutrient needs (e.g. body weight, size, body composition, training program, duration, intensity). Low energy intake can lead to reduced energy availability. Low energy availability not only has a negative impact but also carried some health-related problems. So, Energy expenditure is important in the diet of athletes and a significant prerequisite for maintaining their health and performance (Braun H, Carlsohn A, 2020).

Electrolytes are substances that have a natural positive or negative electrical charge when dissolved in water. They helped to regulate the body's chemical reactions, and maintain the balance between fluids inside and outside your cells. And, kidneys filter excess electrolytes out of your body and into your urine and lose electrolytes through sweat. Fluids and electrolytes (sodium) are consumed by athletes, or recommended to athletes, for several reasons, before, during, and after exercise. These reasons are generally to sustain total body water, as deficits (dehydration) will increase cardiovascular and thermal strain and degrade aerobic performance. Vigorous exercise and warm/hot weather induce sweat production, which contains both water and electrolytes. Daily water (4–10 L) and sodium (3500–7000 mg) losses in active athletes during hot weather exposure can induce water and electrolyte deficits. Both water and sodium need to be replaced to re-establish ‘‘normal’’ total body water. This replacement can be by normal eating and drinking practices if there is no urgency for recovery. But if rapid recovery (524 h) is desired or severe dehydration (45% body mass) is encountered, aggressive drinking of fluids and consuming electrolytes should be encouraged to facilitate recovery for subsequent competition (Susan M *et al.*, 2011).

Since World War II the production of plastic has increased in almost every material. Most of them are designed in such a way thrown away after a single-use. 9% of the total plastic produced in the world is recycled and the rest is just dumped in landfills completely exposed to the environment. If this continues then by 2020 the amount of plastic litter in landfills will reach around 1200 crore *(Patel, Prachi, 2019).* The most common single-use plastic are plastic bottles, food wrappers, plastic bags, plastic spoons and straws, plastic

pouches and films, etc., the amount of plastics used globally today exceeds a million tonnes annually. The result is that plastic packaging is thrown into the environment, and the problem of waste is increasing every year.

A real alternative is the use of bio-based polymer packaging materials. Research carried out in the laboratory context and products tested at the industrial level have confirmed the success of replacing plastic-based packaging with new, edible, or completely biodegradable foils. Of the polysaccharides used to obtain edible materials, sodium alginate can form films with certain specific properties: resistance, gloss, flexibility, water solubility, low permeability to O_2 and vapours, and tasteless or odourless (Roxana Gheorghita *et al,* 2020).

Seaweed packaging material can be made from sodium alginate which is extracted easily from Brown Seaweed which is readily available in the ocean and which can be grown with ease. Sodium Alginate forms a gel structure when reacted with Calcium Chloride. Calcium Chloride is an excellent calcium source. After mixing for a few minutes' jellification starts occurring on the exterior of the liquid. This gel-like structure is extracted carefully and pressed into the long sheets, which in turn are used as the packing material (Patel, Prachi 2019). These balls can be consumed as it is with their outer packaging material. Environmental and Health benefits are the greater advantage.

Methodology

The formulation of an edible instant electrolyte water ball has been represented in Figure 1.

Plate 1 - Formulated edible instant electrolyte water ball

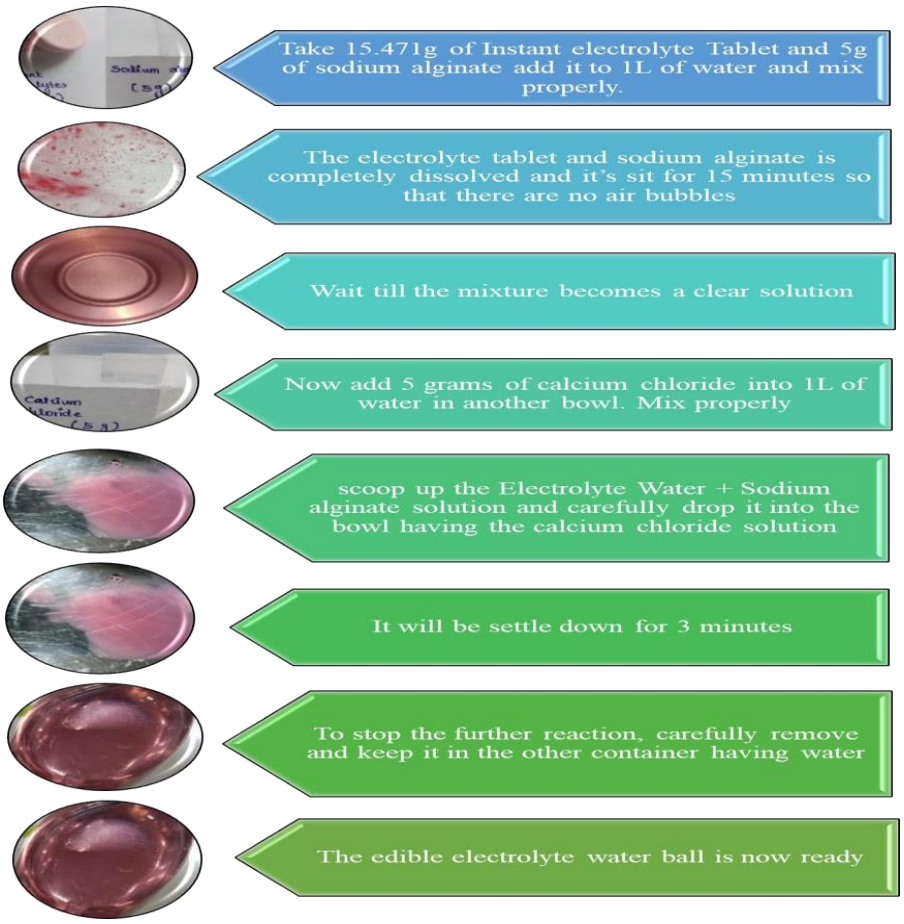


Figure 1 – Formulation of edible instant electrolyte water ball

Results and Discussion

Organoleptic properties of the edible instant electrolyte water ball

The sensory parameters of the newly developed edible instant electrolyte water ball were evaluated by twenty panelists, comprising of athletes, studying in various Department, Bishop Heber College, Tiruchirappalli. The panel members analyzed the sensory quality of the formulated edible instant electrolyte water ball. The overall acceptability result was good. They liked it very much.

Table 1 –Result of the organoleptic evaluation

S.No	SENSORY SCALE FACTORS	PERCENTAGE (%)
1.	Appearance	96.29
2.	Colour	87.96
3.	Flavour	91.66
4.	Taste	89.8
5.	Texture	84.25
6.	Overall Acceptance	93.5

Appearance

The percentage of the person who likes the appearance of the edible instant electrolyte water ball is presented in table 1. The result showed that among 96.29 % of people who like this appearance.

Colour

The above data obtained from the sensory analysis is given in table 1. The results show that 87.96 % liked the color of the edible instant electrolyte water ball.

Taste

It is clear from the above table 1 that 89.8 % of the person who like this taste.

Texture

The texture result shows that 84.25 % liked this edible instant electrolyte water ball texture.

Flavour

The percentage of flavor that was rated for this edible instant electrolyte water ball is 91.66 %.

Overall acceptability

The overall acceptability seemed to be 93.5 % of people who liked and accept the regular conception.

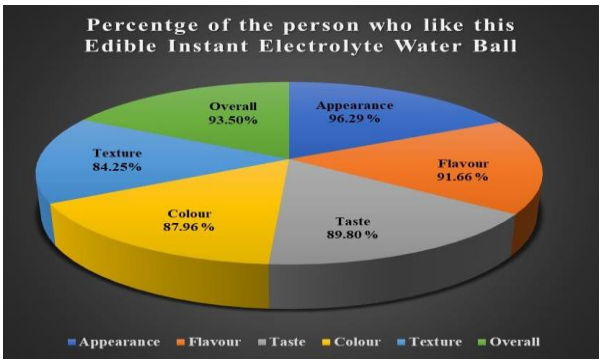


Figure 2 - Sensory scores of edible instant electrolyte water ball

Electrolytes Evaluation of the Edible Instant Electrolyte Water Ball

Table 2-Electrolytes values of edible instant electrolyte water ball

ELECTROLYTES EVALUATION			
S. No	**ELECTROLYTES**	**RESULT**	**TEST METHOD**
1.	Sodium	30mg/100g	FSSAI Manual of Methods
2.	Chloride	180mg/100g	
3.	Nitrate	1.1mg/100g	

Sodium

The sodium content of the newly formulated edible instant electrolyte water ball was 30 mg / 100 g for the sample.

Chloride

The chloride content of the edible instant electrolyte water ball was 180 mg / 100 g for the sample.

Nitrate

The nitrate content of the edible instant electrolyte water ball was 1.1 mg / 100 g for the sample.

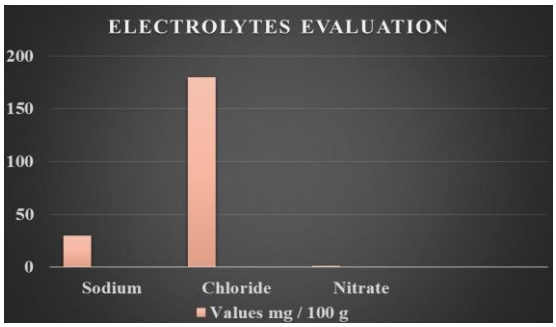


Figure 3-Electrolytes evaluation of the edible instant electrolyte water ball

Conclusion

Food is a basic need of humans that provides nutrients for growth and health (Brown, 2011). Athletes generally prefer high energy and electrolytes sports drinks. Energy drinks play a key role in the life of athletes which has post effects on fluid balance in our body.

Hence, this study focuses on developing an easy-to-carry instant electrolyte specially made for athletes in edible packaging which can prevent plastic pollution to some extent. The main ingredient used in the study is instant electrolytes supplements (Fast & Up) which is to replenish electrolytes lost in during their activity. And another main ingredient of these edible balls is *Beta vulgaris* root extract which can raise nitric oxide (NO) levels in the body. Nitric oxide helps to increase blood flow, improve lung function and strengthen muscle contraction and mainly improves cardiorespiratory endurance and performance. And the other novel ingredients used for the study are sodium alginate and calcium chloride. The present investigation was conducted to infuse electrolytes in edible packaging. The study was further analyzed to assess the overall acceptance of the edible instant electrolyte water ball was selected from sensory evaluation for further analysis. The Electrolytes evaluation studies were analyzed. The sensory evaluation and cost estimation were also determined. The results obtained in this

investigation are summarized in this chapter with a significant conclusion and a further line of work.

Main findings of the study

Organoleptic properties of the edible instant electrolyte water ball

The sensory evaluation was subjected to athletes of our college. A nine - point hedonic scale was used consisting of appearance, color, taste, texture, flavor, and overall acceptability. The percentage of the person who likes these edible electrolyte balls is Appearance - 96.29 %, Colour - 87.96 %, Taste – 89.8 %, Texture – 84.25 %, Flavour – 91.66 %, and Overall acceptance – 93.5 %. The acceptability of the edible instant electrolyte water ball was found to have excellent acceptability.

Electrolytes evaluation of the edible instant electrolyte water ball

The electrolyte value of the edible instant electrolyte water ball has a good source of electrolyte present in it. The sodium content of the newly formulated edible instant electrolyte water ball was 30 mg / 100 g for the sample. The chloride content of the edible instant electrolyte water ball was 180 mg / 100 g for the sample. The nitrate content of the edible instant electrolyte water ball was 1.1 mg / 100 g for the sample.

Limitations of the study

Due to financial constraints, other nutrients like potassium, carbonate, and calcium could not be analyzed. Due to lack of time, shelf life and packaging could not be included.

Suggestions for future study

The product such as any other juices can be formulated using sodium alginate and calcium chloride.

References

1. M.Sanz de la Garza., P.E. Adami. (2021). Textbook of Sports and Exercise Cardiology.
2. Maughan RJ., Shirreffs SM. (2010). IOC Consensus Conference on Nutrition in Sport, International Olympic Committee, Lausanne, Switzerland. *J. Sports Sci.* 29: S1.
3. Braun H., Carlsohn A., Großhauser M., König D., Lampen A., Mosler S., Nieß A., Oberritter H., Schäbethal K., Schek., Stehle P., Virmani K., Ziegenhagen R., Heseker H. (2020). Position of the working group ports nutrition of the German Nutrition Society (DGE): energy needs in sports; 71: 171-177.
4. Susan M., Shirreffs., Michael N., Sawka. (2011). Fluid and electrolyte needs for training, competition, and recovery, *Journal of Sports Sciences*, 29:sup1, S39-S46,
5. Patel, Prachi. (2019). Edible Packaging. 1907-1910.

6. Roxana Gheorghita, Gheorghe Gutt and Sonia Amariei. (2020). The Use of Edible Films Based on Sodium Alginate in Meat Product Packaging: An Eco- Friendly Alternative to Conventional Plastic Materials.

BIOFORTIFICATION: SUSTAINABLE WAY TO ALLEVIATE MALNUTRITION

Kamaladevi. P

Associate Professor, Department of Botany,

Seethalakshmi Ramaswami College, Tiruchirappalli, Tamil Nadu, India

Abstract

Healthy food contributes to healthy society. Balanced nutrition plays the central role in the growth and development of mind and body, and contributes to the societal and economic well-being. Malnutrition affects people of all ages including infants, young children, adolescent girls, pregnant women, adult women and men, besides elderly people. Micronutrient deficiency also known as "hidden hunger" refers to a condition that occurs when the body lacks essential vitamins and minerals that are required in small amounts for proper growth, development and overall health. These deficiencies are particularly common in developing countries, where a lack of access to a varied and nutritious diet makes it difficult for people to get the micronutrients they need. Bio fortification is a promising, economical, and sustainable technique of providing micronutrients. Though various strategies viz., 'food-fortification', 'medical-supplementation' and 'dietary diversification' are used to alleviate malnutrition, they do not offer sustainable solution as these avenues are often limited by lack of purchasing power, robust distribution systems and crop seasonality. Agronomic bio fortification, plant breeding, and transgenic approaches are some currently used strategies in food crops. Indian Council of Agricultural Research (ICAR) led National Agricultural Research System (NARS) has developed and released 87 nutrition-rich crop cultivars in important crops like rice, wheat, maize, pearl millet, finger millet, small millet, lentil, groundnut, linseed, mustard, soybean, cauliflower, potato, and pomegranate. These cultivars have been improved for essential nutrients viz., iron, zinc, calcium, protein, lysine, tryptophan, provitamin-A, anthocyanin, vitamin-C, oleic acid and linoleic acid. The transgenic approach is sustainable, efficient, and rapid, making it suitable for bio fortification programs.

Key words: *Malnutrition, Hidden hunger, Bio fortification, Food-fortification, Dietary diversification, Medical-supplementation.*

Introduction

Over 2 billion people worldwide suffer from micronutrient deficiency which has a negative impact on their health and socio-economic condition [1]. The principal reason is the consumption of cereal-based food which provide enough calories but they are deficient in phytochemicals. These are essential for the

normal growth and development of humans and their deficiencies can have serious health consequences, including diminished cognitive degeneration in children, increased risk of infections and a range of other negative effects on physical and mental health.

The most common micronutrient deficiencies, also known as hidden hunger concern iron, iodine, zinc, and vitamin A [2]. In general, micronutrient deficiencies can have severe health ramifications such as impaired cognitive development, stunted growth, perinatal complications, and even premature death [3]. For instance, vitamin A deficiency is the leading cause of childhood blindness (i.e., xerophthalmia), and it has been estimated that over 190 million children are affected by this deficiency worldwide [2]. Numerous strategies and methods have been recommended to combat micronutrient deficiencies, one of which is bio fortification, or the process of increasing essential nutrients in food through biotechnology, conventional breeding, and agronomic practices.

Bio fortification, the process of breeding nutrients into food crops, provides a comparatively cost effective, sustainable, and long-term means of delivering more micronutrients. This approach not only will lower the number of severely malnourished people who require treatment by complementary interventions but also will help them maintain improved nutritional status. Moreover, bio fortification provides a feasible means of reaching malnourished rural populations who may have limited access to commercially marketed fortified foods and supplements. The bio fortification strategy seeks to put the micronutrient-dense trait in those varieties that already have preferred agronomic and consumption traits, such as high yield. Bio fortified staple foods cannot deliver as high a level of minerals and vitamins per day as supplements or industrially fortified foods, but they can help by increasing the daily adequacy of micronutrient intakes among individuals throughout the life cycle.[4]

1. Minerals and Vitamins

Minerals, in the context of the human diet, are inorganic chemical elements that are required for biological or biochemical processes. Carbon, hydrogen, nitrogen, and oxygen are excluded from the list as these are found in common organic molecules. There are 16 essential minerals, but 11 of them are required in such small amounts and/or are so abundant in food and drinking water that deficiency arises only in very unusual circumstances. The remaining five are present in limiting amounts in many foods, so a monotonous diet can easily result in deficiency. These minerals are iodine (I), iron (Fe), zinc (Zn), calcium (Ca), and selenium (Se). Deficiency diseases arise when diets are based predominantly on staple foods, such as milled cereals, which have a low bioavailable mineral content [5]. Mineral deficiency is

therefore most prevalent in developing countries, where there is poor access to fresh foods, although Ca deficiency is also widespread in the industrialized world [6].

1.1 Iodine

Iodine is an essential component of the thyroid hormones thyroxine and triiodothyronine, which regulate growth and development and maintain the basal metabolic rate. However, only 30 % of the body's iodine is stored in the thyroid gland, and the precise role of the 70 % distributed in other tissues is unknown. It may overlap with the function of other minerals such as Se or Fe and Zn [7]. Goiter is another important symptom of iodine deficiency and results from the lack of thyroxine inducing the production of thyroid-stimulating hormone, which in turn causes the thyroid gland to swell [8]. India is one of the worst affected countries in the world, with more than 50 million cases of goiter and more than two million of cretinism.

1.2 Iron

Iron has numerous important functions in the human body, reflecting its ability to act as both an electron donor and acceptor. In this role, it forms the functional core of the heme complex, which is found in the oxygen-binding molecules hemoglobin and myoglobin, and the catalytic center of cytochromes, which carry out redox reactions. Iron is therefore required for oxygen transport in the body and for energy metabolism, also contributing to the catalytic activity of a range of nonheme enzymes such as ribonuclease reductase [9]. The immediate outcome of Fe deficiency is iron deficiency anemia, which is thought to affect at least two billion people worldwide. More than half of these cases could be addressed by increasing the amount of Fe in the diet, but as for iodine this is difficult in developing countries where the population relies on staples, because cereal grains contain very low levels of Fe and also contain antinutritional compounds such as phytate that inhibit Fe uptake [10].

1.3 Zinc

Zinc is an essential functional component of thousands of proteins. Many contain zinc prosthetic groups (e.g., zinc finger, zinc twist) and approximately 100 enzymes require Zn as a cofactor. Some olfactory receptors cannot function without Zn. Many cells in the body also secrete Zn as a signaling molecule, including cells in the immune and nervous systems [9]. Nearly two billion people are at risk of Zn deficiency, predominantly children and pregnant women. Signs of severe zinc deficiency include hair loss, skin lesions, wasting, and persistent diarrhea. The mineral appears to be particularly important during periods of rapid growth, and insufficient intake during childhood and adolescence can delay growth, sexual development, and psychomotor development [9].

1.4 Calcium

Calcium is the most abundant mineral in the human body, accounting for 1–2 % of an adult's body mass. Over 99 % of Ca is stored in the teeth and bones, where it plays an important structural role [9]. However, Ca, like Zn, is also an enzyme cofactor and an important signaling molecule (a secondary messenger). It plays a pivotal role in the blood clotting cascade. Calcium deficiency has a profound impact on bone health, resulting in rickets if deficiency occurs in the young and osteoporosis if it persists into old age.

1.5 Selenium

Selenium is found in two unusual amino acids— selenocysteine and selenomethionine—which are the principal functional components of selenoenzymes. It is an essential cofactor in approximately 50 enzymes, including those whose function is to reduce antioxidant enzymes and those whose function is to remove mineral ions from other proteins [7]. Se is an antioxidant with health benefits including the prevention of cancer and heart disease [9].

1.6 Vitamin A

Deficiency associated with blindness and increased risk of disease and death for small children and pregnant women can be addressed through supplements, which are now estimated to reach children at least once a year in 40 countries. In 1998, WHO, UNICEF, Canadian International Development Agency, USAID, and the Micronutrient Initiative launched the VA Global Initiative. This provides support to countries in delivering VA supplements.

2. Alleviating Hidden Hunger: Interventions

The diets of a large proportion of the world's population are deficient in Fe, Zn, Ca, Mg, Cu, Se, or I, which affects human health and longevity and therefore national economies. Mineral malnutrition can be addressed by increasing the amount of fish and animal products in diets, mineral supplementation, and food fortification and/or increasing the bioavailability of mineral elements in edible crops. However, strategies to increase dietary diversification, mineral supple mentation, and food fortification have not always proved successful. Food fortification and supplementation are currently the most cost-effective strategies to address global mineral malnutrition. The most successful strategy has been salt iodization (fortification with iodine) which has reduced the incidence of goiter and other iodine deficiency disorders symptoms markedly where the scheme has been introduced [6]. Most strategies to improve mineral nutrition have been less successful because of political, socio economic, infrastructure-related, and technical constraints that are apparent in most developing countries.

2.1 Food Fortification

Food fortification is one of the most cost-effective long-term strategies for mineral nutrition [11]. Fortification of dairy products such as bread and milk with different minerals (and vitamins) has been successful in industrialized countries However, this strategy is difficult to implement in developing countries because it relies on a strong food processing and distribution infrastructure. Fortification takes place during food processing and increases the product price. These factors make fortified products unaffordable to the most impoverished people living in remote rural areas.

Zinc fortification has been implemented in the industrial world but rarely in developing countries. One exception is Zn-fortified wheat and maize flours in Mexico, which are used to make bread and tortillas, the two principal staples [12]. Organizations such as the Zinc Task Force (ZTF) and the International Zinc Nutrition Consultative Group (IZiNCG) are fighting Zn malnutrition by promoting diverse strategies to eliminate it. As Zn and Fe deficiencies tend to go hand in hand, it has been suggested that double fortification would be effective with little additional cost, particularly if Fe fortification were already in place.

2.2 Industrial Fortification

The marketed supply of a widely consumed staple food can be fortified by adding micronutrients at the processing stage, and historically this is how micronutrient deficiencies have been addressed in the developed world. Concentration in the food industry also tends to strengthen compliance and quality assurance. Consumption of wheat flour products is growing around the world, even where wheat is not a traditional food staple, opening new fortification opportunities at the milling stage. Public support for traditional fortification has recently been enhanced by new promotion and coordination efforts.

Certain kinds of fortification may be impractical for some important food staples (e.g., VA fortification of milled rice) or may introduce off colors or flavors (e.g., VA fortification of white maize). Industrial fortification will only apply to marketed supplies and therefore may not reach those among the poor who obtain food outside of commercialized channels. Given these limitations, it is clear that industrial fortification of food cannot provide a complete solution to the problem of micronutrient deficiencies in the medium term. It is in this context that a role emerges for bio fortification as a complementary strategy.

3. Bio fortification

Conventional interventions have a limited impact, so bio fortification has been proposed as an alternative long-term approach for improving mineral nutrition [13]. Bio fortification focuses on

enhancing the mineral nutritional qualities of crops at source, which encompasses processes that increase both mineral levels and their bioavailability in the edible part of staple crops. The former can be achieved by agronomic intervention, plant breeding, or genetic engineering, whereas only plant breeding and genetic engineering can influence mineral bioavailability. The main advantage of genetic engineering and plant breeding approaches for mineral enhancement is that investment is only required at the research and development stage, and thereafter the nutritionally enhanced crops are entirely sustainable. Furthermore, as stated above, mineral rich plants tend to be more vigorous and more tolerant of biotic stress, which means yields are likely to improve in line with mineral content [14 &15]. Unlike conventional intervention strategies, genetic engineering and plant breeding are both economically and environmentally sustainable [16]. Bio fortification is also likely to be more accessible than conventional interventions in the long term because it removes hurdles such as the reliance on infrastructure and compliance. Moreover, plants assimilate minerals into organic forms that are naturally bioavailable and contribute to the natural taste and texture of the food. Economic studies have shown many potential health benefits of bio fortification strategies, especially in combination with conventional strategies [17 & 18].

4. Hindrances or Limiting Factors

Antinutrients

Phytate and tannins are the limiting factors in the absorption of Fe, Zn, and Ca by the gut [19]. Phytate occurs widely in plant tissues but is concentrated in seeds or grain. There is considerable intraspecific variation in phytate concentration in edible portions [20 & 21] that is independent of variation in Fe and Zn concentrations. In addition, several low phytic acid mutants have been produced by non-transgenic techniques in rice, maize, wheat, barley, and soybean [22]. Phytic acid, as well as other metabolites produced by plants, is considered an “antinutrient” because by chelating iron, it can reduce its absorption in the human gut [23]. In plants, however, phytic acid fulfills essential biological functions [24].

5. Bio fortification: Strategic Advantages

The bio fortification strategy seeks to take advantage of the consistent daily consumption of large amounts of food staples by all family members, including women and children who are most at risk for micronutrient malnutrition. Agronomic bio fortification, plant breeding, and transgenic approaches are some currently used strategies in food crops. Indian Council of Agricultural Research (ICAR) led National Agricultural Research System (NARS) has developed and released 87 nutrition-rich crop cultivars in important crops like rice, wheat, maize, pearl millet, finger millet, small millet, lentil,

groundnut, linseed, mustard, soybean, cauliflower, potato, and pomegranate. These cultivars have been improved for essential nutrients viz., iron, zinc, calcium, protein, lysine, tryptophan, and provitamin-A, anthocyanin, vitamin-C, oleic acid and linoleic acid. The transgenic approach is sustainable, efficient, and rapid, making it suitable for bio fortification programs [25].

6. Challenges There are several challenges that need to be overcome in order to effectively implement bio fortification programs:

- **Limited availability of bio fortified varieties:** Many bio fortified crops are still in the development or testing phase and may not yet be widely available for cultivation.
- **Limited awareness and understanding of bio fortification:** Many people may not be aware of the benefits of bio fortified crops or may have misconceptions about their safety or nutritional value.
- **Limited distribution and access:** Even if bio fortified crops are available, they may not reach the people who need them most, due to factors such as inadequate infrastructure, lack of storage facilities, or high costs.
- **Political and regulatory challenges:** The development and distribution of bio fortified crops can be hindered by political and regulatory barriers, such as concerns about intellectual property rights, biosafety and trade issues. The development and commercialization of genetically modified (GM) crops, which are a potential tool for bio fortification, can be subject to complex and often controversial regulations.
- **Agricultural constraints:** Bio fortified crops may not always perform as well as non-bio fortified varieties under certain growing conditions, such as drought or pests.
- **Limited adoption:** Even if bio fortified crops are available, farmers may not choose to grow them if they are not familiar with the benefits or if they are not convinced that the crops will be more profitable.
- **Consumer acceptance:** Bio fortified crops may be perceived as being different or inferior to non-bio fortified varieties, which could affect consumer acceptance. Funding: Bio fortification programs require ongoing funding in order to support research, development, and implementation efforts.
- **Coordination:** Bio fortification programs often involve multiple stakeholders, including governments, NGOs, farmers, and the private sector. Ensuring effective coordination among these stakeholders can be challenging [26].

7. Future prospects

Overall, the future prospects for bio fortification are very promising. Some potential benefits of bio fortification include:

- **Expanding the range of bio fortified crops:** Currently, the main focus of bio fortification has been on staple crops such as rice, wheat and maize, but there is potential to bio fortify other crops as well, such as fruits, vegetables and legumes.
- **Improving the efficiency of bio fortification:** Scientists are working on ways to increase the nutrient content of crops using fewer resources, in order to make bio fortification more cost-effective and sustainable.
- **Improving the distribution and access to bio fortified crops:** This may involve developing new storage and transport technologies, as well as working with governments and other organizations to create supportive policies and infrastructure.
- **Promoting the awareness and understanding of bio fortification:** This could involve educating the public about the benefits of bio fortified crops and addressing any concerns or misconceptions about their safety or nutritional value.
- **Reducing malnutrition and improving public health:** Bio fortification can increase the nutrient value of locally-grown crops, which can help to address deficiencies in essential vitamins and minerals and improve the nutritional status of populations that rely on these crops as a major source of energy and nutrients and contribute to food security by increasing the availability of nutritious foods.
- **Supporting sustainable development:** Bio fortification can be implemented at a relatively low cost and can be integrated into existing farming practices, making it a sustainable and scalable solution for improving nutrition.
- **Improving gender equity:** Women and children are often the most vulnerable to malnutrition, and bio fortification can help to reduce gender disparities in access to nutritious foods [26].

Conclusion

Bio fortification heralds a transformative paradigm in a battle against malnutrition and hidden hunger, which is often not visible to the naked eye, as people may appear well-nourished but still be deficient in essential vitamins and minerals. In some cases, bio fortified crops may also have higher yields, which can help to improve food security and increase income for farmers. It can be a cost-effective and sustainable way to improve nutrition, as it relies on using existing agricultural infrastructure and

practices. It can help to address dietary deficiencies and improve nutrition in low-income populations, which may not have the same access to nutrient-rich foods as those in higher-income groups. The integration of multinutrient bio fortification and cutting-edge nano-technology marks a groundbreaking leap. However, there are several challenges that need to be overcome in order to effectively implement bio fortification programs, including limited availability of bio fortified varieties, high costs of production, limited awareness and understanding, limited distribution and access, and political and regulatory barriers. Bio fortified food crops have the potential to significantly improve the lives and health of millions of underprivileged people in India with careful planning, execution, and implementation while requiring a low investment in research.

References

1. Sheoran S, Kumar S, Ramtekey V, Kar P, Meena RS, Jangir CK. Current status and potential of biofortification to enhance crop nutritional quality: an overview. Sustainability. (2022) 14:3301. doi: 10.3390/su14063301.
2. Saltzman, A.; Birol, E.; Wiesman, D.; Prasai, N.; Yohannes, Y.; Menon, P.; Thompson, J. 2014 Global Hunger Index: The Challenge of Hidden Hunger; Welthungerhilfe International Food Policy Research Institute (IFPRI) Concern Worldwide: Bonn, Germany; Washington, DC, USA; Dublin, Ireland, 2014.
3. Bailey, R.L.; West, K.P.; Black, R.E. The epidemiology of global micronutrient deficiencies. Ann. Nutr. Metab. 2015, 66, 22–33. [CrossRef]
4. Bouis HE, HotzC, McClafferty B,Meenakshi JV,Pfeiffer WH (2011) Biofortification: a new tool to reduce micronutrient malnutrition. Food Nutr Bull 32(Supplement 1):31S–40S.
5. Christou P, Twyman RM (2004) The potential of genetically enhanced plants to address food insecurity. Nutr Res Rev 17:23–42.
6. Galera SG, Rojas E, Sudhakar D, Zhu C, Pelacho AM, Capell T, Christou P (2010) Critical evaluation of strategies for mineral fortification of staple food crops. Transgenic Res 19:165–180.
7. Lyons GH, Stangoulis JCR, Graham RD (2004) Exploiting micronutrient interaction to optimize biofortification programs: the case for inclusion of selenium and iodine in the HarvestPlus program. Nutr Rev 62:247–252.
8. Dunn JT (2003) Iodine should be routinely added to complementary foods. J Nutr 133:3008S–3010S.

9. WHO/FAO (1998) Vitamin and mineral requirements in human nutrition: report of a joint FAO/WHO expert consultation, 2nd edn. Bangkok, 21–30 Sept 1998. URL: http://apps.who.int/iris/handle/10665/ 42716#sthash.niRWmJ9o.dpuf
10. Zimmermann MB, Wegmueller R, Zeder C, Chaouki N, Biebinger R, Hurrell RF, Windhab E (2004) Triple fortification of salt with microcapsules of iodine, iron, and vitamin A. Am J Clin Nutr 80 (5):1283–1290.
11. Horton S (2006) The economics of food fortification. J Nutr 136:1068–1071.
12. IZINCG (2007) Technical brief no 4: zinc fortification. URL: http://www.izincg.org/index.php. Accessed 11 Jan 2015.
13. Zhu C, Naqvi S, Gomez-Galera S, Pelacho AM, Capell T, Christou P (2007) Transgenic strategies for the nutritional enhancement of plants. Trends Plant Sci 12(12):548–555.
14. Frossard E, Bucher M, Machler F, Mozafar A, Hurrell R (2000) Potential for increasing the content and bio availability of Fe, Zn and Ca in plants for human nutrition. J Sci Food Agric 80:861–879.
15. Nestel P, Buois HE, Meenakshi JV, Pfeiffer W (2006) Biofortification of staple food crops. J Nutr 136:1064–1067.
16. Stein AJ, Meenakshi JV, Qaim M, Nestel P, Sachdev HPS, Bhutta ZA (2008) Potential impacts of iron biofortification in India. Soc Sci Med 66 (8):1797–1808.
17. Buois HE (2002) Plant breeding: a new tool for fighting micronutrient malnutrition. J Nutr 132:491S–494S.
18. Stein AJ, Meenakshi JV, Qaim M, Nestel P, Sachdev HPS, Bhutta ZA (2008) Potential impacts of iron biofortification in India. Soc Sci Med 66 (8):1797–1808.
19. Mendoza C (2002) Effect of genetically modified low phytic acid plants on mineral absorption. Int J Food Sci Technol 37:759–767.
20. Glahn RP, Cheng Z, Welch RM (2002) Comparison of iron bioavailability from 15 rice genotypes: studies using an in vitro digestion/Caco-2 culture model. J Agric Food Chem 50:3586–3591.
21. Coelho CM, Tsai SM, Vitorello VA (2005) Dynamics of inositol phosphate pools (tris-, tetrakis- and pentakisphosphate) in relation to the rate of phytate synthesis during seed development in common bean (Phaseolus vulgaris). J Plant Physiol 162(1):1–9.

22. Banziger M, Long J (2000) The potential for increasing the iron and zinc density of maize through plant breeding. Food Nutr Bull 21:397–400.
23. Jin F, Frohman C, Thannhauser TW, Welch RM, Glahn RP (2009) Effects on ascorbic acid, phytic acid and tannic acid on iron availability from reconstituted ferritin measured by an in vitro digestion-Caco-2 cell model. Br J Nutr 101:972–981.
24. Murgia I, Arosio P, Tarantino D, Soave C (2012) Biofortification for combating hidden hunger for iron. Trends Plant Sci 17(1):47–55.
25. Ummed Singh, C S Praharaj, S.K. Chaturvedi, and Abhishek Bohra (2016). Biofortification: Introduction, Approaches, Limitations, and Challenges. Biofortification of Food Crops, DOI 10.1007/978-81-322-2716-81.
26. Avnee, Sonia Sood , Desh Raj Chaudhary , Pooja Jhorar and Ranbir Singh Rana (2023). Biofortification: an approach to eradicate micronutrient deficiency. Frontiers in nutrition, 10:1233070. doi: 10.3389/fnut.2023.1233070

FORMULATION AND DEVELOPMENT OF VALUE ADDED RECIPES USING PLANTAIN FLOWERS AND FLORETS POWDER

Shandhiya. V

Assistant Professor, PG Department of Food Service Management &Dietetics, AIMAN College of Arts and Science for Women, Tiruchirappalli, Tamil Nadu, India

Abstract

Plantain flower is a large, dark purple red blossom that grows from the end of a bunch of bananas.it is a leafy maroon coloured cone with cream coloured florets layered inside. Plantain flower is usually considered as a byproduct of banana cultivation. Plantain flower (Musa acuminate) is rich in phytochemical and antioxidant. It had medicinal properties as well as antioxidant properties. The plantain flower is substantial source of anticancer, antidiabteic, and antibacterial properties. Dried plantain flower powder and dried plantain flower was prepared by using the sundry method. The present study was designed to evaluate the phytochemical and antioxidant properties of dried and fresh plantain flower. The dried plantain flower incorporated products and fresh plantain flower product were sensory evaluated. The product developed were plantain flower poli, plantain flower tea and plantain flower pickle. Plantain flower poli was prepared in three variations and result indicates variation 2 (V2) poli with 20% dried plantain flower powder has significant level of 0.05% and overall acceptability is 4.5±0.5. Plantain flower tea was prepared in three variations and result indicates variation 3 (V3) tea with 50% of DPF has significant level of 0.05% and overall acceptability is 4.2±0.7. Plantain flower pickle was prepared in three variations and result indicates variation 1 (V 1) pickle with 70% of fresh plantain flower has significant level of 0.05% and overall acceptability is 3.8±0.6. Furtherly, the plantain flower developed products for cancer, Alzheimer's disease, anemic and heart conditions for the better improvement.

***Keywords**: Phytochemical, antioxidant, plantain flower, anemic, Alzheimer's disease*

Introduction

Bananas is one of the most widely consumed fruits in the world because of its taste, nutritional value and potential health benefits. In developing countries, bananas are the fourth most important crops after rice, wheat and nearly 90% of the crops grown for local trade and small- scale consumption (Sharrock, Frison, 1998). Several parts of the banana such as leaf, pseudo stem, flowers, fruit or peelhave been used as traditional medicine in America, Asia and Africa whereas stem juice of the banana plant is used commonly for the treatment of diarrhea. (Panda, S.K, Sampath Kumar, 2012).

Plantain flower is usually considered as a by-product of banana cultivation. The Plantain flower is a large, dark purple-reddish blossom that grows from the end of a bunch of bananas. The female flowers are the first to develop into fruits. The first 5-15 basal nodes produce by female flowers and the upper digital nodes produce by male flowers. Plantain flower has 2 parts mainly outer sheath like substance which is dark purple red in color referred asBract. Inner small tubular-toothed whitish flowers that are arrangedalong the floral stacks are known as Florets.

It can grow 2 to 4 meters in height at maturity. Its sizable bracts, or leaves, snugly enclose delicate, sweetly scented male blossoms. The female blossoms, which do not require fertilization to become fruit, grow farther up the stem from the male blossoms. Each time one banana stem produced, one plantain flower, because it is usually harvested together with the banana. The plantain flower oxidizes and turn black when they come in contact with air the plantain flower is one of the most popular in people who living in countries such as Malaysia, Philippines, Indonesia and Sri Lanka. (Salvador, 2018)

Methodology

Phase I

Selection and processing of raw material

Fresh Plantain flower was washed in soft water to get rid of the dusts and dirt present on the surface of Plantain flower. After washing Plantain flower, bracts were peeled and removed the florets until the leaves become too small to peel where the stem were trimmed and discarded. The thin stick in the center called pistils should be removed. Finely chopped them into pieces (where the pickles were made after drying overnight) otherwise chopped plantain flower were kept ready for sun drying. Sun drying should be done by covering using white muslin cloth for 5-7 days (where Tea was made). Dried Plantain flower were brittle and dry which is the best indicator to grind the dried Plantain flower (ready for Poli). They can be stored for longer periods on shelf.

Phase II

Preparation , Standardization & Variation

Table 1 standardization of tea using dried plantain flowerincorporated by dried ginger

Sl. No	Ingredient	Standardization	V1	V2
1 h	Dried plantain flower	50	50	50
2 e	Dried ginger	-	50	20

Standardization

Dried plantain flower of 5gm is added in 200ml of tap water , stirred it gently, and boiled for 2 -3 minutes at medium flame.

Variation 1

Figure 1 Sample of Variation 1

The dried plantain flower of 5gm is mixed with 5gm of dried ginger and added in 200ml of tap water, stirred it gently, and boiled for 2 -3 minutes at medium flame.

Variation 2

The dried plantain flower of 5gm is mixed with 2gm of dried ginger and added in 200ml of tap water , stirred it gently, and boiled for 2 -3 minutes at medium flame.

Phase III

Organoleptic evaluation

Sensory evaluation provides index of overall acceptability of foodstuffs which depends on appearance, texture, colour and taste. The formulated poli, tea and pickle are presented to a 30 panelist with 5 point hedonic scale in which include color, appearance,texture,taste and overall acceptability.

Statistical analysis of the product

Result and Discussion

The data for organoleptic evaluation of Plantain flower tea were tabulated and analyzed statistically. The result obtained during investigation were presented and discussed with respect to experimental data

Organoleptic evaluation of plantain flower tea

Table 2-mean organoleptic scores of plantain flower tea

S.No.	CRITERIA	MEAN SCORES OFVARIATIONS		
		S	V1	V2
1	Colour	3.6±0.81	3.26±1.72	3.7±1.31
2	Aroma	2.5±0.90	3±1.48	4.16±0.69
3	Appearance	3.03±1.06	4.43±0.50	4.33±0.71
4	Taste	2.4±0.89	1.8±0.66	4.33±0.88
5	Overall Acceptability	2.76±0.97	2.36±0.99	4.2±0.76

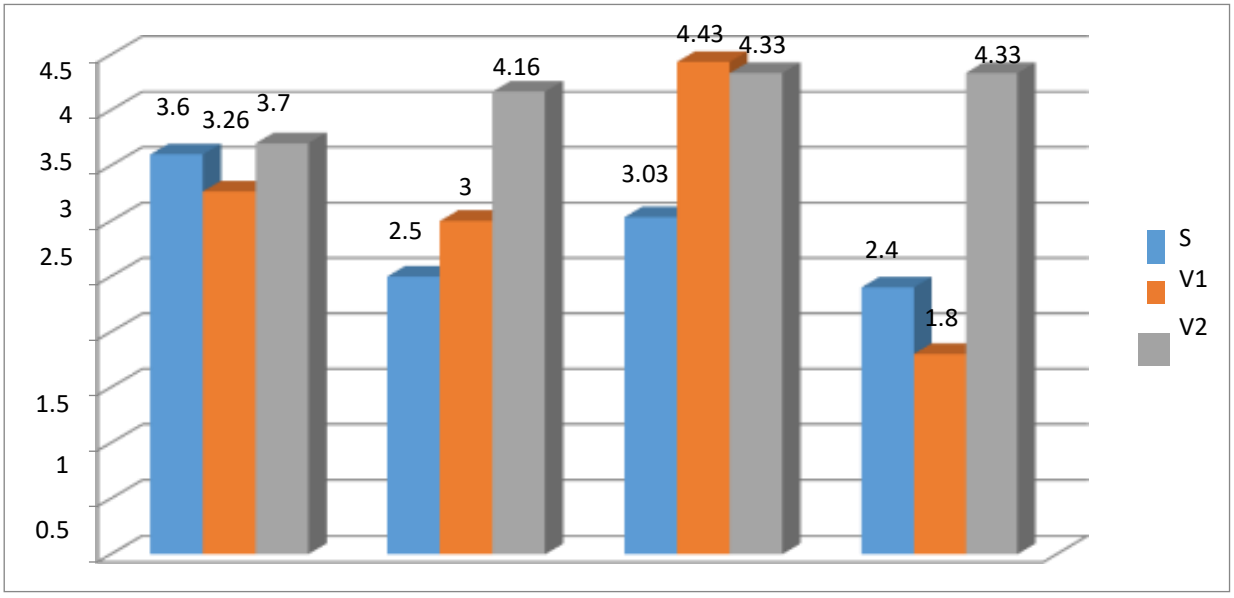


Figure 2 organoleptic evaluation of Plantain Flower tea

Figure 2, shows that mean score for an organoleptic evaluation of PlantainFlower tea such as color, aroma, appearance and taste. Hence, the graphical representation revealed the graphical representation organoleptic evaluation of Plantain Flower tea in three variations (S, V1, and V2).

Colour

The mean score and standard deviation by three variations (S, V1, V2) for the colour were3.6±0.81, 3.26±1.72 and 3.7±1.31 respectively. The V2 has obtained highest score and the colour characteristic of V2 was the addition of 71.4 %of plantain flower in tea

Aroma

The mean score and standard deviation by three variations (S, V1, V2) for the texture were 2.5±0.90, 3±1.48 and4.16±0.69 respectively. The V2 has obtained highest score and the characteristic of V2 was the addition of 71.4% of plantain flower in tea.

Appearance

The mean score and standard deviation by three variations (S, V1, V2) for the appearance were 3.03±1.06, 4.43±0.50 and 4.33±0.71. Hence The V2 has obtained highest score and the characteristic of V2 was the addition of 71.4% of plantain flower in tea.

Taste

The mean score and standard deviation by three variations (S, V1, V2) for the taste were 2.4±0.89, 1.8±0.66and 4.33±0.88 respectively. The V2 has obtained highest score and it gave better taste when compared to other two variations.

Table 3-Nutritive calculation of plantain flower tea

S.NO	CRITERIA	NUTRITIVE VALUE/100g
1	Energy (Kcal)	8.56
2	Carbohydrate (g)	1.96
3	Protein (g)	0.07
4	Fat (g)	0.03
5	Fiber(g)	0 .31
6	Iron(mg)	0.04

The above table depicts the analyzed nutritive values per 100g of sample. The energy content was 8.56kcals, 1.96g of carbohydrate, 0.07g of protein and 0.03g of fat, 0.031g of fiber and 0.04mg of iron respectively.

Conclusion

This product development focus on the nutritional, anticarcinogenic & antioxidant properties of plantain flower which can be used as a food, pharmaceuticals and many other industrial uses. Plantain flower contains free radical scavenging activity, antimicrobial activity, antidiabetic activity, anticancer activity and antioxidant properties. Further, the products developed by using plantain flowers& florets powder can be effective for anemic condition, protein malnutrition condition, heart and diabetic patient for better improvement.

References

1. Denny and J. Buttriss, (2007), Plant foods and health: focus on plant bio actives, EU Information Resource (EuroFIR) Consortium Contract FOOD-CT- 2005-513944.
2. Arya, K.S., and Sinija, V.R., (2016). Proximate Composition and Antioxidant Activity of Banana Blossom of Two Cultivars in India, Journal of Agriculture and Food Science And Technology 7(1) 13-22

ORGANOLEPTIC, NUTRITIONAL CHARACTERISTICS AND STORAGE STABILITY OF NUTRI COMPOSITE BAR

Jothimangalam.S[1], Poongodi Vijayakumar.T[2], T. Ragunath.T[3], Deepa.M[4]

[1]Faculty, [2]Professor and Head, [3]Ph.D. Scholar, [4]Assistant Professor,
Department of Food Science and Nutrition, Periyar University, Salem, Tamil Nadu, India
jothinutritionist@gmail.com

Abstract

In recent years, the global market for nutrient-dense energy bars has grown in significance and appeal, and a vast array of bars are currently available under various brand names. A food product's shelf life, or how long it can be stored in usable storage conditions without losing acceptable quality is a crucial component of its success. Product quality is evaluated using different criteria including sensory, physiological, chemical, and microbiological. Therefore, the goal of the current investigation was to ascertain how stable the produced nutri composite bar would be in storage if it were kept at room temperature and packaged using standard, modified environment, and vacuum packaging techniques. A Nutri Composite Bar was developed with millets and additional nutritious components. The resulting LDPE was then packed in a 1mm thickness using both standard packaging techniques and vacuum packing techniques. The packed bar was assessed based on metrics that were determined after 0, 15, 30, 45, and 60 days of storage. 35g of protein, 353 kcal, and 51 mg of vitamin C were all present in the developed nutri composite bar. The overall cost of manufacture came to Rs. 20 per 100g, or four bars. Both the mothers and the elementary school children thought the created bar were excellent. The minimum recommended shelf life, taking into account peroxide value changes (20% change from original value), was 15 days, while the maximum shelf life, based on the overall sensory score, was 30 days on average.

Key words: *Nutri composite bar, Millet bar, storage stability, shelf life, LDPE Packaging*

Introduction

Nutrient-rich energy bars have become increasingly important and popular in the world market in recent years, and the market currently offers a wide variety of bars under different names. Homemade bars like Horlicks Multi Cereal Nutri Bar, Rite Bite Chocolate Deli Bar, Low Fat Bar, Sugar Free Bar, Women Bar, Fruit Chocolate Bar are becoming increasingly

popular among Indian consumers. Different types of bars with good organoleptic properties and consumer appeal are available on the global market and go by names such as chewy granola bars, organic bars, chocolate bars, muffin bars, and fruit-filled bars. (Padmashree et al., 2012).
Shelf life can be influenced by a variety of factors, including the ingredients used, the characteristics of the packaging material used, the quality of the packaging seal, and storage conditions (Vitali et al., 2004).

Product quality is often modeled mathematically using multiple parameters, such as physicochemical, microbiological, and colorimetric parameters that are essential to the product, and therefore in new product development and testing (Manzocco et al., 2009).
Hence the present study was done to determine the storage stability of developed nutri-composite bar stored at room temperature and packed by ordinary, modified atmosphere and vaccum packaging methods.

Methodology

Materials

Good quality wheat *(Triticum aestivum)*, french millet *(Panicum milliaceum)*, ragi *(Eleusine coracana)*, green gram *(Phaseolous aureus-Roxb)*, amaranth *(Amaranth tristis)*, drumstick leaves *(Moringa oleifera)*, coconut meal *(Cocos mucifera)*, groundnut *(Arachis hypogaea)*, papaya *(Carcia papaya)*, jaggery *(Saceharum offinarum)*, cocoa powder and ghee were purchased from the local market at Salem. Cleaned separately, they were sun-dried, roasted, ground into flour, and sieved through 60 BSS mesh.

Preparation of Nutri-composite Bar

The palm jaggery was dissolved in water (1:1) and made into a syrup by boiling at 70°C to 72°C Brix concentration level and strained. All ingredients were weighed in determined proportion and mixed thoroughly till the desired consistency and finally added ghee, cocoa powder and papaya pulp, poured the mixture in the mould of desired size and shape, allowed to cool and the bar was packed by wrapping it in aluminum foil as a primary packaging material.

Storage Stability Evaluation

Nutri composite bar was packed in LDPE packaging under normal atmospheric conditions and modified atmospheric packaging (filling of pure nitrogen gas (100%)) using

modified atmospheric packaging machine (VEECO in India) and under vacuum where the air was sucked out of the package to introduce 100% vacuum by a Vac-Star vacuum packaging machine (UV-10 GX, Swizerland).

The storage stability of nutri composite bar packed by different packaging methods was analyzed for 60 days stored at ambient temperature by determining the storage stability parameters such as moisture, pH, titrable acidity, vitamin-C, protein, total soluble solids (°Brix), peroxide value, total microbial count and sensory characteristics at 0, 15, 30, 45 and 60 days of storage.

Statistical Analysis

All determined parameters were analyzed statistically (ANOVA with Duncan's test as posthoc comparison) using SPSS package 17.0 version.

Results and Discussion

Nutritional Contribution of Nutri composite bar

The developed nutri composite bar (100g) revealed the nutritional composition as, moisture-12 g%, protein-38.4 g%, fat-2.51 g%, total carbohydrate 47.18 g%, energy-353.15 kcal, crude fiber-0.3 g%, vitamin C- 51.14 mg% and total ash- 3 g% in accordance with the values specified by FSSAI (2009) for processed supplementary food except for moisture.

As per the mid day meal scheme regulation in Tamil Nadu, a meal should provide at least 450 calories, 12g of protein to all children studying in classes 1 to 5 (Wizarat K, 2009). The consumption of 4 servings per day (1 serving is equivalent to 25 g) will provide the minimum calorie and protein requirement specified by mid-day meal scheme regulations of Tamil Nadu. Since the bar is rich in protein of high quality it could be recommended as additional food supplement in mid-day meal.

Changes in Determined Storage Stability Parameters of Nutri-Composite Bar

Moisture

Moisture was significantly reduced during storage, whereas significant difference between packaging methods was noticed from the 45th day of storage; moisture loss was significantly maximum in vacuum packaging and minimum in ordinary packaging.

pH.

The alkalinity of the developed bar was significantly increased at $p<0.05$ during storage. The type of packaging material also influenced the change in pH of the developed nutri-composite bar. The increase in pH was maximum in ordinary packaging and minimum in vacuum packaging. Shifts in pH of food with storage time may reflect microbial activity and foods that are poorly buffered (i.e., do not resist changes in pH) may shift pH values considerably. A food may start with a pH which precludes bacterial growth, but as a result of the metabolism of other microbes (yeasts or moulds) pH shifts may occur and permit bacterial growth (US Food & Drug Administration, 1992). Similar relationship was noted with total microbial count and pH of nutri- composite bar.

Titrable Acidity

The titrable acidity of nutri-composite bar was decreased significantly at $p<0.05$ during storage. But packaging methods did not have significant influence on titrable acidity. The changes in titrable acidity were highly positively correlated with changes in total microbial count of the bar irrespective of different storage method.

Total Soluble Solids (°Brix)

The level of total soluble solids was stable during storage irrespective of packaging material. Only slight reduction was observed on the 60^{th} day of storage.

Vitamin C

The vitamin C content of the nutri-composite bar was found to be decreased significantly at $p<0.05$ after the 30^{th} day of storage. The reduction was significantly gradual in all the three different packaging methods. Freitas and Moretti (2006) reported that the appearance, color and over all impressions of were negatively affected, probably due to the accelerated browning caused by Vitamin C oxidation.

Protein

The protein of nutri-composite bar was decreased significantly after 30^{th} day of storage at $p<0.05$ irrespective of different packaging methods. Simon et al (2009) reported that the shelf life of a protein bar often limited by the development of a hard or tough texture and consumer find unpalatable. Similar results were obtained in the present study.

Peroxide value

The peroxide value of the developed nutri-composite bar was found to be increased significantly at $p<0.05$ on storage. The increase in the peroxide value was consistent in all the packaging methods. No significant difference among the packaging methods was observed.

Changes in sensory attributes

Changes in the sensory attributes like appearance, colour, flavor, texture and taste on a 4-point descriptive scale were determined and the total sensory score of the developed nutri composite bar on different storage period. From the given score it is evident that the total sensory score decreased drastically at $p<0.05$ on storage. Different packaging methods did not have significant difference on total sensory score. Several food bar shelf-life studies conducted by different authors. The bars can harden (Loveday et al., 2009) or lose firm texture during storage.

Conclusion

The present study was to evaluate the nutri composite bar's capacity to be preserved at room temperature for 60 days when packaged using various techniques. As a consequence, it was determined that the created nutri composite bar could supply 51 mg of vitamin C, 353 kcal, and 35g of protein. Both the mothers and the elementary school children thought the created bar was excellent. No matter how the bar was packaged, the minimum recommended shelf life, taking into account peroxide value changes (20% change from original value), was 15 days, while the maximum shelf life, based on the overall sensory score, was 30 days on average.

References

1. Fontana JR, A.J, Understanding the importance of water activity in food, Inn. Food Tech, pp (2008), 116 – 117.
2. Freitas, D. G. C.; Moretti, R. H, Characterization and sensory evaluation of cereal bars. Food Science and Technology Magazine (2006),v. 26, n. 2, p. 318-324,
3. Loveday, S. M., & Winger, R. J, Mathematical model of sugar uptake in fermenting yeasted dough. Journal of Agricultural and Food Chemistry (2007), 55, 6325-6329.
4. Manzocco, lagazio L, “Coffee brew shelf life modelling by integration of acceptability and quality data”. Food Quality and Preference, (2009), Vol-20.

5. Padmashree.A, Sharma GK, Srihari KA, Bawa AS, Development of shelf stable protein rich composite cereal bar, J Food sci technology (2012), 49(3):335-341.
6. Loveday, Jason Hindmarsh, Lawrence K. Creamer, Physicochemical changes in a model protein bar during storage (2009), 2(7):798-806. US Food & Drug Administration, 1992.
7. Vitali, Quast AA, Vida DG, Moura, Reacoes de transformacao e vida de prateleira de alimentosprocessados. 3rd. Campinas (2004), p.49-57.
8. Wizarat K, Study of Best Practices Adopted in Mid-Day-Meal Scheme In Uttar Pradesh. (2009).

DEVELOPMENT AND SENSORY EVALUATION OF BALLOON VINE (*CARDIOSPERMUM HALICACABUM)* INCORPORATED MILLET NOODLES

Selvarani.D [1] and Mohana Priya.M[2]

[1]Assistant Professor, [2] PG Student, PG Department of Food and Nutrition, Bishop Heber College, Tiruchirappalli, Tamil Nadu, India.

selvarani.nd@bhc.edu.in

Abstract

Millets are traditionally important grains and a valuable component of the human diet, particularly in developing countries. Millets have more than fifty phenolic compounds such as phenolic acids and their derivatives, flavonols, flavones, and flavanols which possess a high antioxidant capacity. Epidemiological studies show that increased consumption of millet reduces age-related challenges includes reduced cholesterol, heart-related disease, diabetes and liver disorder. Although millet is known as a nutritious cereal, it is little explored for the possibility of developing novel food products using different processing technologies. The study has selected two exotic millets namely Porso Millet (Broom corn millet) and Brown top millet which should be consumed once in a week. Balloon vine plant is known as mudakkathan keerai. It is given this name as it cures "Mudakku vadham". The present study was aimed to develop nutritious and ready to cook instant noodles using Porso millet and Brown top millet incorporated with Mudakkathan leaves powder. The noodles were prepared by combination of broom corn and brown top millet flour in ratio of 20:20. Mudakkathan leaves powder was incorporated to an acceptable amount of 10%. Whereas noodles prepared out of without incorporation of mudakkathan leaves powder was served as control. The organoleptic evaluation of the developed noodles was carried out using 9 Point Hedonic Scale and determines their acceptability. Based on the scores of sensory evaluations the best accepted noodles were selected for qualitative estimation such as nutrient, phytochemical and microbial analysis.

Keywords: *Millets, Phenolic compounds, Noodles, Balloon vine and Rheumatoid Arthritis.*

Introduction

Noodles are widely consumed throughout the world especially in South-east Asia and it is a fast-growing sector of the noodle industry (Owen, 2001). This is because noodles are convenient, easy to cook, low cost and have a relatively long shelf life. According to the report by World Instant Noodle Association (2014) the annual production of noodles was 105.65

billion packs in 2013 and is increasing at a rate of 3% per year since 2010 (Ojure and Quadri, 2012).

Asian noodles were created in China more than 4,000 years ago. They have developed into a variety of shapes and forms and are now a staple cuisine on every continent. Asian noodles can be prepared from a wide range of ingredients, including wheat flour, rice flour, buckwheat flour or starches made from corn, rice, mung beans, tapioca, sweet potatoes or sago. Nevertheless, the products differ in terms of shape, size and moisture content. Both wheat flour noodles and gluten-free noodles are becoming more and more popular today (Gary G, 2020).

Millets are traditionally important grains and a valuable component of the human diet, particularly in developing countries. Millets have more than fifty phenolic compounds such as phenolic acids and their derivatives, flavonols, flavones and flavanols which possess a high antioxidant capacity (Tahera Nauin). Epidemiological studies shows that increased consumption of millet reduces age- related challenges includes reduced cholesterol, heart-related disease, diabetes and liver disorder (Timnoy Salitxay, 2019). Although millet is known as a nutritious cereal, it is little explored for the possibility of developing novel food products using different processing technologies (Obyedul Kalam Azad et al., 2019).

Broomcorn millet (*Panicum miliaceum*), known by other names such as Porso millet, common millet and hog millet is a minor cereal food crop cultivated in South- east Asian countries since ancient times (Zhang et al.,). Porso millet is rich in minerals (P, Ca, Zn, and Fe) dietary fiber, vitamins (niacin, B-Complex Vitamins, folic acid) and essential amino acids (methionine and cysteine) than barley, oats, rye and wheat. Porso millet have been shown to have a beneficial impact on blood glucose and cholesterol regulation (Chandrasekara and Shahidi, 2011).

Brown top millet (Brachiaria Ramosa.L) are known as pedda- Sama and Korale in Karnataka (Kalpana B, 2020). Brown top millet has phytochemicals such as flavonoids, quinones, tannins and resin. This millet is also gluten free and non- acid forming, easy to digest type of millet and an alternative to replace rice and wheat (M Kirthy Reddy).

Balloon Vine (*Cardiospermum Helicacabum*) plant traditionally known as Mudakkathan Keerai in Tamil. It was given this name as cures or prevents "Mudakku Vadham" in ancient days. *Cardiospermum Helicacabum* is an Herbaceous Climber found throughout the plains of India (Annamalai A, 2019). Balloon vine was used in ayurveda and folk medicine for the treatment of rheumatism, lumbago, earache and fever. Experimental pharmacological studies shows that it has a high rate of analgesic and anti- inflammatory activity in it (P.T.V

Lakshmi). Although these leaves were nutrient rich its smell and flavor were not acceptable when it was cooked alone.

Consuming legumes is a typical and advantageous component of the human diet, which promotes health. They are a necessary source of protein, carbohydrates, dietary fibre, micronutrients and different phytochemicals. Legumes contain a sizable amount of all the required amino acids, with the exception of those that include sulphur. Consuming legumes lowers the risk of developing cardiovascular disease, some cancers (colon, breast and prostate) and also helps to manage body weight due to its satiety value (Kamboj Rajni and Nanda Vikas, 2018).

Even though noodles are a popular fast-food item, those available in the market generally have low nutritional value in terms of dietary fiber, minerals and vitamins (Ojure and Quadri, 2012). Addition of millets and green leafy vegetables in noodles can be a promising technology for enriching its dietary fiber and minerals where green leafy vegetables consumption is unpopular. Balloon vine has a well-established anti-inflammatory property and therefore this study focuses on the formulation and development of a food products using balloon vine powder suitable for rheumatoid arthritis.

The current study was aimed to develop Balloon vine powder incorporated ready to cook healthy millet noodles with the following objectives:

- To formulate and standardize Balloon vine powder incorporated millet noodles.
- To evaluate the organoleptic characteristics of the millet noodles prepared using Balloon vine powder.
- To estimate the nutrients, phytochemicals and perform the microbial analysis of the product.
- To develop packaging and labelling and determine the cost effective of the developed product.

Materials and Methods

1. Collection and Processing of raw materials

Porso millet, brown top millet, wheat flour and red gram dhal was purchased from local market Tiruchirappalli, Tamil Nadu, India. It was selected on the basis of freshness and quality of the product. Organically grown balloon vine leaves were procured from a farm at Manapparai, Trichy.

Balloon vine leaves were washed thoroughly with clean potable water and shadow dried for 2-4 days. The dry leaves were ground into a fine powder, roasted and sieved. This powder

was stored in an airtight container for future use. Brown top millet and Porso millet were cleaned by removing dust particles and soaked in water for 30 minutes. After soaking, millets were sun dried for 2 hours. It was cooled and ground into fine powder and sieved which was stored in air tight container for further process. Red gram dhal was cleaned by removing dust particles and roasted in medium flame for 10 minutes to remove moisture and improve flavour. It was cooled and ground into fine powder and sieved which was stored in air tight container for further process.

Plate 1 - Raw materials

2. Formulation of the Product

Dough was prepared by mixing wheat flour, brown top and Porso millet flour, balloon vine powder, roasted red gram dhal powder, salt and water. The proportions of the raw material were taken in specific ratios to make different variations of noodles as given in Table I.

Table I -Formulation and Standardization of the product

Ingredients	Control	Variation 1	Variation 2	Variation 3
Porso millet flour	20	20	20	20
Brown top millet flour	20	20	20	20
Balloon vine powder	-	5	10	15
Wheat flour	30	30	30	30
Red gram dhal powder	10	10	10	10
Salt	5	5	5	5

3. Preparation of the Noodles

Dough for noodles was made by mixing wheat flour, brown top and Porso millet flour, balloon vine powder and red gram dhal flour. The dough was extruded to noodles and it was sundried for 2 hrs. Three variations of the noodles were prepared by varying the proportion of balloon vine powder.

Plate 2 - Variation (V1, V2, V3)

4. Sensory evaluation of the developed product

Sensory evaluation was done by using the 9 -point hedonic scale with the semi-skilled panel to find out the attributes such as appearance, color, flavor, texture, taste and overall acceptability of the developed product and compared with the standard noodles. The overall acceptability was evaluated by the mean score of all the attributes. The best accepted noodles were selected for qualitative estimation such as nutrient, phytochemical and microbial analysis.

5. Nutrient, phytochemical and microbial analysis

The nutrient analysis for energy, carbohydrate, protein, fat, dietary fibre, moisture and calcium were analyzed according to the AOAC, 2000. Phytochemicals were analysed for the balloon vine powder. The microbial load was determined by using total plate count method to find out the shelf life of noodles.

6. Packaging and labelling of the developed product

Since they are dry meals, deep-fried instant noodles often have a high fat level and a very low moisture content. Hence, the laminated film packaging should have high barrier capabilities to prevent the instant noodles from oxidation and deterioration.

Labelling of the developed product according to food safety and standards (labelling) regulation some mandatory information includes name of the product, list of ingredients, nutritional information, vegetarian or non-vegetarian symbol, name & complete address of the manufacturer, net quantity, batch number, date of manufacture or packing, best before and use by date and instruction for use.

7. Cost calculation of the developed product

The raw materials were procured from the local market Tiruchirappalli and the product was formulated. The cost of the product was calculated based on three criteria. They are cost of materials, employees and overhead cost

Results and Discussion

The results of the study "Development and Sensory Evaluation of Balloon Vine (*Cardiospermum Halicacabum)* Incorporated Millet Noodles" is presented and discussed below:

A. Sensory characteristics of the noodles

The sensory evaluation of the Balloon Vine (*Cardiospermum Halicacabum)* incorporated millet noodles are presented in Table II.

Sensory characteristics of the noodles

Parameter	Variation 1	Variation 2	Variation 3
Appearance	7.9±0.81	8.26±0.85	7.66±0.80
Colour	7.72±0.76	8.66±0.56	7.5±0.68
Flavour	7.54±1.03	8.38±0.70	7.74±0.78
Taste	7.82±0.74	8.38±0.67	7.88±0.75
Texture	7.3±1.21	8.46±0.67	7.52±1.14
Overall acceptability	7.18±1.20	8.38±0.77	7.48±1.24

The above table depicts the scores obtained after the sensory evaluation of the product. Among the different variations prepared, it was found that the noodles of variation 2 was preferred with the overall acceptability and considered best among variation 1 and 3. The cooking quality of the noodles was good and the recipe prepared was good in all the sensory parameters.

B. Proximate composition of the noodles

Based on the overall acceptability of the Balloon vine (*Cardiospermum Halicacabum)* incorporated millet pasta, variation 2 recorded the highest score and therefore it was chosen to perform the proximate composition analysis of the product. The nutrient content of the product was estimated by using standard procedures and the results obtained are presented in Table III.

Table II - Nutrient content of the noodles

Nutrients	Balloon Vine incorporated noodles (Variation 2) (1g of Sample)
Energy (K.cal)	4
Carbohydrate (g)	0.7
Protein (g)	0.7
Fat (g)	0.09
Fibre (g)	0.5
Calcium (mg)	0.6
Iron (mg)	0.08
Moisture (%)	0.02

The energy content of the Balloon vine incorporated V2 Noodles was 4 calories for 1g of the sample. 100 g of the sample would therefore provide 400 calories.

Traditionally available noodles are prepared from wheat flour or refined wheat flour that is generally rich in carbohydrates. The carbohydrate content in 1g of the Noodles was founded to be 0.71g. Therefore the carbohydrate content of 100 g of Noodles would be 70 g. In the regular noodles that is available commercially the protein content is very less and is about 4.9g because it is cereal based. The quantity of protein present in 1g of the sample is 0.7g which will amount to 70g per 100g of the sample. Hence, find that the protein content is appreciably high and could be used as part of a balanced diet.

The amount of fat in the product was found to be 0.09g in 1g of the sample. Therefore, in 100g of the sample it would be 9g.

The fibre content of the Balloon Vine incorporated noodles was found to be 0.5 g/ g of the sample. While calculating the fibre for 100g of the sample it would be 50 g. The amount of fibre present in the commercially prepared noodles was found to be 1.4 g. Value added noodles prepared incorporating Balloon vine contains a high amount of fibre and could be used as part of the meal for the children and adults.

The amount of calcium present in 100g of the product was found to be 60 mg, while the commercially available noodles contain 12 mg. The amount of iron in the product was found to be 0.08 in 1g of the sample. Therefore, in 100g of the sample it would be 8mg.

The storage stability of the extruded snacks is usually evaluated by two parameters i.e. moisture content of the product and sensory evaluation. The moisture content of the samples was estimated by adopting standard procedure. The moisture present in 1g of the sample was found

to be 0.02 which would be 2% for 100g of the sample. The moisture is very much less which would ensure the keeping quality of the product.

C.Phytochemical analysis of balloon vine incorporated noodles

According to studies, phytochemical screening of aqueous of Balloon vine confirmed the presence of terpenoids, flavonoids, saponin, tannins, alkaloids, steroids, glycosides, cardiac glycosides, coumarin, emodin, anthroquinone, anthocyanin, xanthoproteins and phenols but leo anthocyanin was not detected. In this study Balloon vine was dried, roasted and the powder was incorporated in the recipes. The absence of phytochemicals may be attributed to the extrusion process.

D.Microbial analysis of noodles

The variation 2 was subjected to microbial analysis and the results of the bacterial load present in the Balloon vine incorporated noodles was $2.34x10^9$ colony forming units which is within the desirable range and safe for consumption. The yeast colonies were 3.99×10^5 and mold colonies were not found in the variation 2 noodles.

E. Cost calculation of the developed noodles

The cost calculation of the variation 2 noodles is calculated according to the raw material cost in the market. The cost of the Balloon vine incorporated noodles was Rs.30 for 100 g. One serving of Balloon vine incorporated millet noodles, approximately 50g, would therefore cost Rs.15.

Conclusion

The study was carried to provide a healthy and nutritious foods to all age groups especially elderly people. The nutrient rich noodles were developed and formulated by Balloon vine powder, broom corn and brown top millet flour, wheat flour and roasted red gram dhal powder. The results proved that Balloon vine has potential to be used in value added products and satisfy the craving of arthritis and diabetics. The developed noodles will be an alternative source to decrease the intake of junk foods and it improves the nutritional status of the adults those who are more prone to rheumatoid arthritis and diabetes. The formulated noodles are suitable for people of all age group. Noodles were formulated in three different variations. A standard noodle was prepared with millets and wheat flour used for the baseline comparison with the newly formulated balloon vine incorporated millet noodles.

Among the three variations prepared V2 variation was preferred with an overall acceptability when compared to variation 1 and 3. The nutritive value of the highly accepted variation 2 noodles was analyzed. Nutrient analysis revealed that Balloon vine incorporated noodles had protein, fiber, iron, energy, and carbohydrates, fat.

The total bacterial colonies, yeast colonies and mold colonies were estimated in the selected Variation 2 to determine the shelf life of the product. The total bacterial colonies were found to be 2.34×10^{9}. The yeast and mould count ranged from 3.99×10^{5} and 0 respectively. The cost of the Balloon vine incorporated noodles was Rs.30 for 100 g. The cost of the noodles is relatively low and affordable to all people. The study recommends further research into the toxicity levels, antioxidant and anti-inflammatory activity of Balloon vine and various other ready-to -use recipes.

References

1. Abbirami Elangovan, Ethno medical, phytochem Ojure and Quadri cal and pharmacological insights on an Indian medicinal plant: The balloon vine (Cardiospermum halicacabum Linn.) (2022).
2. Annamalai.A., Effect of Drying Treatment on the Contents of Antioxidants in Cardiospermum Halicacabum, Department of Biotechnology, Karunya University, Coimbatore.
3. Gary G. Hou, Asian Noodle Manufacturing Ingredients, Technology, and Quality, Legume Research - An International Journal, pp. 325-332 (2018).
4. Jeyadevi Ramachandran, Ethnomedical, phytochemical and pharmacological insights on an Indian medicinal plant: The balloon vine (Cardiospermum halicacabum Linn.) (2022)
5. Nivedhitha and K. Lakshmi Priya, Effect of Pre-Treatments on the Quality of Brown Top Millet Flour and Development of Cookies, Journal of tropical agriculture (2018).
6. Krishna Murti and Mayank A., Pharmacological Properties of Cardiospermum Halicacabum-A Review Asst. professor, Department of Pharmacology, Vidyabharti Trust College of Pharmacy, Umrakh, Gujarat, India.
7. Lizhen Zhang and Ruihai Liu, Phytochemical and Antiproliferative Activity of Proso Millet (2014).
8. Kirthy Reddy, Brown Top Millet (Urochloa ramosa) - Underutilized Millet, Department of Food Safety and Quality Assurance, Chennai, Article ID: 38450 (2019).
9. Ravikesavan Rajasekaran, Genetic and Genomic Resources for Improving Proso Millet (Panicum miliaceum L.): A Potential Crop for Food and Nutritional Security (2020).
10. 10.Syed Atif Raza, Shahzad Hussain, Humayun Riaz, Review of Beneficial and Remedial Aspects of Cardiospermum Halicacabum L. School of Pharmacy, University of Punjab, Lahore, Pakistan (2013).

ASSESSMENT PERIOD OF GERMINATION AND FERMENTATION IN DEVELOPMENT OF IDLY USING MAIZE FLOUR

Vijayarani.D[1] , Varshini.K[2]

[1,2]Department of Home Science- Nutrition and Dietetics, V.V.Vanniaperumal College for Women, Virudhunagar, Tamil Nadu, India

22702214@vvvcollege.org

Abstract

Germination and fermentation improve the bioavailability of nutrients and increase the nutrient content of cereals based food products. Germination is an effective processing method to improve nutritional quality, reduce anti-nutritional factors and to improve digestibility. Fermentation not only enhances the nutritional value, but also improves the digestibility and destroys undesirable components. Fermented food products provide health benefits such as anti-microbial, anti- fungal, anti- inflammatory and anti-diabetic properties. In most fermented foods, the fermentation process is predominantly initiated by lactic acid bacteria. These organisms have been termed as probiotic bacteria- a group that appears to have specific health- promoting attributes. Maize is an important source of essential nutrients such as fibre, vitamins and minerals which are vital for human health. The maize was subjected to soaking for 24 hours and to different germination periods of 24 hours, 48 hours, 78 hours and 96 hours. The germinated samples were portioned equally and subjected to drying in cabinet drying. The comparative analysis of the germination period showed that 96 hours germination was found to be the best method to process the maize due to high protein composition and it was made into flour. From the selected germinated maize flour, idly was developed with different fermentation intervals of 6 hours, 8 hours, 10 hours and 12 hours. The prepared maize flour incorporated idly was subjected to sensory evaluation. Therefore, the consumption of maize or its derivate such as idly become functional food, with the ability to be used to prevent the incidence of diseases such as cancer, diabetes, obesity, and neurodegenerative disorders. The prepared maize flour incorporated food products aid in the management of lifestyle diseases.

Keywords: *Maize, Fermentation, Germination*

Introduction

Maize (Zea mays) has a major influence on the human diet and the quality of human lives. It has a high energy value and is used for human food (Brockway, 2001). The health benefits associated with regular intake of millets and cereal foods reduce protein energy malnutrition, boosts nervous system function and also treats anaemia. Cardiovascular diseases are prevalent in today's world. These diseases are related to cholesterol deposition. Using different fermented foods the cholesterol level can be lowered and heart diseases can be avoided (Marco et al., 2017). Similarly, The Gastrointestinal health can be protected using fermented foods. It makes the brain to work properly and increase memory. These foods have antiallergic, anti-microbial and anti-carcinogenic effect as well. The beneficial effects of these foods are enormous and these foods are easily prepared and are economical (Ebner et al., 2014). Fermented foods not only provide nutritional content but the foods natural content is preserved and can helps to promote human health. Use of such foods will eliminate the risk of antimicrobial resistance, heart diseases, toxification and allergies to a great extent. The prevalence of pellagra may be countered by eating foods that complement the protein and vitamins present in maize to provide a well-balanced diet (Okoruwa & Kling, 1996).

Maize is a source of nutrition as well as phytochemical .Resistant starch (RS) from maize reduces the risk of cecal cancer, atherosclerosis, and obesity-related complications (Tajamul Rouf Shah and Kamlesh Prasad,2016).Phytochemicals are bioactive chemical compounds naturally present in plants that provide human health benefits and have the potential for reducing the risk of major chronic diseases (Liu, 2004). Maize is an essential source of various major phytochemicals such as carotenoids, phenolic compounds, and phytosterols (Jiang & Wang, 2005; Kopsell et al., 2009; Lopez-Martinez et al., 2009). The protein present in the maize increases by processing techniques such as soaking germination and fermentation. In maize, germination and fermentation have been reported to improve bioavailability of nutrients and vitamin content of cereal-based food products. Germination unlocks many nutrients which are in bound forms, increases nutrient bio-availability, energy density and acceptability. Germination of legumes and cereals seed causes a change in the biochemical and a nutritional characteristic of the legumes that may be beneficial to human's health and nutritional status. Germination is an inexpensive and effective technology for improving nutrients availability and diminishing anti-nutritional factors present in legume and cereal grains and maximizes the levels

of some of the utilizable nutrients(Inyang and Zakare, 2008; Maisont and Narkrugsa, 2010). Germinated seeds are good source of ascorbic acid, riboflavin, choline, thiamine, tocopherols. In recent years, germinated seeds have gained a lot of popularity and widely accepted as a functional food because of its nutrition and health benefits in several aspects. (Gupta and Signal,s. 1991). Germination and fermentation of cereals is an affordable and widely practiced processing technique that has been practiced in Asia for generations. Germination unlocks many nutrients which are in bound forms, increases nutrient bio-availability, energy density and acceptability (Mtebe et al., 1991).

The fermented maize- based foods are economical, enhance the sensory and nutritional quality, reduce the risk of detrimental diseases, improve shelf life, and produce anti-microbial substances and health- stimulating compounds.

Methodology

1. Collection of Materials

Maize grains were purchased from local market in Sattur. The raw purchased millets were placed in a tray and the damaged grains, stones or pebbles together with all other extraneous matter were removed by hand and washed with water.

2. Preparation of germinated maize flour germinated at 96 hours

Ingredients were individually soaked in water at 24 hours and the water was drained. They were germinated at 96hours. And the water was sprinkled occasionally to maintain the moisture. The millets were dried using cabinet drier and grinded by using milling machine and was stored separately in a container for further analysis.

3. Development of germinated maize flour incorporated idli fermented at 10 hours

The ratio used for preparing maize flour incorporated idli fermented at 10 hours were selected by following the ratios of 2:1,3:1 and 4:1. The germinated maize flour was added into the ratio of 25%, 50% and 75% in all samples to make idli flour by using replacement method and the acceptability test was done by 10 panel members. The ingredients used for the preparation of idli are given in table 1.

Table 1-Ingredients used for the preparation of the germinated maize flour incorporated idli fermented at 10 hours

Ingredients used	Control Sample	Experimental Sample A	Experimental Sample B	Experimental Sample C
Maize flour(g)	-	25	50	75
Rice flour(g)	75	50	25	-
Urad dal flour(g)	25	25	25	25
Salt (to taste)	To taste	To taste	To taste	To taste

Table 1 shows the ingredients used for the preparation of germinated maize flour incorporated idli fermented at 10 hours

4.Sensory evaluation of germinated maize flour idli fermented for 10 hours

For evaluating the sensory characteristics, the three different formulations of germinated maize flour incorporated idli fermented at 10 hours were assessed by 10 panel members. The panellists were asked to determine the sensory attributes on the basis of 5point Hedonic scale and they were scored on the basis of sensory qualities such as appearance, colour, taste, texture and odour. The overall acceptability was evaluated by the mean score of all the attributes.

Figure 1-Prepared germinated maize flour incorporated idli fermented for 10 hours

Figure1 shows the prepared germinated maize flour incorporated idli fermented at 10 hours.

5.Preparation of germinated maize flour incorporated idli batter fermented at various periods with the selected ratio

Idli batter was prepared with the selected ratio of selected germinated maize flour, rice flour and black gram dhal flour. This selected sample was fermented at various periods of 6 hours, 8 hours, 10 hours and 12 hours.

6. Determination of protein of the selected germinated maize flour incorporated idli batter fermented at various periods

The protein content of the sample was determined by using "Lowry's Method". The amount of protein present was calculated from the nitrogen concentration of the sample. In this study, protein content was determined for germinated maize flour idli batter fermented at various periods of 6 hours, 8 hours,10 hours and 12 hours.

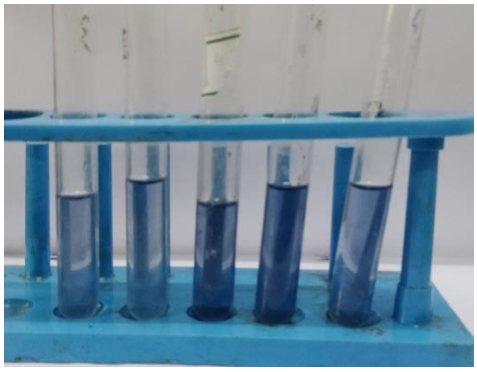


Figure 2-Estimation of protein

Figure 2 shows the estimation of protein present in germinated maize flour incorporated idli batter fermented at various periods.

7. Determination of Vitamin C of the germinated maize flour idly batter fermented at various periods

Fermentation of cereals product enhance vitamin C content. In this study, ascorbic acid was determined for the germinated maize flour idly batter fermented at various periods of 6 hours,8 hours,10 hours and 12 hours.

8. Development of the selected germinated maize flour incorporated idli batter fermented for 12 hours

The nutritional values of protein and vitamin C were compared in the developed batter fermented at various periods of 6 hours,8 hours,10 hours and 12 hours. The batter which was fermented at 12 hours had high protein and vitamin C contents. So it was selected to develop and

standardize idli incorporated with maize flour. The selected germinated maize flour was added into the ratio of 25%, 50% and 75% in all samples to make idli by using replacement method and the acceptability test was done by 10 panel members. The ingredients used for the preparation of maize flour incorporated idli are given in table 2.

Table 2-Ingredients used for the preparation of selected germinated maize flour incorporated idli batter fermented for 12 hours

Ingredients used	Control Sample	Experimental Sample A	Experimental Sample B	Experimental Sample C
Maize flour(g)	-	25	50	75
Rice flour(g)	75	50	25	-
Urad dal flour(g)	25	25	25	25
Salt (to taste)	To taste	To taste	To taste	To taste

Table 2 shows the ingredients used for the preparation of the selected germinated maize flour incorporated idli batter fermented at12 hours

9. Sensory evaluation of germinated maize flour incorporated idli batter fermented at 12 hours

For evaluating the sensory characteristics, the three different formulations of germinated maize flour idli fermented for 10 hours were assessed by 10 panel members. The panellist ware asked to determine the sensory attributes on the basis of 5 point Hedonic scale and they were scored on the basis of sensory qualities such as appearance, colour, taste, texture and odour. The overall acceptability was evaluated by the mean score of all the attributes.

Figure 3- Prepared germinated maize flour incorporated idli fermented at 12 hours

Figure 3 shows the prepared germinated maize flour incorporated idli fermented at 12 hours

Results and Discussion

1. Selection of the ratio of the ingredients used for preparing germinated maize flour incorporated idli

According to research done by Debasree Ghosh and Parimal Chattopadhyay et al 2011, It is evident that 10 hours of fermentation of idli batter provided maximum production of all vitamins and the preferred ratio of idli batter was 3:1 which produced considerable amount of B vitamins. Therefore 3:1 ratio fermented at 10 hours was used for preparing the batter for this study.

2.Sensory evaluation of the germinated maize flour incorporated idli fermented for 10 hours

The germinated maize flour was incorporated in the ratio of 25%, 50%, and 75%to make Idly. They were subjected to sensory evaluation by 10 panel members and then the mean scores were obtained and analysed statistically.

Table–3 Mean scores of the germinated maize flour incorporated idli fermented for 10 hours

Characteristics	Control	Experimental sample A	Experimental sample B	Experimental sample C
Flavour	4.2±0.5	3.8±0.3	4.6±0.6	4.1±0.3
Taste	4.4±0.37	3.6±0.2	4.8±0.77	4.2±0.74
Colour	4.5±0.44	3.9±0.8	4.8±0.24	4.4±0.8
Texture	4.5±0.45	3.4±0.5	4.9±0.7	4.2±0.7
Overall acceptability	4.5±0.8	3.7±0.74	4.7±0.8	4.2±0.4

Table 3 shows the mean score of the germinated maize flour incorporated Idli fermented for 10 hours. Evaluation of organoleptic attributes of the germinated maize flour Idly fermented for 10 hours for colour, texture, flavour, taste and overall acceptability revealed 50% germinated

maize flour incorporated Idly was excellent with the mean score of 4.7±0.8 than the other two variations. Therefore, 50% maize flour incorporated Idli batter was selected for further analysis.

3. Comparison of the protein present in the germinated maize flour incorporated idle batter prepared from the selected ratio fermented at various periods

The protein content of the samples were determined by Lowry's method. Protein is essential for muscle development and body building. It plays a vital role in preventing protein energy malnutrition. The protein present in the germinated maize flour incorporated idli batter fermented at various periods are given below

Table 4-Comparison of protein present in the germinated maize flour incorporated idli batter fermented at various periods

S. No	Fermentation periods	Protein value(g)
1	6hrs	8
2	8hrs	11
3	10hrs	12.4
4	12hrs	15.2

Table 4 shows the protein content of the germinated maize flour incorporated idli batter prepared from selected ratio fermented at various periods. The result found that the fermentation period of 12hours had high protein content compared to other periods of fermentation.

Table 5-Comparison of vitamin C present in the germinated maize flour incorporated idli batter fermented at various period

S. No	Fermentation periods	Vitamin C value(mg)
1	6hrs	8
2	8hrs	8
3	10hrs	12
4	12hrs	20

Table 5 shows the Vitamin C content of the germinated maize flour incorporated Idli batter prepared from the selected ratio fermented at various periods. The result found that the fermentation period of 12 hrs. had high Vitamin C content compared with other periods of fermentation.

4. Sensory evaluation of the selected germinated maize flour incorporated idli . fermented at 12 hours

The selected germinated maize flour was incorporated in the ratio of 25%, 50%, and 75% to make idli. They were subjected to sensory evaluation by 10 panel members and then the mean scores were obtained and analysed statistically.

Table 6–Mean scores of the selected germinated maize flour incorporated idli fermented for 12 hours

Characteristics	Control	Experimental sample A	Experimental sample B	Experimental sample C
Flavour	4.1±0.6	4.2±0.4	4.6±0.6	4.2±0.3
Taste	4.2±0.5	4.5±0.75	4.5±0.77	4.1±0.74
Colour	4.2±0.24	3.6±0.8	4.8±0.24	3.6±0.7
Texture	4.1±0.2	3.5±0.6	4.4±0.7	3.8±0.5
Overall acceptability	4.2±0.4	4.0±0.6	4.5±0.8	4±0.3

Table 6 shows the mean score of the selected germinated maize flour incorporated idli fermented for 12 hours. Evaluation of organoleptic attributes of the selected germinated foxtail millet batter incorporated idli for colour, texture, flavour, taste and overall acceptability. 50% germinated maize flour incorporated idli was excellent with the mean score of 4.5±0.8 than the other two variations.

Conclusion

The study concluded that the implementation of fermentation for12 hours maize flour idly batter resulted in bioavailability of the nutrients such as protein and vitamin C. So fermented maize flour food product serves as a low cost nutrient rich food to prevent many of the lifestyle diseases. Hence, the sprouting and fermentation method can be used to develop value added food products. A small step to process the maize flour helps in enhancing the nutritional value of the products.

References

1. Antia, F.P. (1973). Clinical dietetics and nutrition. 2nd edition. Delhi: Oxford University Press.
2. AOAC. (1984). Official methods of analysis. 14th edition. Washington D.C.: Association of Official analytical Chemists.
3. Bhise, V.J., Chevan, J.K., & Kadam, S.S. (1988). Effects of malting on proximate composition and in vitro protein and starch digestibility of grain sorghum. Journal of Food Science and Technology, 25, 237-239.
4. Brockway, B.E. (2001). Maize. In: Dendy, D.A.V., Dobraszczyk, B.J., editors, Cereals and Cereal Products Chemistry and Technology. Maryland: Aspen publishers Inc., p. 315 – 24.
5. Chevan, J.K., & Kadam, S.S.. (1989). Nutritional improvement of cereals by fermentation and technology. Critical Reviews in Food Science and Nutrition, 28, (5) 349.
6. FAO. (1992). FAO year book, 1992: Maize in Human Nutrition. pp. 13-29 Osborne, D.R., & Voogt, P. (1978). The analysis of nutrients in Foods. New York: Academic Press, p.151-153.
7. Rouf Shah, T., Prasad, K., & Kumar, P. (2016). Maize—A potential source of human nutrition and health: A review. *Cogent Food & Agriculture*, *2*(1), 1166995.
8. Frias, J., Martinez-Villaluenga, C., & Peñas, E. (Eds.). (2016). Fermented foods in health and disease prevention. Ongol, M.
9. Niyonzima, P, E., Gisanura, I., & Vasanthakaalam, H. (2013). Effect of germination and fermentation on nutrients in maize flour. *Pakistan Journal of Food Sciences*, *23*(4), 183-188.
10. Oladeji, B. S., Akanbi, C. T., & Gbadamosi, S. O. (2017). Effects of fermentation on antioxidant properties of flours of a normal endosperm and quality protein maize varrieties. *Journal of Food Measurement and Characterization*, *11*, 1148-1158.

DEVELOPMENT OF PEARL MILLET MILK POWDER AND ITS ANALYSIS

Muthu Reka.S[1] and Vijayanchali.S.S[2]

[1]Ph.D. Research Scholar, [2]Professor,

Department of Home Science, The Gandhigram Rural Institute

muthurekasankar@gmail.com

Abstract

Pearl millet is more abundant in nutrients than other grains, it is cost-effective, and it is mostly unutilized millet. Pearl millet helps control anaemia as it contains iron and zinc, which regulate haemoglobin levels in the body. With the above information, the study was conducted with the following objectives: to develop pearl millet milk powder; to analyze the acceptability of the developed pearl millet milk powder; to analyze the nutrient composition of the pearl millet milk powder, and to find the cost of the developed pearl millet milk powder. The study concludes that the created pearl millet milk powder demonstrates considerable acceptability alongside a commendable quantity of nutrients, all while remaining cost-effective. Consequently, the developed pearl milk powder could be a viable substitute for commercially available milk powder.

Keywords: *Pearl millet, Pennisetum typhoides, Bajra, Milk Powder*

Introduction

Pearl millet, scientifically known as *Pennisetum glaucum* is predominantly grown in hot and arid regions with soils with low water-holding capacity. This crop exhibits great resilience and sustainability, allowing it to withstand harsh environmental conditions, making it a suitable choice for cultivation in both arid and semi-arid areas. India and other developing countries commonly cultivate pearl millet as it serves as a staple food crop in these regions. Being a cereal-based crop, pearl millet is a significant part of the diet for vegetarian individuals who primarily rely on cereals as their main source of sustenance. The cultivation of pearl millet presents a promising solution to combat challenges related to nutritional security and food security, especially in regions that have limited access to diverse food sources [1], [2].

Pearl millet possesses numerous benefits as a crop. Additionally, it is an abundant source of protein with a well-balanced amino acid composition, and it boasts high concentrations of iron, zinc, and dietary fibre [3].

Pearl millet is a highly nutritious grain that offers numerous health benefits. It serves as an exceptional source of dietary fibre, aiding in digestion and supporting a properly functioning digestive system. Additionally, this grain is rich in essential minerals such as iron, magnesium, and phosphorus, which play a vital role in maintaining strong bones and preventing anaemia. Because it is gluten-free, pearl millet proves to be a suitable alternative for individuals who have gluten intolerance or celiac disease. Moreover, its low glycaemic index ensures that it does not cause a sudden increase in blood sugar levels, making it particularly advantageous for people with diabetes or those who aim to regulate their blood sugar levels [4].

The germination of pearl millet enhances the levels of proteins, dietary fibre, minerals, and bioactive compounds present in the grain. Nutrient bioavailability in millet, including proteins, vitamins, and minerals, is improved through germination, as it reduces the phytate content. Germinated millet flour displays functional properties, serving as a hypoglycaemic, antioxidant, and anti-inflammatory food [5], [6].

The objectives of the study:

1. To develop pearl millet milk powder;
2. To analyze the acceptability of the developed pearl millet milk powder;
3. To analyze the nutrient composition of the pearl millet milk powder and
4. To find the cost of the developed pearl millet milk powder.

Methodology

Developed of Pearl Millet Milk Powder

The pearl millet was procured and inspected for its quality. Pearl millet was rinsed with water to eliminate the particles of dust and subsequently soaked in water for a period of 9 hours. Following the 9-hour period of immersion, the water was drained and the millet was transferred onto a muslin cloth for the purpose of initiating the sprouting procedure. The sprouting procedure was permitted to occur over a duration of 18 hours. The sprouted millets were then ground in order to extract the milk. Subsequently, the milk was transferred onto a tray and left to dry under the sun for a span of 3 days. After the drying process, the dried pearl millet milk powder was once again pulverized using a mixer in order to obtain a fine milk powder. Consequently, the powder was stored in a zip lock bag for future utilization.

Sensory Analysis of the Developed Pearl Millet Milk Powder

Fifteen panellists, who were partially trained, were enlisted to examine the general acceptability of the developed pearl millet milk powder. They utilized a 9-point hedonic scale, which encompassed characteristics such as appearance, flavour, aroma, consistency, and overall acceptability.

Nutrient Composition of the Developed Pearl Millet Milk Powder

The various nutrients, including moisture, ash, carbohydrate, fat, protein, iron, and calcium, were determined for the newly developed pearl millet milk powder through the utilization of the established protocol derived from the AOAC methodology.

Result and Discussion

Table I-Sensory Analysis of the Developed Pearl Millet Milk Powder

Sensory Attributes	Appearance	Flavour	Aroma	Texture	Overall acceptability
Pearl Millet Milk Powder	8.4	8.1	8.3	8.3	8.4

The general acceptability of pearl millet milk powder is rated at 8.4 out of 9 points. Pearl millet milk powder exhibits favourable sensory characteristics in terms of its appearance, flavour, aroma, and texture, resulting in a significant overall acceptability rating. These discoveries imply that consumers are inclined to positively receive the product due to its sensory attributes.

Table 2-Nutrient Composition of the Developed Pearl Millet Milk Powder

Nutrients	Nutrient Composition of Pearl Millet Milk Powder per 100g
Moisture (%)	8.4
Ash (g)	1.4
Carbohydrate (g)	63
Fat (g)	2.1
Protein (g)	11.9
Iron (mg)	7.7
Calcium (mg)	39.4

Pearl millet milk powder comprises a moisture content of 8.4%, an ash content of 1.4g, a carbohydrate content of 63g, a fat content of 2.1g, a protein content of 11.9g, an iron content of 7.7mg, a calcium content of 39.4mg. The composition of pearl millet milk powder is notably low in carbohydrates and fats while being rich in protein.

Table 3-Cost Calculation of the Developed Pearl Millet Milk Powder

Product	Amount per 500g
Developed Pearl Millet Milk Powder	Rs. 23
Commercially Available Milk Powder	Rs. 308

The cost of the developed pearl millet milk powder compared to commercially available milk powder. The cost of the developed pearl millet milk powder is Rs. 23 per 500g, while the commercially available milk powder is priced at Rs. 308 per 500g. It is evident that the developed pearl millet milk powder is significantly more cost-effective compared to the commercially available milk powder.

Conclusion

From this study, it has been determined that the developed pearl millet milk powder possesses a copious abundance of nutrients. Furthermore, this pearl millet milk powder has been ascertained to exhibit a substantial degree of overall acceptability and a bountiful supply of nutrients. The study concludes that the created pearl millet milk powder demonstrates considerable acceptability alongside a commendable quantity of nutrients, all while remaining cost-effective. Consequently, the developed pearl milk powder could be a viable substitute for commercially available milk powder.

References

1. Singhal T, Tara Satyavathi C, Singh SP, Mallik M, Anuradha N, Sankar SM, Bharadwaj C, Singh N. Achieving nutritional security in India through iron and zinc biofortification in pearl millet (Pennisetum glaucum (L.) R. Br.). *Physiology and Molecular Biology of Plants*. 2022 Apr;28(4):849-69.
2. Srivastava RK, Satyavathi CT, Mahendrakar MD, Singh RB, Kumar S, Govindaraj M, Ghazi IA. Addressing Iron and Zinc Micronutrient Malnutrition Through Nutrigenomics in Pearl Millet: Advances and Prospects. *Frontiers in Genetics*. 2021 Nov 18; 12:723472.

3. Singh RP, Qidwai S, Singh O, Reddy BR, Saharan S, Kataria SK, Tiwari H, Naresh RK, Kumar L. Millets for food and nutritional security in the context of climate resilient agriculture: A Review. *International Journal of Plant & Soil Science*. 2022 Oct 31:939-53.
4. Fuller DQ, Barron A, Champion L, Dupuy C, Commelin D, Raimbault M, Denham T. Transition from wild to domesticated Pearl Millet (Pennisetum glaucum) revealed in ceramic temper at three middle Holocene sites in Northern Mali. *African Archaeological Review*. 2021 Jun; 38:211-30.
5. Theodoro JM, Grancieri M, Gomes MJ, Toledo RC, de São José VP, Mantovani HC, Carvalho CW, da Silva BP, Martino HS. Germinated Millet (Pennisetum glaucum (L.) R. Br.) Flour Improved the Gut Function and Its Microbiota Composition in Rats Fed with High-Fat High-Fructose Diet. *International Journal of Environmental Research and Public Health*. 2022 Nov 18; 19(22):15217.
6. Radhai Sri S, Sindhu S. Antioxidant Properties of Pearl Millet (Pennisetum glaucum). *International Journal of Multidisciplinary*. 2020 Aug 27; 3(6):136-9.

ASSESSMENT ON STRESS AND DIETARY PATTERN OF COLLEGE STUDENTS BEFORE AND DURING EXAMINATION

Madhumitha.T[1], Mahalakshmi.J[2], Chitra.B[3] and Pandeeswari.I[4]

[1] Postgraduate student, Dr. N.G.P Arts and Science College, Coimbatore, Tamil Nadu, India

[2,3,4]Assistant Professor of Nutrition and Dietetics, The Standard Fireworks Rajaratnam College for Women, Sivakasi, Tamil Nadu, India

Abstract

Stress and dietary behavior are the common phenomenon among college students especially during the exam days. Stress management needs to starts before college life, as stress hinder the college student's ability to engage in healthy dietary behavior and cognitive. Dietary habits related to lifestyle are key to elements for healthy living. Poorer mental and physical health has always been associated with psychological distress. It is important to investigate and understand the environments that affect college student's dietary behaviors because eating patterns at this time in one's lifespan can affect health and food behaviors throughout the adulthood. Students with high stress showed less healthy dietary behaviors compared to students with low stress. It should be managed properly to prevent unhealthy dietary behaviors because of stress. Moreover, information on stress management should be provided to students, considering that high-stress students tend to involve unhealthy habits. Emotional eating should be self-monitored and alternative stress-management strategies should be exercised for stress relief. The purpose of this study is to investigate the stress and dietary behavior of college students for self-reporting. Questionnaires were collected through Google form for analyzing the stress pattern and 24-hour dietary recall has also been collected during the period of before and during examination. It is found that students with high perceived stress levels exhibited increased unhealthy dietary behaviors and they skip meal.

Key words: *Stress pattern, Dietary pattern, Survey, RDA, Questionnaire, Data.*

Introduction

Adolescence is a transitional phase of human being between the stage of childhood and adulthood. The World Health Organization defines an adolescent as any person between ages 10 to 24. It is a unique stage of human development and an important time for lying the foundations of good health. Adolescents experience rapid physical, cognitive and psychological growth.

Adolescence is the most difficult period of one's life. There are far too many significant life changes occurring in one's life, such as physical, psychological and behavioral changes. Making mistakes is a common method for adolescents to get lost while searching for the adult world. Teenagers often become angry and are in constant anxiety. Due to all this changes, this stage becomes difficult for adolescents. It is also vulnerable time for children since they may experience several problems of adolescents such as unhealthy eating behaviors, which may lead to significant problems later in life.

Adolescents are vulnerable emotionally and physically. Without proper nutrition healthcare, they are susceptible to illness. 1.3 million adolescents died in 2015, a majority of them had preventable diseases (WHO Report, 2015). Teenagers have a hectic schedule as they hope from one activity to another with little time to eat or rest properly. Unhealthy eating habits prevent them getting the nutrition they need. Consciousness about their body can lead to eating disorders, especially in girls. Adolescent girls who worry about their weight and appearance can develop disorders like anorexia or bulimia. Mental stress during this period also leads to loss of appetite and sleeplessness in young children and adolescents. Hence this research study was undertaken with the following objectives,

- To assess the level of stress and dietary pattern among adolescent girls, before and during examination.
- To calculate and compare the nutrient intake of college going adolescent girls with the Recommended Dietary allowances, 2020

Methodology

The methodology adopted for the study entitled "Assessment of stress and dietary pattern among adolescent girls before and during examination" is discussed under the following headings

A. Selection of area

The study was carried out at Sivakasi – an industrial town at the southern part of Tamil Nadu, due to the familiarity of the investigator and easy accessibility of adolescent girls for the purpose of the research study to elicit information on the stress and dietary pattern of adolescent girls during and after examination. The selected subjects were motivated to extend their full co-operation for the successful conduct of the study and informed consent was obtained from them.

B. Selection of samples

A total of 50 samples consists of adolescent girls in the age group of 17 – 20 years (N=50) were selected for the study by Purposive sampling method. Purposive sampling is a sampling procedure in which the elements are selected from the target population on the basis of their fit with purpose of the study and specific inclusion and exclusion criteria. Oral consent was obtained from the participants before staring the study.

Inclusion criteria

- Female subjects in the age group of 17 – 20 years.
- Willing to give consent to take part in the study regularly for a period of one month.
- Willing to co-operate with the investigator during the study period.

Exclusion criteria

- Age group less than 17 and more than 20.
- Non- co-operative and not willing to give consent and participate in the study.
- Having health problems.
- Under medical care.

C. Developing questionnaire and formulation of tools

The purpose of a questionnaire is to gather data from a target audience. To collect data, stress pattern questionnaire and 24hour diet recall are play a vital role as a tool in our survey to assess the stress and dietary pattern among the participants.

D. Pretesting of questionnaire

Pretesting of the questionnaire was done among 5 trained participants and their suggestion were implemented in the final questionnaire.

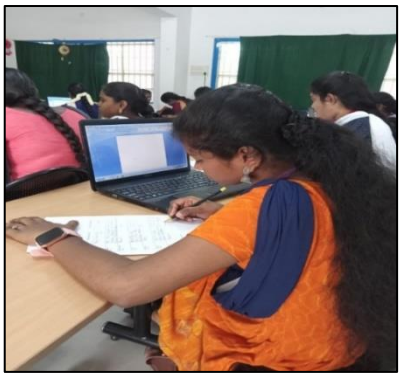
E. Collection of data

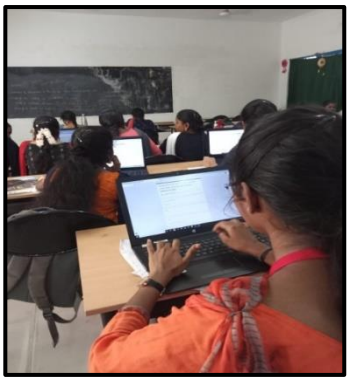
After modifying the questionnaire, it was circulated among the participants as Google form to collect the data about their stress pattern. 24 – hour dietary recall was collected by face- to- face interview method. Data collection was planned in 2 schedules on during the normal days (i.e.) before the examination and this was conducted before the Term Test II in the even semester of the academic year 2022-2023. In another schedule, the data was collected during the exam days (i.e.) exactly during the examination and this was conducted during the Term Test II in the even semester of the academic year 2022-2023.

F. Analysis of data

Data, collected and analyzed to answer the research questions. The data thus obtained were consolidated, tabulated and necessary statistical analysis were carried out in Microsoft Excel. Through data analysis we can find how stress affect the adolescent girl's diet and elaborative discussion with gathered scientific data were given in the Results and Discussion.

Fig 1: Survey on 24-hour dietary pattern **Fig 2: Survey on stress pattern**





Results and Discussion

The results and discussion pertaining to the present study on "Assessment on Stress and Dietary pattern of college students before and during examination" are discussed in the following headings.

Stress pattern

The comparison of stress pattern among adolescent girls during and before the examination is discussed as follows.

Table 1- Levels of Stress

	Normal Days		Exam days	
Levels of Stress	**Frequency (N)**	**Percentage (%)**	**Frequency (N)**	**Percentage (%)**
Very low	1	2	3	6
Low	6	12	2	4
Medium	37	74	34	68
High	1	2	7	14
Very high	5	10	4	8
	N=50	100	N=50	100

During normal days, adolescent girls experience medium stress level as well as in their exam days. From this study, low stress level is higher in exam days compared to normal days. Whereas 74% of them experience medium stress level in their normal days and 68% of them experience medium stress level in their exam days. Medium stress level higher in normal days compared to exam days.

2% of adolescent girl experience high stress level on normal days. 14% of adolescent girl experience high stress level on exam days. In this study high stress level higher in exam days compared to normal days. Among them 10% of adolescent girl's experience very high stress level on normal days. And 8% of adolescent girl's experience very high stress level on their exam days. In this research study, very high stress level higher in normal days compared to exam days.

Table 2 - Ways adopted to relieve stress

	Normal Days		**Exam days**	
Ways adopted to relieve stress	**Frequency (N)**	**Percentage (%)**	**Frequency (N)**	**Percentage (%)**
Nothing	3	6	5	10
Eat	3	6	6	12
Exercise	0	0	2	4
TV/mobile	14	28	13	26
Pray/meditation	2	4	3	6
Read books	3	6	0	0
Go out with friends /partying	5	10	2	4
Art/crafts	3	6	1	2
Music/dancing	11	22	13	26
Others	6	12	5	10
	N=50	100	N=50	100

Among them 28% of adolescent girls used mobile phone and watching television to relieve their stress on normal days. During exam days 26% of them experience high stress level, so they relieve their stress by singing and dancing. And 10 % of them go out with their friends to relieve. During exam days 12% of them eat foods to relieve their stress. And 4% of them do exercise.

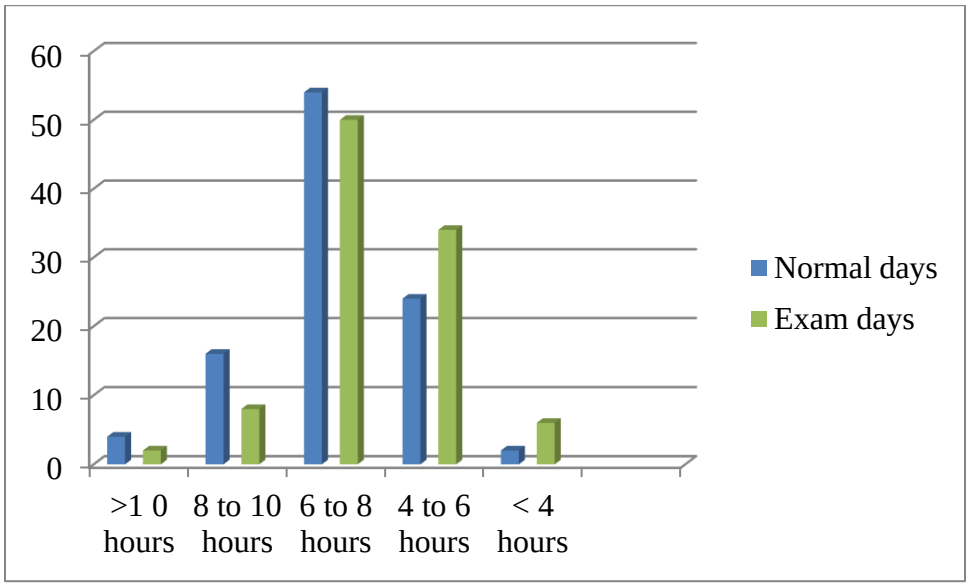
Table 3 - Skipping of meal pattern					
Skipping of meal pattern	**Options**	**Normal days**		**Exam days**	
		Frequency (N)	**Percentage (%)**	**Frequency (N)**	**Percentage (%)**
Breakfast	Yes	8	16	10	20
	No	42	84	40	80
Lunch	Yes	5	10	1	2
	No	45	90	49	98
Dinner	Yes	3	6	2	4
	No	47	94	48	96
		N=50	100	N=50	100

While examination days 20% of adolescent girls skip their breakfast. And most of them skip their breakfast both on normal days and exam days. Especially they skip breakfast because of their exam stress and irregular meal time. But most of them don't skip their meals at normal days. During exam days 4% of them skip their dinner. And 6% of them skip their dinner during normal days. In this survey most of the adolescent girls skip their meals during exam days.

Table 4 - Angry and their tension levels					
		Normal days		**Exam days**	
Angry and their tension level	**Options**	**Frequency (N)**	**Percentage (%)**	**Frequency (N)**	**Percentage (%)**
Fight with your friends/parents	Yes	20	40	16	32
	No	30	60	34	68
Tension	Yes	22	44	29	58
	No	28	56	21	42
		N=50	100	N=50	100

While compared to normal days, 32% of adolescent girls fight with friends and parents during exam days. But in normal days 40% of them never experienced like this mood swings and 58% of them experienced tension during exam days and 44% of them experienced. Tension was increased during exam days.

Fig 1- Sleeping time



While compared to normal days 54% of adolescent girls sleeping time is less than the exam days. They experienced lack of sleep during exam days. Whereas 6% of them sleep less than 4 hours during exam days. While compared to normal days the sleeping time is slightly vary from exam days.

Dietary pattern

The comparison of dietary pattern and the average nutrient intake among adolescent girls during and before the examination is discussed as follows.

Dietary pattern

Nutrients	Before	During	RDA
Energy	1198.22	1067.94	2500 kcal
Protein	41.7	33.3	46.2g
Fat	28.38	24.36	35g
Calcium	352.46	303.02	1050mg
Iron	20.24	14.72	32mg
Carbohydrates	199.34	171.38	130g

In this research study, 24 -hour dietary recall has been taken among the adolescent girls before and during examination. Based on RDA adolescent girls daily nutrient requirement

are energy as 2500kcal, protein as 37 g, fat as 35 g, calcium as 250 mg, iron as 18 mg, carbs as 130 g.

Energy

Before examination the average energy intake is found to be 1198.2kcal, which is higher compared to during examination that is 1067.94 kcal. While comparing with RDA table, the energy level is very low than normal days. From this study, we have found that the energy deficiency due to very low intake of meals. This prolonged calorie deficit dietary pattern is the major cause for chronic malnutrition.

Protein

The protein intake before examination is found as 41.7g which is higher compared to during examination as 33.3 g. While comparing with RDA, protein intake is slightly same both before and during examination.

Carbohydrates

The carbohydrate intake before examination is found as 199.34 g which is higher compared to during examination as 171.38g. While comparing with RDA, calcium intake is less both before and during examination.

Fat

The fat intake before examination is found as 28.38 g which is higher compared to during examination as 24.36g. While comparing with RDA, calcium intake is same both before and during examination.

Calcium

The calcium intake before examination is found as 352.46 mg which is higher compared to during examination as 303.02mg. While comparing with RDA table, the calcium level is very low than normal days. This issue should be addressed to prevent the calcium deficiency. It might be causing bone deficiency diseases like Oestemalacia and osteoporosis during the post-menopausal period of women's life. It also causes body weakness and tiredness among the population.

Iron

The iron intake before examination is found as 20.24 mg which is higher compared to during examination as 14.72g. While comparing with RDA, calcium intake is more or less same both before and during examination.

Conclusion

From the above study it is concluded that, increase in the stress levels and disturbed sleeping pattern is observed during examination days and it also shows the significant impact on their dietary habits and meals skipping pattern and not meeting their daily requirements. So further nutritional awareness and stress management strategies should be considered for adolescent girls.

References

1. Adriaanse, M. A., de Ridder, D. T., & Evers, C. (2011). Emotional eating: Eating when emotional or emotional about eating? *Psychology and Health, 26*(1), 23–39.
2. Algren, M. H., Ekholm, O., Nielsen, L., Ersbøll, A. K., Bak, C. K., & Andersen, P. T. (2018). Associations between perceived stress, socioeconomic status, and health-risk behavior in deprived neighborhoods in Denmark: A cross-sectional study. *BMC Public Health*, *18*(1), 250.
3. Appelhans, B. M. (2010). Circulating leptin moderates the effect of stress on snack intake independent of body mass. *Eating Behaviors*, *11*(3), 152–155.
4. Barrington, W. E., Beresford, S. A., McGregor, B. A., & White, E. (2014). Perceived stress and eating behaviors by sex, obesity status, and stress vulnerability: Findings from the vitamins and lifestyle (VITAL) study. *Journal of the Academy of Nutrition and Dietetics*, *114*(11), 1791–1799.
5. Indian Council of Medical Research (ICMR), (2020). Nutrient requirements and Recommended Dietary allowances for Indians. Available from: icmr.nic.in/final/RDA.
6. Haberman S & Luffey (2008). Weighing in college students' diet and Exercise Behaviors, Journal of American College Health. Vol. 46, 189 – 191.
7. Ramachandran P. (2010) Nutrition transition in India 1947-2007.
8. Greeno, C. G., & Wing, R. R. (1994). Stress-induced eating. *Psychological Bulletin*, 115(3), 444–464.

9. Habhab, S., Sheldon, J. P., & Loeb, R. C. (2009). The relationship between stress, dietary restraint, and food preferences in women. *Appetite*, *52*(2), 437 - 444
10. Winchendon, J.R.; Bugti, S.A.; Unger, J.; Spruit-Metz, D.; Nguyen-Rodriguez, S.T. (2009) Perceived stress, coping and night-eating in college students. *Stress Health*, *25*, 235–240

IMPACT OF BEETS (*BETA VULGARIS.L)* ON THE HOMOCYSTEINE LEVELS OF VARICOSE VEINS (CHRONIC VENOUS DISEASE) – A REVIEW

Nirmala Devi.S.

Guest faculty, B. Voc. Food Processing, DDU-KK.GRI

nirmaladeviroshan@gmail.com

Abstract

Varicose veins, being the most dreadful occupational hazard that is unattended, slowly gaining importance these days. Many reasons, including strenuous standing for prolonged hours and walking, result in the bulging of blood vessels. Pooling of blood in lower limbs leads to bleeding ulcers if unattended. Many therapeutic trials are at the experimental level. Homocysteine level in the blood is an independent factor. Homocysteine, thereby converts into methionine and cysteine in blood through transulfuration and transmethylation cycle. The elevated homocysteine level may increase thromboembolic factors, CVD problems, and blood vessel disorders. Betacyanins, from Beta vulgaris.L, tend to control the increasing homocysteine levels in blood thereby reducing the risk factors of Hyperhomocysteinemia.

Key words: *varicose, transsulfuration, transmethylation, homocysteine, hyperhomocysteinemia*

Introduction

Varicose veins are swollen, twisted veins that lie under the skin and are commonly found in legs. It affects the veins in the legs. Prolonged standing and walking increase the pressure in the veins, especially in the lower limbs, causing severe pain and discomfort. The blood pools and even flows backward due to weakened walls and valves. The incidence may lead to high risk for those who have a family history of various thromboembolism.[1] An intensely painful, achy feeling, burning, and itching, with possible side effects such as infection, leg ulcers, thrombosis, and changes in stasis. (Richard Jones H., *et.al.* 2008) Individuals' homocysteine levels have received more attention these days since numerous studies have demonstrated that they are a separate risk factor for chronic venous illnesses.

The severity of this terrible non-communicable disease has been demonstrated to be reduced by beets (*Beta vulgaris* L.), which also lower plasma homocysteine levels. Ulceration risk is higher in patients with varicose veins, deep vein incompetence, and skin abnormalities associated with chronic venous insufficiency. Smokers, obese people, people with limited ankle

mobility, and people with decreased calf muscle pump strength may all be at higher risk. (Robertson *et.al*, 2009)

Figure 1- Venous ulceration in lower limbs

Homocysteine : Hcy

Hcy is a sulfur amino acid that interacts with B Vitamins, and is converted to Methionine, an essential amino acid and Cysteine. For remethylation to Methionine, it requires folate and Vit.B12 and transulfuration to cystathionine, with pyridoxal-5-po4. The normal level of Homocysteine is from 5-15μm (Micromoles/lt)[2] Disrupted homocysteine metabolism leads to hyperhomocysteinemia, a condition linked to a higher risk of vascular disease. High homocysteine levels are in three categories:

Moderate: if from 16-30 μm/L

Intermediate: if from 31 – 100 μm/L

Severe: if over 100 μm/L [(3)]

Elevated homocysteine level affects both the vascular cell structure and blood coagulation system.(Selhub, J.,1999) Veeranki,S., et.al(2017) stated that Homocysteine, an essential amino acid that can be converted to Cysteinine or recycled to Methionine, with the specific aid of B vitamins. The levels may vary with men and women and it is between 5-15mmol/L and levels above 15 mmol/L result in hyperhomocysteinimia.

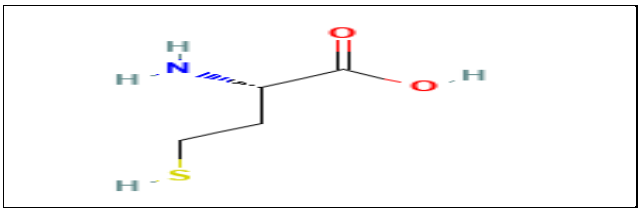


Figure 2-Chemical 2D structure of L-Homocysteine compound

(Source: https://pubchem.ncbi.nlm.nih.gov/compound/L-Homocysteine#section=2D-Structure)

Transulfuration and transmethylation pathways

The body's sulfur balance is largely regulated by the transulfuration pathway, a metabolic pathway that also regulates the metabolism of cysteine and homocysteine. It maintains a close relationship with the methionine and folate cycles, among other pathways. Reduced cysteine levels and a rise in homocysteine are the results of impaired TSP activity. It might also rise as a result of low levels of methionine and folate. Severe stages of cardiovascular disease are linked to elevated homocysteine levels.

The production of Hcy from methionine via S-adenosyl-l-methionine (SAM)-dependent methylation processes, its remethylation back to methionine, and its catabolism via the transmethylation and transulfuration pathway are all balanced in tissue Hcy levels.(Garibotto,*et.al.*,2022).The alteration in these metabolic pathways leads to various impairments.

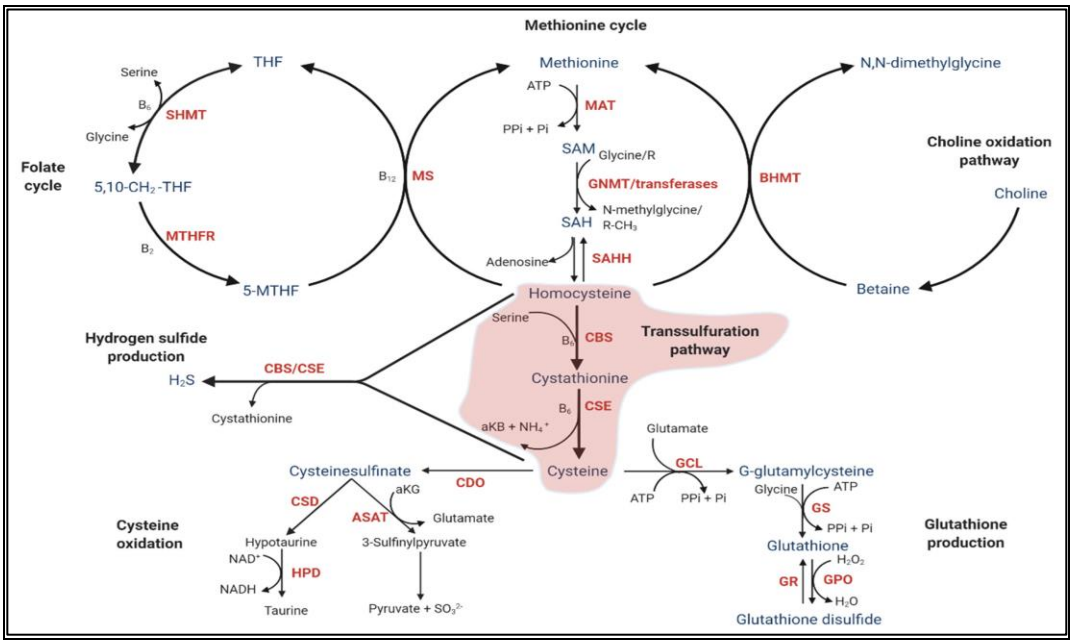


Figure 3 -Source: https://www.mdpi.com/2077-0383/10/5/1081

Homocysteine test

Homocysteine is an amino acid. Normally, the levels of homocysteine levels are low. If the levels are high, it is an indication of the damage inside the arteries and results in blood clots and increases the risk of heart diseases, and blood vessel disorders.[4] This test is conducted in the morning while the patient is fasting, except for water. Blood Serum is tested for homocysteine levels. If the levels are more than 15.1micromoles/L, indicates the risk of Hyperhomocysteinemia.

Hyperhomocysteinemia (Hhcy) and varicose veins

A component of complex chronic venous illness, chronic venous ulceration (CVU) is a primary cause of persistent sores on the lower extremities. Several thrombotic factors, such as Hhcy, may be associated with chronic venous ulcers. (de Franciscus S., *et.al.,* 2013)

The belief that an elevated total plasma homocysteine concentration is linked to a greater risk of coronary artery disease, stroke, and venous thromboembolism has been confirmed by data from retrospective and prospective research. Nowadays, it is believed that hyperhomocysteinemia is a rather modest prothrombotic factor. (Anetta undas, *et.al,* 2005) There is a growing body of evidence that supports the diagnosis and treatment of excessive homocysteine levels in high-risk individuals generally and in patients with vascular disease in particular. (Stanger.O. *et.al.,* 2004).

Venous ulceration is a multi-factorial disease, Hhcy promotes primary varicose to venous ulcers. (Guo Z.,*et.al.,* 2022) Struder M *et.al.*,2011 discovered that hyperhomocystenimia is presently acknowledged as a separate risk factor for occlusive artery disease. Without regard to gender or type of ulcer, 56% of the 68 patients who were included had venous leg ulcers, 18% had arterial leg ulcers, and 20% had leg ulcers of mixed origin. Xia R et.al.(2014) added that elevated homocysteine levels may lead to endothelial damage and a reduction in vessel flexibility and vasodilator factor synthesis impairment and thereby hypertension. Thrombophilia is becoming more well-acknowledged as a significant risk factor for deep vein thrombosis, which raises the possibility of chronic vein ulcers (CUV)., (Mackenzie RK *et.al.*, 2002)

Clinical evidence supports the independent risk factor status of homocysteine (Hcy) for peripheral artery occlusive disease (PAD), cerebral PAD, and peripheral venous thrombosis. (Fridman. O,1999)

Betalains:

Betalains are the water-soluble pigment.

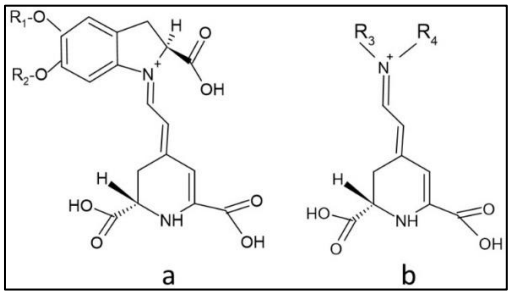


Figure 4- Structure of Beta cyanins and Beta xanthins

Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8123435/

Beets and varicose

Treatment of varicose veins includes conservative treatment measures like compression stockings, the elevation of the affected leg, life style modifications, weight loss, ligation, phlebectomy, stripping etc., The concept of treating varicose veins with diet is to focus on weight loss with high fibre diet. Foods rich in vitamin C aid good blood circulation, and keep veins toned and strong. Bioflavanoids strengthen the vessel walls and prevent stress with the veins from free radicals (Richard Jones., *et.al.*,2008) In recent years, beets (*Beta vulgaris L*) have become a popular 'functional food'(Frank., *et.al.*,2005)

Beta vulgaris. L, contains a glucoside of betanidin found in red beets, includes betanin, commonly referred to as "Beetroot Red," the most prevalent betacyanin. Plants belonging to the Caryophyllales order include pigments called betalains that are soluble in water. All betalains have betalamic acid. The class of betalains is identified by the type of substituent for betalamic acid. (Sadowska-Bartosz I, *et.al.*,2021)

Red beetroot tissues contain thirty betalains, which are made up of twelve betaxanthins and eighteen betacyanins. The most common betalains among those found were vulgaxanthin I (betaxanthins) and betanin and isobetanin (betacyanins). (Tomasz Sawicki.*et.al.,* 2016) Red beetroot contains the richest source of betalains. (Esatbeyoglu, 2015) Betalains are water-soluble nitrogen-containing pigments that are subdivided into red-violet betacyanins and yellow-orange betaxanthins. (Esatbeyoglu, 2015 a)

A naturally occurring root vegetable, red beetroot (*Beta vulgaris* L.) is a great source of phytochemicals and bioactive substances. It is suggested that supplements be used to manage blood pressure, diabetes, and vascular health. It is safe to treat betalains and consume a diet high in them. It may also be the ideal substitute for many supplement therapies, including those for conditions linked to inflammation, oxidative stress, and dyslipidemia, such as cancer, atherosclerosis, stenosis of the arteries, and hypertension. (Rahimi.B et.al, 2019)

The high nitrate contents in beetroot juice will be transformed into nitric oxide (NO) after consumption. The human body uses nitric oxide for several purposes, one of which is the vasodilatory action, which lowers blood pressure and improves the supply of nutrients and oxygen for various organs. (Zamani H. *et.al*, 2020)

Beets and Homocysteine levels

A correlation between the supplementation of betalains and the reduction in homocysteine levels will reveal the effect of this phytonutrient's importance in individuals who suffer from varicose veins, a chronic venous disease.

A study showed that supplementation of betalain – rich extracts of foods (supplement of red beetroot) for two weeks showed a reduction in homocysteine levels, and can be considered as functional foods. (Rahimi P. *et.al.,* 2019) Nitrate (No3-), which contains bioactivity in the cardiovascular system and possible qualities like polyphenols, pigments, and organic acids, is present in beta vulgaris L juice. (Milton Laskibar I, *et.al.,* 2021). Kelly J, *et.al,* (2013) found that a supplementation of 140 ml/day of beetroot juice for three days showed a significant decrease in systolic and diastolic arterial pressures. Rahimi P. *et.al,* (2019) added that Betalain rich beetroot supplement mediates the reduction in the plasma homocysteine level.

An investigation was carried out to assess the plasma bioavailability of nitric oxide (NO) and betanin. Beetroot juice, which is high in phytonutrients, has been shown to significantly improve the availability of plasma nitric oxide. (Clifford. *et.al,* 2017)

Many foods are suggested for reducing the severity of varicose veins. Buckwheat may improve blood circulation, citrus, a known antioxidant, is the inhibitor of free radicals, and has a great potential ability to protect blood capillary vessels. Ginger being the pungent herbal medicine, has the super ability to dissolve fibrin and to reinstate blood flow.

As Beet contains betacyanin, it can reduce blood vessel damage and regulate blood homocysteine levels. The dietary factor that determines homocysteine levels is folic acid. Comprehensive research is still needed, however dietary supplements of folic acid, vitamin B12, B6, and B2 have been shown to lower homocysteine levels. More investigation is needed to ascertain the levels of absorption and restoration of this water-soluble pigment when it is given to patients with varicose veins because betalains have the potential to leach away.

Conclusion

Varicose veins are a non-communicable, alarming disease for the human community, due to stress and work pressure given to the lower limbs. The causative factors for varicose veins are multifactorial, where one such independent factor is the elevated homocysteine levels in the plasma concentration. Based on the information that is now available, beets seem to be a potent therapeutic and health-promoting agent for a variety of pathologic conditions. Intake of beets

(*Beta vulgaris L)* will reduce the Homocysteine levels thereby the severity of varicose veins, a chronic venous disease (CVD). Stage by stage, varicose veins may lead to bleeding ulcers. Future research should focus on this extremely concerning ignored work danger because bleeding varicose veins has the potential to be a fatal complication.

References

1. Esatbeyoglu, Tuba, et al. "Betanin—A food colorant with biological activity." *Molecular nutrition & food research* 59.1 (2015): 36-47.
2. de Franciscis S, De Sarro G, Longo P, Buffone G, Molinari V, Stillitano DM, Gallelli L, Serra R. Hyperhomocysteinaemia and chronic venous ulcers. Int Wound J. 2015 Feb; 12(1):22-6. doi: 10.1111/iwj.12042. Epub 2013 Feb 19. PMID: 23418772; PMCID: PMC7950680.
3. Esatbeyoglu T, Wagner AE, Schini-Kerth VB, Rimbach G. Betanin--a food colorant with biological activity. Mol Nutr Food Res. 2015 Jan; 59(1):36-47. doi: 10.1002/mnfr.201400484. Epub 2014 Oct 3. PMID: 25178819
4. Frank T, Stintzing FC, Carle R, Bitsch I, Quaas D, Strass G, Bitsch R, Netzel M. Urinary pharmacokinetics of betalains following consumption of red beet juice in healthy humans. Pharmacol Res. 2005 Oct; 52(4):290-7. doi: 10.1016/j.phrs.2005.04.005. PMID: 15964200.
5. Fridman O. Hiperhomocist(e)inemia: aterotrombosis y neurotoxicidad [Hyperhomocysteinemia: atherothrombosis and neurotoxicity]. *Acta Physiol Pharmacol Ther Latinoam.* 1999;49(1):21-30. Spanish. PMID: 10797837.
6. Giacomo Garibotto,Daniela Picciotto,Daniela VerzolaAlessando Valli,Antonella Sofia,Fr ancesca Costigliolo, Michela Saio, Francesca Viazzi,. Pasquale Esposito, 'Homocysteine exchange across skeletal muscle in patients with chronic kidney disease', DOI: 10.14814/phy2.15573
7. Guo Z, Li X, Wang T, Yang X, Fan L. Elevated serum homocysteine levels are associated with the development of chronic venous ulcers. Vasc Med. 2022 Aug; 27(4):358-364. doi: 10.1177/1358863X221080486. Epub 2022 Mar 31. PMID: 35361027.
8. Jones RH, Carek PJ. Management of varicose veins. *Am Fam Physician*. 2008 Dec 1;78(11):1289-94. PMID: 19069022.

9. Kelly J, Fulford J, Vanhatalo A, Blackwell JR, French O, Bailey SJ, Gilchrist M, Winyard PG, Jones AM. Effects of short-term dietary nitrate supplementation on blood pressure, O2 uptake kinetics, and muscle and cognitive function in older adults. *Am J Physiol Regul Integr Comp Physiol*. 2013 Jan 15; 304(2):R73-83. doi: 10.1152/ajpregu.00406.2012. Epub 2012 Nov 21. PMID: 23174856.
10. Lee M, Hong K S, Chang SC, Saver JL. Efficacy of Homocysteine – lowering therapy with folic acid in stroke prevention: a meta analysis. Stroke.2010 Jun; 41 (6): 1205-12.
11. London NJ, Nash R. ABC of arterial and venous disease. Varicose veins. BMJ. 2000 May 20;320(7246):1391-4. doi: 10.1136/bmj.320.7246.1391. PMID: 10818035; PMCID: PMC1118055
12. Milton-Laskibar I, Martínez JA, Portillo MP. Current Knowledge on Beetroot Bioactive Compounds: Role of Nitrate and Betalains in Health and Disease. Foods. 2021 Jun 7;10(6):1314. doi: 10.3390/foods10061314. PMID: 34200431; PMCID: PMC8229785.
13. Park WC, Chang, JM. Clinical implications of Methylenetetra hydrofolate Reductase Mutations and Plasma Homocysteine levels in patients with Thromboembolic Occlusion/ Vasc.Specialist Int.2014. Dec. 30(4): 113-9.
14. Rahimi P, Abedimanesh S, Mesbah-Namin SA, Ostadrahimi A. Betalains, the nature-inspired pigments, in health and diseases. Crit Rev Food Sci Nutr. 2019;59(18):2949-2978. doi: 10.1080/10408398.2018.1479830. Epub 2018 Nov 18. PMID: 29846082.
15. Robertson L, Lee AJ, Gallagher K, Carmichael SJ, Evans CJ, McKinstry BH, Fraser SC, Allan PL, Weller D, Ruckley CV, Fowkes FG. Risk factors for chronic ulceration in patients with varicose veins: a case control study. *J Vasc Surg.* 2009 Jun;49(6):1490-8. doi: 10.1016/j.jvs.2009.02.237. PMID: 19497512.
16. Sadowska-Bartosz I, Bartosz G. Biological Properties and Applications of Betalains. Molecules. 2021 Apr 26;26(9):2520. doi: 10.3390/molecules26092520. PMID: 33925891; PMCID: PMC8123435.
17. Selhub,J. Homocysteine metabolism.Annu.Rev.Nutr.1999; 217-46 doi: 10.1146/annurev.nutr.19.1.217.PMID:10448523
18. Stanger O, Herrmann W, Pietrzik K, Fowler B, Geisel J, Dierkes J, Weger M. Clinical use and rational management of homocysteine, folic acid, and B vitamins in cardiovascular

and thrombotic diseases. Z Kardiol. 2004 Jun;93(6):439-53. doi: 10.1007/s00392-004-0075-3. PMID: 15252738.

19. Studer M, Barbaud A, Truchetet F, N'guyen PL, Bursztejn AC, Schmutz JL. Hyperhomocystéinémie et ulcères de jambes : étude prospective de 68 observations [Hyperhomocysteinemia and leg ulcers: A prospective study of 68 patients]. Ann Dermatol Venereol. 2011 Oct;138(10):645-51. French. doi: 10.1016/j.annder.2011.05.009. Epub 2011 Jun 28. PMID: 21978499.
20. Tomasz Sawicki, Natalia Bączek, Wieslaw Wiczkowski,Betalain profile, content and antioxidant capacity of red beetroot dependent on the genotype and root part, Journal of Functional Foods,Volume 27,2016,Pages 249-261,ISSN 1756-4646, https://doi.org/10.1016/j.jff.2016.09.004.
21. Undas A, Brozek J, Szczeklik A. Homocysteine and thrombosis: from basic science to clinical evidence. Thromb Haemost. 2005 Nov;94(5):907-15. doi: 10.1160/TH05-05-0313. PMID: 16363230.
22. Veeranki,S. Gandhapudi SK, Tyagi SC. Interactions of Hyperhomocysteinemia amd Tcell immunity in causation of Hypertension. *Can J Physiol. Pharmacol*.2017, Mar; 95(3): 239-246
23. Xie R, Jia D, Gao C, Zhou J, Sui H, Wei X, Zhang T, Han Y, Shi J, Bai Y. Homocysteine induces procoagulant activity of red blood cells via phosphatidylserine exposure and microparticles generation. Amino Acids. 2014 Aug;46(8):1997-2004. doi: 10.1007/s00726-014-1755-6. Epub 2014 May 11. PMID: 24817414.
24. Zamani H, de Joode MEJR, Hossein IJ, Henckens NFT, Guggeis MA, Berends JE, de Kok TMCM, van Breda SGJ. The benefits and risks of beetroot juice consumption: a systematic review. Crit Rev Food Sci Nutr. 2021;61(5):788-804. doi: 10.1080/10408398.2020.1746629. Epub 2020 Apr 15. PMID: 32292042
25. Clifford T, Constantinou CM, Keane KM, West DJ, Howatson G, Stevenson EJ. The plasma bioavailability of nitrate and betanin from Beta vulgaris rubra in humans. Eur J Nutr. 2017 Apr;56(3):1245-1254. doi: 10.1007/s00394-016-1173-5. Epub 2016 Feb 12. PMID: 26873098; PMCID: PMC5346430.
26. http://1.nhnlbi.nih.gov/health/varicose-veins
27. https://www.medicalnewstoday.com/articles/homocysteine-levels

28. https://nutritionandmetabolism.biomedcentral.com/articles/10.1186/s12986-019-0421-0
29. https://medlineplus.gov/lab-tests/homocysteine-test

QUALITY OF LIFE AMONG SELECTED NURSES

Ignacious Mary.S[1], Sridevi Sivakami.PL[2]

[1]Research Scholar, Department of Women's Studies, [2]Associate Professor, Department of Food Service Management and Dietetics, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu, India.

Abstract

Nursing stands one of the professions dominated by women who are the key for sustainable development in the family. Global nurse's statistics are 27 million. In India and Odisha it is 33.42 lakhs and 82,189 thousands respectively. Nurses are educated to take the patients' quality of life and healthcare into account but they rarely do so. Inaccessibility to health amenities and ignorance of wellbeing practices of general public are the challenges for Odisha nurses. Present study was conducted among the selected 126 registered nurses working in a multispecialty hospital in western Odisha. In the present study the demographic profile of nurses revealed that 80 of them are below the age group of 30 years. General Nursing and Midwifery was the basic qualifications of 96 nurses. Among them 74 nurses were unmarried. Most of them were working in general wards (102). Nurses with less than 3years' experience and more than one experience were 64. Nurses with 4 to 10 years' experience were 22, whereas nurses with more than 11 years' experience were 40. The working hours were more than 48 hours for 90 nurses nevertheless 72 have their monthly income less than Rs.15000. Assessment of quality of life shows that physical domain obtained the highest score 15 and the social domain obtained the lowest score 5. The psychological and environmental domains were 10 and 13 respectively. In the transformed score with the range of 4-20 also physical domain scored 58 whereas the social domain scored 20. The psychological and environmental raw scores were 37.2 and 54.4 respectively. The present study findings show that nurses participated in this studies are satisfied with their physical domains of quality of life whereas it was very low in social domain. In terms of rating of quality of life, 84 of them have rated that their quality of life is good and 36 have rated it is very good. Analysis of their satisfaction on health revealed that 79 were satisfied with their health and 35 were very satisfied with their health.

Keywords: *Nurses, Quality of life, Physical, Psychological, Social & environmental domains.*

Introduction

Women are the key person for the sustainable development of a family. At present, womenfolk of every ethnic group are represented in the labour force. However, this means that women who work both professionally and mostly at home now have higher obligations than they did in the past. These dual responsibilities can increase stress, jeopardize physical and mental health, cause burnout, and reduce productivity at work. Their quality of life is compromised. Nursing is one of the professions dominated by women. Approximately the global nurse's statistics are 27 million (WHO, 2022). According to Medical Dialogue (2022) India has 33.42 lakh registered nurses. A latest study by NITI Aayog has exposed that Odisha falls short of public health standard norms in hospital staffing (New Indian Express October2nd 2021). In Odisha 82,189 nurses are working in the health care industry. The ratio of staff nurses in proportion to norms is 0.5 with the State ranked 16th (Central Bureau of Health Intelligence, 2020). Maximum nurse leaders from place to place in the world is concerned about the ideal nurse to patient ratio. It affords benefits for both nurses and patients, which is crucial for the health and safety of the care given to patients as well as the nurses' living conditions. In association to their aims, anticipations, principles and uncertainties, societies 'imitations of their place in life within the framework of the values and cultural structures in which they live are referred to as their quality of life. Nurses are taught to think about the patient's quality of life and care, but they almost ever think about their personal; they hardly ever deliberate that they or others working in the occupation might require care.

Quality of life (QOL) is a broad notion that attempts to describe a person's sense of happiness. It describes the extent to which a person is capable of engaging in or appreciating life events, as well as being healthy, happy and comfortable. It encompasses all aspects of human lifestyle at that particular time, both good and bad.

It differs from person to person. Various factors determine quality of life of peoples. One person may define quality of life according to physical possession or satisfaction with life, another person may define it in terms of capabilities and values e.g., having the ability to live a good life in terms of emotional and physical well-being, living with good moral values. (Britannica., 2022)

A differently abled person may report a high quality of life accepting his disability, whereas a healthy person who experienced some acute crisis in his life may report a low quality

of life. Therefore, description of quality of life is highly subjective in nature. Within the arena of health care, quality of life is viewed as multidimensional, encompassing physical, psychological, social and environmental well-being. (Crispin Jenkinson., 2022).

A person's valuation of his place in life is relation to their intentions, anticipations, values, and uncertainties, in addition to the values and cultural frameworks, in which they live, are referred to as their quality of life.

According to this definition, everyday activities, reliance on medications and medical support, vitality and tiredness, adaptability, discomfort and pain sleep and rest, and job capability all contribute to physical health.

Psychological wellbeing includes bodily image and appearance, negative feelings, positive feelings, self-esteem, spirituality / Religion / Personal beliefs, thinking, learning, memory and concentration. Social well-being includes personal relationships, social support and Sexual activity. (WHO. 2012)

Many studies have been conducted on quality of life of many categories of people including health care industry workers. Amit Kumar (2018) conducted a study on 100 doctors and 100 nurses with the aim of assessing their quality of life and the psychological factors influencing it and identified that the complete insight of quality of life was normal, the overall stress level of health-care workers was moderately elevated and majority showed average coping resources.

Quality of life was lower in older nurses who were working rotated shift and those having higher years of experience(Huda et al 2020) which is in line with studies that found a significant association between quality of life and age (Albuquerque et al., 2019) and years of experience.

Geographic inaccessibility of health services, cultural barriers, and the health environment includes, among other things, a lack of understanding about healthy behaviors, inadequate service, and a disproportionate reliance on unauthorized health practitioners in Odisha. The nurses in Odisha during Covid19 had felt demoralized due to lack of recognition for their service, the risk of exposing to infection, stress and anxiety of being separated their families due to employment, these staff nurses are also facing social ostracism, harassment and even assault

(The Times of India, 2020). Ultimately all these factors are the challenges for nursing fraternity in Odisha.

From the existing literature it has been revealed that although there have been a few researches on quality of life nurses in India and abroad, yet there is a lack of research conducted on the working nurses' quality of life in hospitals in Odisha, and the present research emphases on the Quality of Life of nurses in Odisha hospitals.

Methodology

Selection of samples: A descriptive study was conducted among 126 registered female nurses who were involved with direct patient care in all the departments of selected Odisha hospitals. The age group was between 21 and 50 years with the experience of more than one year. Male nurses and nurses involved in teaching were not included.

Formulation of the Interview Schedule

Predesigned, pre-tested and validated questionnaire was formulated covering their socio-demographic variables and variables on their working environment which had different variables like age, professional qualifications, marital status, and area of current works, experience, working hours and monthly income.

WHO BREF Quality of life scale which had 26 questions and four domains of Physical, Psychological, Social and Environmental were used for data collection**.** Besides there two separate questions which analyze the overall rating of quality of life and health. Question one inquires about a person's general evaluation of life quality, whereas Question two inquires about a person's overall health perception. These two items are separately analyzed. All items are rated on a 5pointLikert scale with ranges from 5 (Always)–1(Never), with the highest scores representing better quality of life. The four domain ratings represent a person's assessment of their quality of life from each specific domain. The average score for each domain's items used to determine the domain score. Scores are transformed from the obtained raw data according to the WHO-recommended criteria.

Method of data collection

The data were collected for one month. After providing them with the pertinent information regarding the objectives, importance, and risks associated with the study,

respondents were requested to sign an informed consent form. Additionally, they were told that they might leave the study at any time by telling the researcher.

Analysis of Data

SPSS was used to examine the acquired data once they had been coded and summarized in a master sheet.

Findings of the Study

The descriptive study which was conducted on randomly selected 126 registered female nurses who completed one year experience in the hospital with the age between 21 and 50 years and involved with direct patient care. WHO BREF scale was used for data collection. The raw scores were transformed to converted scores. The first conversion method translates scores to range between 4-20, comparable with the WHO QOL-100. The second transformation technique converts domain scores to a 0-100 scale.

Table 1 Profile of the Selected Respondents' Demographics

The sample characteristics are described in terms of frequency and percentage n=126

Particulars	**N=126**	**%**
Age (years)		
21-30	80	63.5
31-40	22	17.5
41-50	24	19.0
Professional qualification		
General Nursing and Midwifery	96	76.2
Undergraduate	30	23.8
Marital status		
Un married	74	58.7
Married	52	41.3

Area of current work		
General Wards	102	81.0
Admin	4	3.2
ICU	18	14.3
Emergency/Trauma care	2	1.6
Experience		
1-3 years	64	50.8
4-6 Years	18	14.3
7-9 years	4	3.2
10-12 years	12	9.5
13 years and above	28	22.2
Working Hours/week		
48 hours	20	15.9
More than 48 hours	94	74.6
Less than 48 hours	12	9.5
Monthly Income (Rs)		
10000 - 15000	72	57.1
15001 - 20000	26	20.6
20001 - 25000	28	22.2

In the present study the demographic profile of nurses revealed that 80 of them are below the age group of 30 years. General Nursing and Midwifery was the basic qualifications for the 96 nurses among them 74 nurses were unmarried. Most of them were working in general wards (102). Nurses with less than 3years' experience and more than one experience were 64. Nurses with 4 to 10 years' experience were 22, whereas nurses with more than 11 years' experience were 40. The working hours were more than 48 hours for 90 nurses nevertheless majority of them (72) had their monthly income less than Rs.15000.

Table 2-Domains of Quality of life of nurses

Domains of QOL	Mean±SD	Transformed Score (4-20) *	Transformed Score(0-100) *
Physical	15±4.5	60.8	94
Psychological	10±2.5	39.2	91
Social	5±2.7	23	83
Environmental	13±6.2	57.4	95

*WHO BREF scale. In accordance with the WHOQOL-100, its first transformation method transforms results to a range between 4 and 20. The second transformation technique scales domain scores from 0 to 100.

Assessment of quality of life shows that physical domain obtained the highest score 15 and the social domain obtained the lowest score 5. The psychological and environmental domains were 10 and 13respectively. In the transformed score with the range of 4-20 also physical domain scored 58 whereas the social domain scored 20. The psychological and environmental raw scores were 37.2 and 54.4 respectively. The present study findings show that nurses participated in this studies are satisfied with their physical domains of quality of life which is supported by the study done by Rajeshwari Sathyananda and Usha Manjunath (2017) on 70 health workers working in primary health care centers in Karnataka found out that women health care workers were more satisfied with physical health domain then the psychological, social and environmental domains. Study conducted by Ergun (2016) reveled with present study where a physical domain was scored high, whereas it is in disagreement with the study of Orszudak (2022) who studied quality of life and working behaviours of 312 nurses and found out that nurse's quality of life in physical domain was the lowest. Nurses in this study have scored less in social domains and not satisfied with their personal relationship, sex life and support from their friends and family. The same findings were noted by Huda (2020), who studied quality of life of 119 nurses in Lebanon found out nurses have score the lowest score in social domain which supports the present study.

Table 3- Overall rating of quality of life and health satisfaction among the selected nurses

Rating the Quality of Life	**Neither poor nor good**	**Good**	**Very good**
	6	84	36
Level of Satisfaction on health	**Neither satisfied nor dissatisfied**	**Satisfied**	**Very satisfied**
	12	79	35

In terms of rating of quality of life, 84 of them have rated that their quality of life is good and 36 have rated it is very good. Analysis of their satisfaction on health revealed that 79 were satisfied with their health and 35 were very satisfied with their health.

Table 4-Level of significance with demographic variables and QOL domains

Demographic Variables	**Physical**	**Psychological**	**Social**	**Environment**
Age	-.234*	-.246**	-.449**	-.335**
Marital status	-277**	- 453**	- 744**	-282**
Professional Qualification	106	-.264**	-.401**	-130
Area of current work	.005	.152	-.142	.027
Experience	-.278**	-.309**	-.578**	-.343**
Working Hours/week	.188*	-.080	.027	.116
Monthly Income	-.269**	-.315**	-.603**	-.243**
***** Correlation is significant at the 0.01 level (2-tailed)***				

Two tailed correlation was used to study the associations between demographic variables and four domains of QOL. Correlation was significant between Physical domain and age, marital status, years of experience and monthly income. In Psychological domain the level of significance was noted at 0.01levels with the years of experience, marital status, professional qualification, years of experience and monthly income. Social domain was significantly correlated with age, marital status, qualification, experience and monthly income. Environmental domain was correlating significantly with age, marital status, experience and monthly income. Overall age, marital status, professional qualification, experience and monthly income are significantly correlating with all four domains.

Conclusion

It is very important to know the QOL and the level satisfaction on health to meet the challenges of the health care professional in the health care delivery system, the present study revealed that the nurses who took part in these assessments are content with their physical spheres of quality of life and yet not in their social spheres. They are content with their health and feel good about their overall quality of life.

References

1. Access Health international.,2016., https://accessh.org/health-system-odisha-challenges-opportunities-investment-improvement/
2. Albuquerque, G. P. M. D. , Abrão, F. M. D. S. , Almeida, A. M. D. , Alves, D. L. R. , Andrade, P. D. O. N. , & Costa, A. M. D. (2019). Quality of life in the climacteric of nurses working in primary care. *Revista Brasileira De Enfermagem*, 72, 154–161, 10.1590/0034-7167-2018-0306 [PubMed] [CrossRef] [Google Scholar].
3. Central bureau of health intelligence, 2020, https://www.ceicdata.com/en/india/health-human-resources-number-of-nurses-registered/number-of-nurses-registered-odisha-general-nursing-and-midwives.
4. Ergun FS, Oran NT, and Bender CM. Quality of life of oncology nurses. Cancer Nursing. 2016 May-Jun; 28(3):193-9.
5. Medical Dialogue., 2022., https://medicaldialogues.in/nursing/news/3341-lacs-nurses-registered-in-india-govt-tells-rajya-sabha-91031
6. The World Health Organization quality of life assessment (WHO QOL), 2012., Position paper from the World Health Organization. SocSciMed ; 41:1403-9.
7. The Times Of India., 2020., Odisha: Contractual NHM nurses allege government apathy amid ..https://timesofindia.indiatimes.com/city/bhubaneswar/odisha-contractual-nhm-nurses-allege-government-apathy-amidst-fight-againstcoronavirusarticleshow/75542199.cms
8. WHO 2022., Nursing and Midwifery., https://www.who.int/news-room/fact-heets/detail/nursing-and-Midwifery.
9. https://www.newindianexpress.com/states/odisha/2021/oct/02/odisha-falls-short-of-public-health-standard-norms-in-hospital-staffing-niti-aayog-report-2366669.html.

10. Amit Kumar, Pookala Shivaram Bhat, Sumalatha Ryali.,2018., Study of quality of life among health workers and psychosocial factors influencing it., Volume : 27 | Issue : 1 Page : 96-102.
11. Rajeshwari Bangalore Sathyananda, Usha Manjunath.,2017., Assessment of quality of life among the health workers of primary health centers managed by a nongovernment organization in Karnataka, India: A case study., Volume : 6 | Issue : 4 | Page : 240-244.
12. Huda A. Anshasi, Mirna Fawaz, Sura Alhalalmeh, Wafa Qasem Ahmad, and Ahmad Tassi.,2020., Nurses' stressors and their quality of life: A study on nurses caring for older patients.,Vol: 7(6): 1698–1706.
13. Natalia Orszulak, KlaudiaKubiak, Adam Kowal, Michał Czapla and Izabella Uchmanowicz.,2022., Nurses' Quality of Life and Healthy Behaviors.,*19*(19), 12927; https://doi.org/10.3390/ijerph191912927
14. Crispin Jenkinson., 2022., https://www.britannica.com/topic/quality-of-life

EXPLORING CUTTING EDGE RAMAN SPECTROSCOPY IN NANOPARTICLE INFUSED FOOD PACKAGING: COMPREHENSIVE REVIEW

Anitha A.G [1], Rizwana Begum.S [1], Padmavathy.M [2]
[1]Department of Physics, Seethalakshmi Ramaswami College
Tiruchirappalli Tamil Nadu, India.
[2] PG Asst, Athena Global School, Chidambaram, Tamil Nadu, India
aganithasrc@gmail.com

Abstract

This review explores the realm of nanoparticle-infused food packaging and delves into the pivotal role of Raman spectroscopy in characterizing and optimizing these advanced materials. With a focus on nanotechnology, we scrutinize how Raman spectroscopy provides intricate details about the composition, distribution and interactions of nanoparticles within packaging matrices. The paper highlights the practical application of Raman spectroscopy for real-time monitoring of nanoparticle behavior, ensuring both the efficacy of packaging and the safety of the packaged food. Our aim is to provide a comprehensive overview for researchers and industry professionals, showcasing the current strides in leveraging nanotechnology and Raman spectroscopy to create safer, more efficient, and technologically advanced food packaging solutions. By examining the latest findings, this review offers valuable insights into the potential future developments and challenges in the dynamic intersection of nanotechnology, Raman spectroscopy, and food packaging.

Keywords: *Nanotechnology, Raman spectroscopy, Food packaging*

Introduction

In the realm of contemporary food packaging innovation, the amalgamation of nanotechnology and cutting-edge Raman spectroscopy has ushered in a paradigm shift. Nanotechnology has paved the way to innovative food packaging materials and analytical methods to provide the consumers with healthier food and to reduce the ecological footprint of the whole food chain. [1] As the demand for enhanced food safety and quality persists, the utilization of nanoparticles in packaging materials has garnered attention for its potential transformative impact. Within this dynamic landscape, Raman spectroscopy emerges as a pivotal analytical tool, offering unparalleled precision in probing molecular structures and interactions. The introduction of nanoscale materials into food packaging demands a meticulous exploration of the intricate characteristics of nanoparticles. Raman spectroscopy,

with its capacity for elucidating vibrational modes, emerges as a cornerstone in characterizing nanoparticles, delving into nuanced parameters such as size, morphology, and spatial distribution within the packaging matrix. This exploration extends beyond the current frontiers, delving into the horizon of possibilities offered by Raman spectroscopy in nanoparticle-infused food packaging. Futuristic perspectives encompass advancements in standardization, scalability, and prolonged safety evaluations. However, the journey is not without challenges, and this study aims to unravel these intricacies, laying the groundwork for a comprehensive comprehension of the field's potential trajectory.

Principles of Raman spectroscopy

Raman spectroscopy is a non-invasive spectroscopic method that allows for the detection of internal vibrational modes of molecules, which yields comprehensive insights into chemical structure, crystallinity, and molecular interactions. When light interacts with the chemical bonds of molecules, Raman spectroscopy can extract specific molecular characteristics from the resulting spectrum. [2] It detects these vibrational modes by measuring the energy differences between the incident and scattered photons. Each vibrational mode produces a unique Raman spectrum, providing a fingerprint of the molecular structure. Raman spectroscopy is used in chemistry as a tool to identify molecules in a sample. Indeed, each Raman peak is associated with a vibration mode of a molecule; it is considered as a more useful approach to monitor the chemical parameters of samples tested in several fields, especially in food safety. [3]

Nanoparticle Characterization: Unveiling the Molecular Tapestry

The initial exploration within this domain involves a detailed examination of how Raman spectroscopy serves as a precise instrument in characterizing nanoparticles. This subheading delves into the specific parameters of size, shape, and distribution, highlighting the capabilities of Raman spectroscopy in unraveling the intricate details at the molecular level. Examples of successful applications and case studies can be presented to illustrate the effectiveness of Raman spectroscopy in providing invaluable insights into the physical attributes of nanoparticles.

Molecular Insights into Nanoparticle Dynamics: A Comprehensive Examination

Moving beyond the superficial characteristics, this section focuses on the dynamic aspects of nanoparticles within food packaging materials. Raman spectroscopy, with its capacity for probing vibrational modes, allows for a comprehensive examination of the molecular dynamics at play. It provides in-depth insights into the behavior of nanoparticles over time, shedding light on their stability, reactivity, and potential transformations within the packaging matrix. Examples of successful applications and case studies can be presented to illustrate the effectiveness of Raman spectroscopy in providing invaluable insights into the physical attributes of nanoparticles.

Structural Integrity Assessment: Raman Spectroscopy as the Sentinel

Ensuring the structural integrity of packaging materials is essential for maintaining food safety. This investigates how Raman spectroscopy acts as a sentinel, meticulously assessing the structural soundness of nanoparticle-infused packaging. It discusses the specific features and markers Raman spectroscopy can identify to gauge the overall quality and reliability of packaging materials, providing examples of successful quality assurance applications.

Unraveling the Molecular Dance: Interactions in Nanoparticle-Infused Packaging

Understanding the molecular interactions between nanoparticles and the packaging matrix is crucial. This highlights how Raman spectroscopy serves as a powerful lens, unraveling the molecular-level interplay. Specific molecular bonds, changes, and adaptations can be explored to showcase the depth of information that Raman spectroscopy can provide regarding the synergies between nanoparticles and packaging materials. It delves into studies and findings that showcase Raman spectroscopy's role in elucidating the impact of temperature and humidity on the stability and resilience of nanoparticle-infused packaging materials. Beyond safety, ethical considerations in nanoparticle integration are vital. This subheading discusses how Raman spectroscopy aids researchers and industry stakeholders in navigating regulatory frameworks that ensure ethical standards. It may delve into discussions on transparency, informed consent, and responsible innovation in the context of integrating nanotechnology into food packaging.

Advanced Techniques in Raman Spectroscopy

Surface-Enhanced Raman Spectroscopy (SERS)

Surface-enhanced Raman spectroscopy (SERS) is a powerful technique that amplifies Raman signals by several orders of magnitude through the interaction of molecules with plasmonic nanoparticles. In the context of nanoparticle-infused food packaging, SERS offers unique advantages for studying nanoparticle interactions and surface properties. By functionalizing metallic nanoparticles and incorporating them into packaging materials, researchers can achieve enhanced Raman signals from molecules in close proximity to the nanoparticles. This allows for sensitive detection and characterization of nanoparticle-polymer interactions, as well as surface modifications on nanoparticle surfaces.

Confocal Raman Microscopy: (CRM)

Confocal Raman microscopy combines the spatial resolution of optical microscopy with the chemical specificity of Raman spectroscopy, allowing for high-resolution imaging and depth profiling of samples. In the analysis of nanoparticle-infused food packaging, confocal Raman microscopy enables researchers to visualize the distribution of nanoparticles within packaging matrices with sub-micron resolution. By acquiring Raman spectra from different depths within the sample, researchers can generate three-dimensional maps of nanoparticle distribution, providing valuable insights into their spatial organization and dispersion homogeneity.

Coherent Anti-Stokes Raman Spectroscopy (CARS)

Coherent anti-Stokes Raman spectroscopy (CARS) is a nonlinear optical technique that offers label-free imaging of vibrational modes in samples. In the context of nanoparticle-infused food packaging, CARS has the potential to provide real-time, high-resolution imaging of nanoparticle distribution and dynamics within packaging materials. Unlike conventional Raman spectroscopy, CARS does not require fluorescent labeling or extensive sample preparation, making it particularly well-suited for studying nanoparticles in complex food packaging matrices. By providing insights into nanoparticle interactions and dynamics, CARS can help optimize the design and performance of nanoparticle-infused food packaging materials.

Applications in Nanoparticle Dispersion and Distribution

Advanced Raman spectroscopy techniques play a crucial role in characterizing nanoparticle dispersion and distribution within food packaging matrices. By combining surface-enhanced Raman spectroscopy, confocal Raman microscopy, and CARS imaging, researchers can obtain detailed information about nanoparticle localization, aggregation, and migration within packaging materials. This knowledge is essential for optimizing the formulation and processing of nanoparticle-infused food packaging to ensure uniform dispersion and stability over time. Raman spectroscopy enables researchers to assess the homogeneity of nanoparticle dispersion within food packaging matrices. By acquiring Raman spectra from different locations across the packaging material, researchers can identify variations in nanoparticle concentration and distribution. Any non-uniformities or clustering of nanoparticles can be detected through changes in Raman signal intensity and spectral features. This information is crucial for ensuring consistent performance and properties of nanoparticle-infused packaging materials.

Analysis of Nanoparticle Interactions

Understanding nanoparticle interactions with packaging polymers and other components is essential for optimizing the performance and stability of nanoparticle-infused food packaging materials. Advanced Raman spectroscopy techniques provide valuable insights into nanoparticle-polymer interactions, including surface adsorption, chemical bonding, and phase separation. By monitoring changes in Raman spectra and imaging nanoparticle distribution, researchers can assess the impact of processing conditions, environmental factors, and storage conditions on nanoparticle stability and performance within food packaging matrices.

Monitoring Nanoparticle Migration

Raman spectroscopy can be used to monitor nanoparticle migration within food packaging matrices over time. By acquiring Raman spectra at different time points during storage or processing, researchers can track changes in nanoparticle distribution and assess their stability within the packaging material. Any migration or aggregation of nanoparticles can be detected through shifts in Raman signal intensity and spectral features. This information

helps ensure the long-term stability and performance of nanoparticle-infused packaging materials under various environmental conditions.

Quantifying Nanoparticle Concentration

Raman spectroscopy can also be used to quantify nanoparticle concentration within food packaging matrices. By correlating Raman signal intensity with known nanoparticle concentrations in calibration standards, researchers can estimate the absolute concentration of nanoparticles in the packaging material. This quantitative analysis provides valuable information for quality control and regulatory compliance, ensuring that nanoparticle-infused packaging materials meet desired specifications and performance requirements.

Development of Multifunctional Packaging

The development of multifunctional packaging involves creating packaging materials that serve multiple purposes beyond just containment and protection of the product. These materials often incorporate additives, coatings, or technologies that provide additional functionalities to enhance product quality, safety, and shelf life. Raman spectroscopy can play a crucial role in the characterization and optimization of these multifunctional packaging materials.

Antimicrobial Packaging

One aspect of multifunctional packaging is its ability to inhibit microbial growth and extend the shelf life of perishable products. Researchers can use Raman spectroscopy to study the incorporation of antimicrobial agents, such as silver nanoparticles or essential oils, into packaging materials. Raman spectroscopy can help in understanding the interaction between these additives and the packaging matrix, as well as monitoring their release kinetics over time. The main mechanism by which the nanoparticles exhibit antimicrobial property is not understood completely. By means of electrostatic interaction, nanoparticles can attach to the cell membrane and disrupt it. [4]

Active Packaging for Freshness Maintenance

Active packaging systems release or absorb substances to maintain the freshness and quality of the packaged product. Raman spectroscopy can be utilized to analyze the effectiveness of oxygen scavengers, moisture absorbers, or ethylene scavengers incorporated into packaging films. By monitoring chemical changes or reactions occurring within the packaging material, researchers can optimize the formulation and design of active packaging systems.

Smart Packaging with Active Components

Multifunctional packaging may also include active components that respond to external stimuli or environmental conditions. Raman spectroscopy can monitor the activation and release of active ingredients (e.g., antimicrobial agents, antioxidants) in response to changes in temperature, pH, or humidity. This real-time monitoring capability enables researchers to optimize the design of smart packaging systems for targeted and controlled release of active components.

"Future Directions in Raman Spectroscopy: Advancements Shaping Analytical Techniques and Applications"

Overall, forthcoming advancements in Raman spectroscopy are expected to drive innovation in materials science, analytical chemistry, and biomedical research, enabling new insights into molecular structures, interactions, and dynamics across a wide range of disciplines. These advancements hold the potential to address current challenges and unlock new opportunities for scientific discovery and technological advancement.

Conclusion

In conclusion, the trajectory of advancements in Raman spectroscopy represents a captivating journey at the intersection of physics, materials science, and analytical chemistry. With each stride forward, the field's evolution not only deepens our understanding of fundamental physical principles but also expands the boundaries of technological innovation and practical application. The incorporation of cutting-edge spectroscopic techniques such as Raman spectroscopy holds immense promise for quality assurance and safety in food

packaging. By harnessing the power of molecular analysis, researchers can detect minute contaminants, monitor degradation processes, and ensure the integrity of packaging materials with unparalleled precision and sensitivity. Together, we can harness the full potential of cutting-edge physics principles to propel food packaging into a new era of efficiency, sustainability, and consumer safety.

References

1. Marco Rossi , Daniele Passeri , Alberto Sinibaldi , Mariglen Angjellari , Emanuela Tamburri, Angela Sorbo , Elisabetta Carata , Luciana Dini, (2017), Nanotechnology for Food Packaging and Food Quality Assessment (82), 149-204.
2. Long Wu a, Xuemei Tang, Ting Wu, Wei Zeng a, Xiangwei Zhu, Bing Hu, Sihang Zhang, (2023,), A review on current progress of Raman-based techniques in food safety: From normal Raman spectroscopy to SESORS (169) 112944.
3. Benattia, Farah K., Arrar, Zoheir, Dergal, Fayçal, (2024), Methods and Applications of Raman Spectroscopy: A Powerful Technique in Modern Research, Diagnosis, and Food Quality Control, 20 41-61(21).
4. Shubham Sharma, Swarna Jaiswal, Brendan Duffy and Amit K. Jaiswal, (2019), Nanostructured Materials for Food Applications: Spectroscopy, Microscopy and Physical Properties. 6, 26.

DEVELOPMENT AND QUALITY EVALUATION OF TAPIOCA INCORPORATED PASTA

Namitha Prastheena Joseph,[1] Shilpa Jose[2] and Blossom K L[3]

[1] Assistant Professor, Department of Clinical Nutrition and Dietetics, St. Teresa's College (Autonomous), Ernakulam

[2] Associate Professor, Department of Home Science and Centre for Research, St. Teresa's College (Autonomous), Ernakulam

[3] Assistant Professor, Department of Fish Processing Technology, Kerala University of Fisheries and Oceanography Studies, Panangad

amithaprastheena@gmail.com

Abstract

Pasta is an instant food which is widely consumed and becoming popular worldwide. It is often used as a convenience food due to ease of cooking, low cost as well as due to quick cooking characteristics. Tapioca flour derived from the root of cassava plant is a good source of carbohydrate and dietary fibre. The present study was designed to develop pasta by incorporating tapioca flour in different levels of substitution (30%, 40% and 50%) to wheat flour. Nutrient value, cooking quality characteristics and colour analysis of the tapioca incorporated pasta was determined. The ratio of tapioca incorporated pasta selected by sensory evaluation was wheat-tapioca pasta (70:30) with maximum overall acceptability of 89%. The selected tapioca pasta comprises of moisture (4.2%), ash (2.4%), protein (1.3%), fat (0.9%) and fibre (5.5%). Cooking quality characteristics indicated selected tapioca pasta had a cooking time of 7.05 min, cooking loss of 9.9% and water absorption of 218.8%. Colour analysis showed an increase in parameters like L (lightness) values ranging from 81.29-82.99 while a* (redness) and b* (yellowness) values exhibited a decrease of 3.36-2.91 and 19.34-18.37 respectively during the storage period of 30 days. Therefore, the present study revealed that incorporation of tapioca flour is an effective approach of developing versatile pasta products with improved taste and nutritional profile.*

Keywords: *pasta, tapioca, cooking quality characteristics, nutrient value and colour analysis.*

Introduction

Pasta is one of the most commonly consumed cereal-based food products due of its accessibility, palatability and the extended shelf life [1]. Basically, pasta products are popular not only all over the world but also in the Indian subcontinent [2]. Pasta is described as a healthy, sustainable, and standard food model WHO (World Health Organization) and FAO (Food and Agriculture Organization). In general, pasta contains low fat and readily digestible carbohydrates which make it is very nutritious [3]. Tapioca is a tuber crop which grows in tropical and subtropical regions of the world [4]. Tapioca is a rich source energy, carbohydrates and dietary fibre [5]. Among the roots and tubers, tapioca has high yield, low production cost and the unique functional properties of its flour and starch make it suitable for partial or complete replacement for wheat flour [6]. Tapioca flour has interesting benefits with respect to cereal flour in terms of starch, low retrogradation and high water-holding ability [4].

The present study aims to develop healthy pasta by the incorporation of tapioca flour in wheat flour. The combination of wheat flour and tapioca flour may offer a unique nutritional profile that complements each other's strengths. As wheat flour is a good source of protein and essential nutrients, while tapioca flour contributes a distinct texture and is rich in carbohydrates and dietary fibre. The synergy between these two ingredients has the potential to enhance the overall nutritional quality of the pasta, making them a wholesome and well-balanced dietary choice.

Methodology

1. Raw materials

The main ingredients selected for the product development were whole wheat flour and tapioca flour. Whole wheat was milled into wheat flour and tapioca flour was procured from local market.

2. Preparation Formulation of Pasta Samples

Wheat flour and tapioca flour was mixed with salt and kneaded the flour with adequate water to form dough. The dough was passed through the sheet making dye for the sheet formation. This was followed by passing the sheet through the pasta dye for the formation of pasta strands. The pasta strands were collected in trays and were placed in hot air oven for drying at 50^0 C for 5 hours. Now the dried tapioca pasta was cooled in room temperature and packed in a polypropylene material. Three combinations of wheat-tapioca pasta were

formulated by adding tapioca flour to wheat flour in three different proportions (T30=30:70, T40=40:60 and T50=50:50).

3. Sensory Evaluation

The sensory evaluation was carried out using 9-point hedonic scale and the cooked tapioca pasta samples were evaluated for its appearance, texture, flavor, taste and over acceptability by 15 trained panel members.

4. Nutrient Analysis

The developed tapioca pasta samples were analyzed for moisture content, ash content, protein content and fat content using AOAC (2005) method [7]. Fibre content was analysed using AOAC (2000) method [8].

5. Cooking Quality Characteristics

The cooking time and cooking loss of the selected tapioca pasta was determined using AACC (2000) method [9] and the water absorption was analyzed using AACC (2005) method [10].

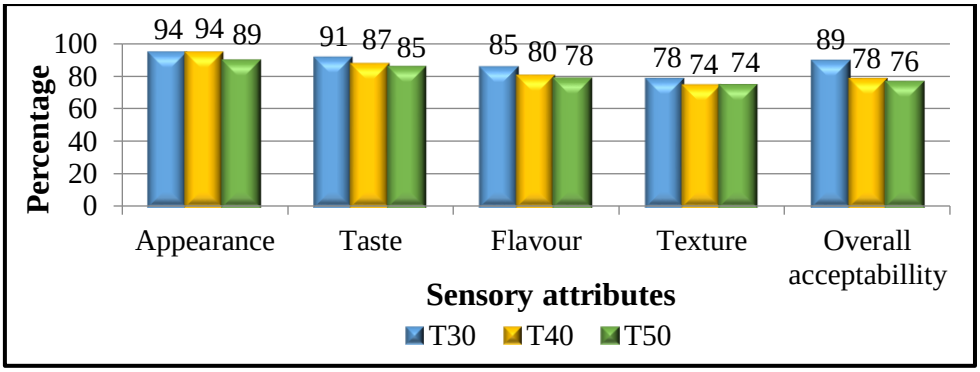
6. Colour analysis

The selected tapioca pasta which was packed and stored under room temperature were evaluated for changes in colour at 30 days interval. Colour of raw pasta was determined using hunter lab mini scan EZ colorimeter. The parameters determined were L* (lightness or darkness): L* = 0-50 indicate darkness and L* = 51-100 indicate lightness), a* (red-green component: -a* indicate greenness and a* indicate redness) and b* (yellow-blue component: -b* indicate blueness and b* indicate yellowness).

Results and Discussion

Sensory evaluation

Results showed that pasta sample T30 (pasta with 70g wheat flour, 30g tapioca flour) had better sensory scores for appearance, taste, flavor, texture and overall acceptability. This positive sensory response suggests that the incorporation of tapioca in the pasta formulation has the potential to enhance the overall eating experience. Results of sensory evaluation of pasta samples are presented in figure 1.



* T30 – pasta with 70g wheat flour, 30g tapioca flour; T40 - pasta with 60g wheat flour, 40g tapioca flour and T50 - pasta with 50g wheat flour, 50g tapioca flour.

Fig.1-Sensory evaluation of tapioca pasta samples

Nutrient Value

It was observed that tapioca pasta T30 exhibited moisture (4.2%), ash (2.4%), protein (1.3%) content, fat (0.9%) and fibre (5.5%). Nutritional value of the selected tapioca pasta is presented in figure 2.

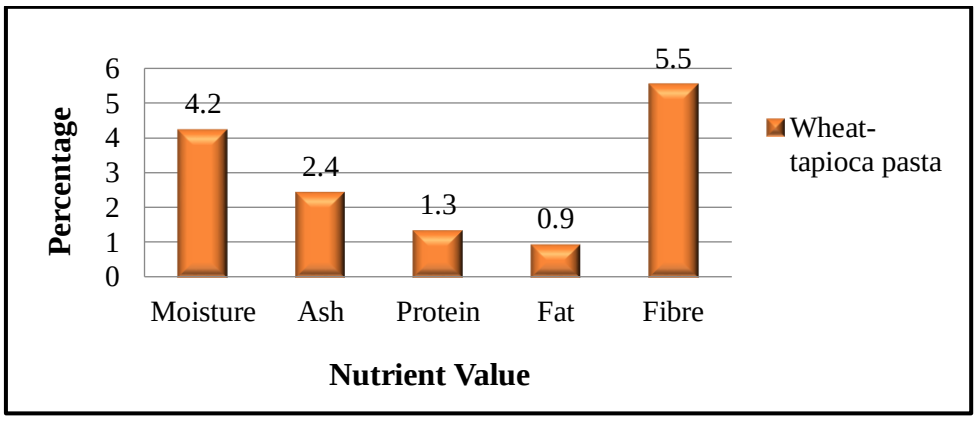


Fig 2- Nutrient value of selected tapioca pasta

Cooking quality characteristics

Cooking quality characteristics like cooking time, cooking loss and water absorption were evaluated. The cooking quality characteristics is presented in table 1.

Table 1- Cooking quality characteristics

Cooking quality characteristics	Wheat-Tapioca Pasta
Cooking Time	7.05 min
Cooking Loss	9.9 %
Water Absorption	218.8 %

It was found that selected tapioca pasta (T30) had a high cooking time (7.05 min) and water absorption (218.8%). The high cooking time of tapioca pasta is due to its high fibre content which limits the leaching of starch particles and delays the entry of water. This in turn increases the gelatinization temperature and cooking time. The high fibre content also resulted in greater water absorption due to the strong water binding capacity of fibers. But the selected tapioca pasta (T30) had a low cooking loss (9.9%). The low cooking loss might be due to the better binding of starch granules and tapioca flour within the gluten network.

Colour analysis

Colour is one of the most prominent quality properties for the acceptability of food. Figure-3 indicates the color characteristics of selected tapioca pasta (T30) based on L*, a* and b* values obtained from Hunter Lab colorimeter over a storage period of 30 days.

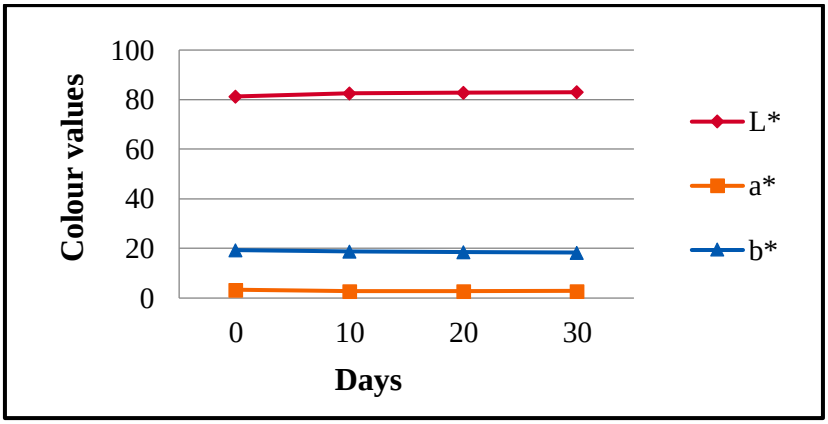


Fig. 3- Effect of storage on colour of selected tapioca pasta

A slight and progressive increase in L* value and a decrease in a* and b*value was observed in the selected tapioca pasta (T30) during the storage period of 30 days. Since the tapioca pasta had a lighter shade and thus, it had a high L* value ranging from 81.29-82.99. Whereas the tapioca pasta a low a* and b* value ranging from 3.36-2.91 and 19.84-18.37 respectively.

Conclusion

The developed tapioca pasta sample (T30) showcases favorable sensory attributes, promising nutritional composition and distinctive cooking characteristics. These findings support its potential as a unique and appealing alternative in the market. However, further research into long-term storage stability and potential color changes is recommended for a comprehensive understanding of the product's quality over time. Overall, the developed tapioca

pasta holds promise as a nutritious and sensory-rich addition to the diverse landscape of pasta products.

References

1. Bustos, C. M., Perez, T. G. & Leon, E. A., Structure and quality of pasta enriched with functional ingredients, *RSC Advances*, 2015, 5 (39), 30780-30792.
2. Karpagavalli, B. and Amutha, S., Development of pasta products using cereal pulse blends, *Asian Journal of Dairy and Food Research*, 2015, 34 (3), 213-218.
3. Bresciani,A., Pagani, A. M. and Mart, A., Pasta-Making Process: A Narrative Review on the Relation between Process Variables and Pasta Quality, *Foods*, 2022, 11 (3), 256.
4. Li. M., Zhang, Y., You, X., Ying, W., Zhou, K., Wei, P. and Wei, L., Assessment of Functional Properties of Wheat–Cassava Composite Flour, *Foods*, 2023, 12 (19), 3585.
5. Dhas, A. T., Rao, A. V., Sharon, M. E. M., Manoharan, P. A. and Nithyalakshmi, V., Development of fibre enriched ready-to-cook pasta with foxtail millet and tapioca flour, *The Pharma Innovation Journal*, 2021; 10 (5), 1432-1435.
6. Lu, H., Guo, L., Zhang, L., Xie, C., Li, W., Gu, B. and Li, K., Study on quality characteristics of cassava flour and cassava flour short biscuits, *Food Science and Nutrition*, 2020, 8 (1), 521–533.
7. AOAC, Official Method of Analysis, Chemists, Association of Official Analytical Washington D. C., 18th edition, 2005.
8. AOAC, Official Method of Analysis, Association of Official Analytical Chemists Washington D. C., 17th edition, 2000.
9. AACC, American Association of Cereal Chemists, Approved methods of the AACC, The Association. Saint Paul, M. N., 10th edition, 2000.
10. AACC, American Association of Cereal Chemists, Approved methods of the AACC, The Association. Saint Paul, M. N., 11th edition, 2005.

FAST FOOD CONSUMPTION AMONG SELECTED SCHOOL AND COLLEGE GOING STUDENTS

Kaleeswari Gurusamy[1] and Sathya [2]

[1]Assistant Professor, Department of Nutrition and Dietetics, AIMAN College of Arts & Science for Women, Tiruchirappalli, Tamil Nadu, India

[2]Associate Professor, Department of Home Science, Gandhigram Rural University, Gandhigram.

Kaleeswari Gurusamy, Email: kaleesfsn2017@gmail.com

Abstract:

India has rich heritage of fast foods and recipes. Fast food has become an important part of dietary menu. Fast food consumption is rising in India across all income categories and this is contributing significantly to rising trend of non-communicable diseases (NCDs) in this country. As per the National Institute of Nutrition (NIN), "unhealthy (junk) foods are those containing little or no proteins, vitamins or minerals but are rich in salt, sugar and fats and are high in energy (calories). The term fast food and junk food are often used interchangeably. Fast food is now served as restaurants, drive-in, at stadiums, airport, zoos, schools, university, trains, and airplanes. Fast foods are foods already made or cooked to order within minutes for consumption noodles, pizzas, hamburgers, breaded chicken, chicken nuggets, tacos chips, salads, pizzas, sandwiches, flavored aerated drinks, potato chips, French fries. Fast foods consumption increases in adolescents and college going students. The availability, taste, color and appearance increases the frequency of fast food consumption. The present study conducted among selected school and college going students (Number 200) by using structured interview schedule. The present article reveals the fast food consumption pattern among the study population and its associated factors.

Key words: *Fast food consumption, school students, college students, harmful effects of fast foods.*

Introduction

'Eat healthy and live healthy' is one in all the essential necessities for long life. Junk food merely suggests that an empty calorie food. India's impressive economic growth in previous decades and more inclusive growth recent years have not only resulted in steadily increasing income but it brought socio cultural transformation. In this process globalization and increasing urbanization contributed immensely. India with rich heritage of foods and recipes had the tradition of preparing foods by deep frying in fats. This situation is getting complicated by emerging fast

food culture in all sections of society primarily due to their readily availability, easy to access, taste, marketing strategies and cafeteria culture. Therefore it becomes imperative to introspect about fast food consumption. There are enough scientific evidences in India to substantiate that fast food have become integral component of diet in all section of society. High consumption of fast food has been reported in school going children and this is quite substantial in college and university students - in spite of the fact that a significant proportion of population are aware about adverse consequences of fast food consumption. Children of pregnant and lactating women eating fast foods are more prone to obesity. High fat and high sugar diet leads to change in fetal brain reward pathway altering food preferences. Fast food consumption is rising in India across all income categories and this is contributing significantly to rising trend of non-communicable diseases (NCDs) in this country.

An empty calorie food could be a high calorie or calorie made food that lacks in micro-nutrients such as vitamins, minerals, or amino acids, and fiber however has high energy (calories).These foods don‘t contain the nutrients that your body must keep healthy. Hence, these foods that has poor biological process worth is considered unhealthy and will be known as junk food. Junk food is an informal term applied to some foods that are appeared to have little or no biological process worth, however that additionally have ingredients thought-about unhealthy once eaten regularly, or to those thought-about unhealthy to consume in any respect. The term junk food was coined as along within the public interest in 1972 by Michael Jacobson, Director of the middle for Science,

These foods have little enzyme manufacturing vitamins and minerals and but contain high level of calories in their place. A food that's high in fat, sodium, and/or sugar and provides high calories yet useless in worth is mostly called a junk food. On the contrary, food is simple to hold, purchase and consume. Fast foods are characterized as fast, simply accessible and low cost alternatives to home cooked meals, in step with the National Institutes of Health (NIH). In spite of substantial economic growth during the last few decades, extreme poverty and food insufficiency still exist in developing countries like India. High use of fast and junk food has added another big problem. It has pushed country towards double burden of diseases.

India has rich heritage of fast foods and recipes. Fast food has become an important part of dietary menu. The term fast food and junk food are often used interchangeably. Most of the junk foods are fast foods as they are prepared and served fast, but not all fast foods are junk foods,

especially when they are prepared with nutritious contents. As per the National Institute of Nutrition (NIN), "unhealthy (junk) foods are those containing little or no proteins, vitamins or minerals but are rich in salt, sugar and fats and are high in energy (calories)."Globally, the term junk food is popularly used to identify items with little or no nutritional value but high in fat, salt and sugar. Foods with similar attributes are also termed as following.

- ***EDLNF EDNPFC:*** Energy dense low-nutrient density foods or energy dense and nutrient poor foods for children; as in republic of Korea.
    - ***FMNV:*** Foods of minimal nutritional value as in United States.
    - ***Foods with imbalance of nutrients:***
- absence or limited presence of nutrients which are favourable in maintaining health such as proteins, vitamins, phytochemicals, minerals and dietary fibre;
- ***HFSS foods:*** Foods that is high in fat, salt and sugar, by the World Health Organization (WHO) and certain other countries.

Related studies

Fast food costs relatively little and tastes good, but the negative effects on physical health last much longer than these immediate concerns. With the high-calorie meals come more fat, cholesterol, salt and sugar and therefore fewer vitamins, minerals and other nutrients than in healthier foods. The objective of this study to know about the effect of fast food consumption on the health of school going children (9-13year). Total of 100 school going student were selected from five different schools of Lucknow District. The study was carried out by using the following tools to analyze the effect of fast food consumption health of respondents. Self-designed & pre tested questionnaire was used in the study. The result found that among 9 year 100% respondents were found obese level. Among 10 year 42.8% of respondents were found obese level 3. Among 11 year 8.6% of respondents were found obese level 3. Among 12 year, 36.3% respondents were found obese level. Among 13 year 8.3% respondents were found obese level.

Fast food culture is an emerging trend among the younger generation. The ready availability, taste, low cost, marketing strategies and peer pressure make them popular with children. Fast food restaurants are primed to maximize the speed, efficiency and conformity. The menu is kept limited and standardized essentially to minimize the waiting time so that the customers eat quickly and leave. This perspective delineates the emerging fast food culture in

India, its impact on children and strategies to counter it. Fast foods are widely available in schools through variety of outlets.

Health problems

Junk foods are unhealthy foods. Most of these quick and convenient meals contain high amount of sodium, which increases and aggravates the risks of high blood pressure. Excessive use of fat, butter in cooking increases saturated fat intake as well as calorie intake. Fast food consumption leads to obesity. There are several teenage obesity causes. Tran's fat is considered as the most harmful type of fat because it not only increases the bad cholesterol (Low density lipoprotein levels, but also reduces the good cholesterol (High density cholesterol) levels.

Obesity and obesity related problems

"Obesity is defined as an abnormal or excessive fat accumulation that may impair health. The operational definitions of obesity and overweight are based on Body Mass Index which is closely correlated with body". Regular and excessive consumption of fast food often results in obesity, which is one of the gripping problems adult. Obesity can also lead to other complications like increase in the cholesterol level, blocking of the arteries, the increased risk of coronary diseases, and physical discomfort. This is because most fast food is high in sugar, salt, saturated fat and trans fats, processed ingredients, and calories, and low in antioxidants, fiber, and many other nutrients. Many fast food meals are very low in fiber. A low-fiber diet is associated with a higher risk of digestive conditions such as constipation and diverticular disease, as well as reductions in healthy gut bacteria**.**

Methodology

The methodology pertaining to the study on "Fast Food Consumption among Selected School and College going students" explained in this chapter under the following headings;

Area of the study

The area chosen for the study was Kumarappa Chettiyar Matriculation Higher Secondary School-Nilakottai, Panchayath Union Middle School-Chinnalapatti, PVP Arts and Science College at Chinkarakotai, and Parvathy's Arts and Science College at Dindigul.

Selection of sample

The total of was interviewed from school and college students two hundred (N=200) 34 students PVP Arts and science college ,66 students from Parvathy Arts and science college, 78

students from Kumarappa Chettiyar Matriculation Higher Secondary School, Nilakottai, remaining 22 students from Panchayath Union Middle School at Chinnalapatti.

Data collection procedure

Survey method was used for data collection using a questionnaire. Questionnaire is described as "document that contains a set of questions, the answers to which are to be provided personally by the respondents". The closed ended questions are the fixed choice questions which require respondents to answer in their own words. Survey has been conducted among the college students to understand their food habits especially the consumption of fast food. Initially the purposes of the study explain to the respondents, as they were literates about this tool chosen. An interview schedule was adopted with questionnaire to collect the data.

Assessment of nutritional status

Anthropometric measurements like height, weight, body mass index were used to assess the nutritional status of the subjects. Body weight and height of the respondents reflect the state of health.

Results and Discussion

Table 1-General Background of the Respondents

S.No	Age in years	Number (N=200)	Percentage %
1	13-14	36	18
2	14-15	19	9
3	15-16	45	23
4	17-19	70	35
5	20-21	30	15
	Total	**200**	**100**
S.No	**Sex**	**Number (N=100)**	**Percentage %**
1	Female	114	57
2	Male	86	43
	Total	**200**	**100**

Table I illustrates general background of the respondents regarding their age and sex. Thirty five percent of the respondents (35%) were belonged to the age of 17-19 years; twenty three

percent of respondents (23%) were belonged to the age of 15-16. Eighteen percent of the respondents (18%) were belonged to the age of 13-14, Fifteen percent of respondents (15%) were belonged to the age of 20-21, and remaining nine percent of the respondents (9%) were belonged to the age of 14-15.

Regarding the sex, Fifty seven percent of respondents (57%) were female and forty three percent of the respondents (43%) were male.

Table II - General particulars of the Respondents

S.No	Name of the College	Number (N=100)	Percentage %
1	PVP Arts and Science College	34	17
2	Parvathy's Arts and Science College	66	33
3	Kumarappa Chettiyar Matriculation Higher Secondary School	78	39
4	Panchayat Union School	22	11
	Total	**200**	**100**

Table II indicates the distribution of the respondents based on their studying college and education status. Thirty nine percent of the respondents (39%) are studied from School students of Kumarppa chettiyar school, Thirty three percent (33%) of the respondents from parvathy Arts and Science College students, seventeen percentages from PVP Arts and Science college students. Eleven percent of the respondents (11%) are Panchayath Union Middle School.

Table III-Factor for selection of Fast food

S.No	Selection of fast food	Number (N=200)	Percentage
1	Easily available	16	8
2	Satisfy by the hunger	10	5
3	New variety	36	18
4	Tasty	118	59
5	Attraction	16	8
6	Dislike food	4	2
	Total	**200**	**100**

Table III shows the factors for their selection of fast food items. It was observed fifty nine percent (59%) of the respondents were chosen the fast foods for its taste. Eighteen percent (18%)

of the respondents were chosen fast food for it's a new variety. Eight percent (8%) of the respondents were chosen for its attraction, five percent t(5%) of the respondents were consumed during the hunger leads to immediate consumption and remaining two percent(2%) of the respondents were reported that they don't like food.

Table IV-Distribution of the respondents based on Body Mass Index

S.No	Body Mass Index	Number (N=200)	Percentage %
1	Under Weight(<18.5)	42	21
2	Normal(18.5-22.9)	74	37
3	Over Weight(23-25)	68	34
4	Grade I Obese	16	8
	Total	**200**	**100**

The above table indicates the distribution of the respondents based on their BMI. Thirty seven percent (37%) of the respondents were normal BMI, twenty one percent (21%) of the respondents were underweight thirty four (34%) percent of the respondents were overweight, remaining eight percentage (8%) of the respondents are grade I obese. Over weight leads to obesity was found high among college students.

Conclusion

Fast foods are becoming a part of the life style especially among younger generations. Even though this diet plan gives dieters the information necessary in order to reduce calorie intake it still supports the intake of fast foods, which will undoubtedly contain unhealthy ingredients regardless of the choices made. The fast foods contain substances that increase free radical exposure causing inflammation and possibly increasing the risk of many diseases including cancer. Health center in colleges and schools should take up the responsibility in imparting nutrition and health education to the student's community.

Suggestions

- ✓ Awareness programmes should be conducted at the colleges and teenage students
- ✓ Important nutrition and beneficial functions of food to be created in children and adolescent
- ✓ Nutritious foods should be supplied in college campus.
- ✓ Fermenting, malting and sprouting can be done at home which enhance the nutritive value without increasing the processing cost.

- ✓ Steamed foods are less expensive than fried foods. Low cost diets have fewer amounts of fats oils and sugars.

References

Book references

1. Heloen Knowtaluk (1997) "Food for Today", 6th edition, New York; Glemcoe Mcgraw-hill.
2. S.P Gupta (2004), "Statistical Methods", 3rd edition, Published by Sultan Chand and Sons, New Delhi
3. Ker linger (1996), "Methodological information."
4. Eunj Ha NataileCaine- Bish, Karen Lowry-Gorden, "Journal of nutrition Education", July-August (2009), Vol-41, Issue 4.
5. Williams J, Scarborough P, Matthews A, Cowburn G, Foster C, Robert N, Rayner M. A systematic review of the influence of the retail food environment around schools on obesity-related outcomes. Obes Rev 2014; 15(5):359-74.
6. Shah T, Purohit G, Nair SP, Patel B, Rawal Y, Shah R. Assessment of obesity, overweight and its association with the fast food consumption in medical students. J ClinDiagn Res 2014; 8(5):CC05-7.
7. Al-Otaibi HH, Basuny AM. Fast food consumption associated with obesity/overweight risk among University female student in Saudi Arabia. Pak J Nutr 2015; 14(8):511.
8. Singh, M., &Mishra, S. (2014). Fast food consumption pattern and obesity among school going (9-13 year) in Lucknow District. *Int J Sci Res*, *3*, 1672-4.
9. Keshari, P., &Mishra, C. P. (2016). Growing menace of fast food consumption in India: time to act. *Int J Community Med Public Health*, *3*, 1355-1362.
10. Ashakiran, Deepthi R. Fast foods and their impact on health. *Journal of Krishna Institute of Medical Sciences University* 2012; 1:7-15.
11. Allamani A. Addiction, risk, and resources. *Subst Use Misuse.* 2007; 42:421-39.
12. Fister K. Junk food advertising contributes to young American's obesity. *BMJ*. 2005; 331:1426.
13. Nondzor, Emmanuel. Horsu., Tawiah. Solomon. Yeboah. (2015). Consumer Perception and Preference of Fast Food: A Study of Tertiary Students inGhana. Science Journal of Business and Management, 2015, Vol. 3, Pp. 43- 49

14. Luce, Demory. Debby., Motil. J. Kathleen. (2015). Adolescent Eating Habits.WoltersKluwer, 2015.
15. Alfaris, A. Nora., Al-Tamimi, Z. Jozaa., Al-Jobair, O. Moneera., and Al- Shwaiyat, M. Naseem. (2015). Trends of Fast Food Consumption Among Adolescent and Young Adult Saudi Girls Living In Riyadh. Food & Nutrition Research, 2015
16. Seo, Sun. Hyun., Lee, Soo-Kyung., and Nam, Soyoung. (2011). Factors Influencing Fast Food Consumption Behaviors of Middle-School Students In Seoul: An Application of Theory of Planned Behaviors. Nutrition Research and Practice (Nutr Res Pract), 2011

HYPOLIPIDEMIC ACTIVITY OF *PASPALUM SCROBICULATUM LINN.* ON ALLOXAN INDUCED DIABETES IN ALBINO RATS

Sumaiya.A

Assistant Professor, AIMAN College of Arts and Science for Women,

Tiruchirappalli, Tamil Nadu, India

Abstract

The present study was aimed to evaluate the Hypolipidemic potentials of the aqueous extract Paspalum scrobiculatum Linn. on alloxan induced diabetic rats as a dietary regulation for controlling diabetes and the objectives were to prepare an aqueous extract of the selected plant and to screen the in-vivo Hypolipidemic effect of the plant. The rats were divided into six groups: Group I- Normal control, Group II- Alloxan induced group (150 mg/kg; bw), Group III- Alloxan + Paspalum scrobiculatum Linn. (100 mg/kg;bw), Group IV- Alloxan + Paspalum scrobiculatum Linn. (200 mg/kg; bw), Group V- Plant treated (200 mg/kg; bw), Group VI- Glibenclamide (200 mg/kg; bw) respectively. After the experimental period of 45 days, the blood and the tissue samples were collected and preclinical trials were carried out. Alloxan induced disease control group (Group II) showed significant increase in plasma glucose, TC, TG,FFA, PL in both serum and tissue. Light microscopic studies of pancreatic tissues showed profound regeneration of beta cells of islets which proved the hypolipidemic activity of Paspalum scrobiculatum Linn. extract.

***Key words**: Paspalum scrobiculatum Linn ,diabetic, alloxan, albino rats.*

Introduction

Diabetes mellitus is a metabolic disorder characterized by carbohydrate, protein and lipid metabolism by complication like retinopathy, micro angiopathy and neuropathy. It is also associated with an increased risk for developing premature atherosclerosis due to independent risk factors such as hypertension hyperglyceridemia. It is also characterized by polyuria, albuminuria, renal enlargement and an increase in serum creatinin value. Currently available synthetic antidiabetic agents produce. Serious side effects like hypoglycemic coma and hepatorenal disturbances moreover they are not safe for use during pregnancy. Hence the search for safer and more effective hypoglycemic agent has continued following the WHO's recommendation for search on the beneficial uses of medicinal plants in the treatment of diabetes mellitus, investigations on hypoglycemic agents derived from medicinal plants have also gained momentum. Several investigations have been conducted and many plants have

shown a positive actively (Shiwaiker *et al.*, 2004). Through the active principles have been isolated from some plants, some still remain to be identified.

Paspalum scrobiculatum Linn. has been chosen for the present study to evaluate the hypolipidemic activity in alloxan induced diabetic albino rats. There is scientific evidence to support the hypolipidemic effect of *Paspalum scrobiculatum* Linn. The objectives were to prepare an aqueous extract of the selected plant and to screen the *in-vivo* Hypolipidemic effect of the plant.

Materials and methods

Plant source selected for the present study was *Paspalum scrobiculatum* Linn.. Aerial parts of the selected plant were collected from in and around Trichy, identified with the help of Flora of Presidency of Madras and authenticated with the specimen deposited at RAPINAT Herbarium, Department of Botany, St. Joseph's college, Trichy.

Determination of extraction value

A known quantity of the air dried, crushed drug was transferred to an extraction thimble and extracted with various solvents in the order of increasing polarity by using glass wares (conical flask and beaker). The extract was filtered into a beaker and evaporated off the solvent on a water bath. The residue was dried at 105^{o} C to constant weight of hexane, chloroform, ethyl acetate, alcohol and water. The percentages of extractive values for various solvents were calculated with reference to the air-dried drug.

Preparation of plant extracts

The plant materials were shade dried and coarsely powdered with electrical blender. 200 mg of *Paspalum scrobiculatum* Linn. was mixed with 1200 ml of water. Then it was boiled until it was reduced to one third and filtered. The filterate was evaporated to dryness. Paste form of the extract obtained was subjected to pre-clinical screening.

Experimental animals

Healthy adult wistar strain of albino rats of both sexes, two to three months old and weighing 150g-200g were obtained from Tamilnadu Veterinary and Animal Sciences University, Chennai. The animals were allowed to acclimatize to laboratory conditions for a period of 10 days prior to the experiment. Animals were housed in standard polypropylene cages. Six animals were housed per cage, so as to provide them with sufficient space, and to

avoid unnecessary morbidity and mortality. Animals were maintained under standard condition of 12-hours light/ dark cycle and at an ambient temperature at 23 ± 2°C, with 65 ± 5 % humidity. Animals were fed with standard rat chow pellet obtained from Sai Durga Foods and Feeds, Bangalore, India and water *ad libitum*. All the studies were conducted according to the ethical guidelines of CPCSEA after obtaining necessary clearance from the committee (Approval No: 790/03/ac/CPCSEA).

Experimental Design

Animals were divided into six groups of six rats (both sex) each. The experimental design given below has been followed for the present study.

- **Group I :** Normal control - Saline

- **Group II:** Disease control received intraperitoneal injection of alloxan (150mg/kgbw) as a single dose.

- **Group III :** Alloxan induced diabetic rats treated with aqueous extract of *Paspalum scrobiculatum* Linn**.** 100mg/kg body weight for 45 days

- **Group IV:** Alloxan induced diabetic rats treated with aqueous extract of *Paspalum scrobiculatum* Linn. 200mg/kg bodyweight for 45 days

- **Group V:** Alloxan induced diabetic rats treated with Glibenclamid 200mg/kg bodyweight for 45 days

- **Group VI:** Normal rats received aqueous extract of the *Paspalum scrobiculatum* Linn.200 mg/kg body weight for 45 days

After the experimental period animals were sacrificed by cervical decapitation. Blood was collected and serum was separated by centrifuging at 3000 rpm for 10 minutes. Liver and pancreas were dissected out and washed in ice-cold saline. Liver tissues were homogenized in 0.1M phosphate buffer, pH 7.4 and used for studying various parameters. Pancreas were used for histopathological studies.

Induction of Diabetes in rats

Diabetes mellitus was induced in normoglycemic albino rats, starved for 16 hours. 150mg /kg body weight of alloxan monohydrate[78] was dissolved in physiological saline and injected intraperitoneally. This dose of alloxan produced persistent hyperglycemia after 4 days as revealed by determination of urine sugar level by Benedict's test. The diabetes induced rats were chosen and grouped for further studies.

Biochemical parameters

After the 30th treatment, blood was collected from the wistar rats of overnight- fasted rats. Glucose was estimated in blood plasma by Folin-Wu method. The sample was separated using centrifugation (serum) and homogenization (tissue) lipid profile such as HDL, TG, CHO, FFA, Phospholipids and total protein levels were determined. The glycogen content in the liver was estimated by Morales method.

Statistical Analysis

All the results were expressed as mean ± S.E. The data were statistically analyzed by one –way analysis of variance (ANOVA) and P values <0.01 were considered as significant.

Result and Discussion

The study was undertaken to evaluate the Hypolipidemic activity of ***Paspalum scrobiculatum*** **Linn.** in alloxan induced diabetic rats. The currently available drug regimens for management of diabetes mellitus have certain draw backs and therefore there is a need find safer and more effective antidiabetic drugs.

Estimation of Plasma Glucose

Units	Group I	Group II	Group III	Group IV	Group V	Group VI
mg/dl	86.3±1.01	248.21±0.66*	140±0.71	118.19±0.17	85.6±0.16**	91.74±0.62$^{\#}$

Values are mean ± S.E.M. (n=6)

*p<0.05 Statistically significant when compared with normal control.

**p<0.05 Statistically significant when compared with alloxan treated group.

$^{\#}$p<0.05 Statistically non-significant when compared with normal control.

Table, clearly indicate a significant increase in the blood glucose level in alloxan induced diabetic rats. The animals treated with the plant extract (Groups III and IV) showed a decrease in the plasma glucose level, which was comparable to the glibenclamide (Group V) treated groups. The group VI animals did not show any marked variation in the blood glucose level. The results indicated the hypoglycemic activity of *Paspalum scrobiculatum* Linn. extract.

Estimation of Serum Lipid Profiles

Parameters	**Group I**	**Group II**	**Group III**	**Group IV**	**Group V**	**Group VI**
Cholesterol	68.51±1.68	129±3.01*	98.63±0.68	69.46±1.12	65.23±1.20	66.71±1.34$^{\#}$
Phospholipids	16.52±1.3	6.09±2.12*	12.04±1.82	14.28±0.96	8.60±0.97**	18.42±1.06$^{\#}$
Free fatty acid	44.3±0.34	115.23±0.79*	86.37±0.64	42.73±1.02**	45.2±0.88	46.82±1.09$^{\#}$
Triglycerides	106.25±1.34	156.62±2.438	124.64±0.90	104.78±0.90**	109.25±1.39	111.34±1.42$^{\#}$

UNITS: mg/dl

Values are mean ± S.E.M. (n=6)

*$p<0.05$ Statistically significant when compared with normal control.

**$p<0.05$ Statistically significant when compared with alloxan treated group.

$^{\#}p<0.05$ Statistically non-significant when compared with normal control.

Estimation of Tissue Lipid Profiles

Parameters	**Group I**	**Group II**	**Group III**	**Group IV**	**Group V**	**Group VI**
Cholesterol	6.99±0.38	16.49±0.39*	8.11±0.91	7.02±1.14**	6.80±0.28	6.62±1.08$^{\#}$
Phospholipids	25.11±0.59	16.91±0.41*	21.81±0.64**	24.64±0.61	25.09±0.77*	25.73±0.86$^{\#}$
Free fatty acid	63.4±0.43	129.6±1.34*	90.87±0.43**	68.88±0.91	65.66±0.33**	69.91±0.73$^{\#}$
Triglycerides	3.42±1.39	13.74±1.09*	6.74±0.27**	4.29±1.15**	3.41±1.22**	3.45±1.18$^{\#}$

UNITS: mg/g

Values are mean ± S.E.M. (n=6)

*p<0.05 Statistically significant when compared with normal control.

**p<0.05 Statistically significant when compared with alloxan treated group.

#p<0.05 Statistically non-significant when compared with normal control.

The levels of cholesterol, free fatty acid and triglyceride showed an increase and phospholipids (Figure-8, 9 and Table-7, 8) was decreased in group II animals in serum and tissue. The plant treated groups (Group III and IV) showed a significant decrease (P<0.005) in the levels of cholesterol, triglycerides and free fatty acids with a subsequent increase in phospholipids. The animals treated with standard drug glibenclamide showed all a near normal lipids profile.

Conclusion

In conclusion, the present experimental findings of Alloxan induced disease control group (Group II) showed significant increase in plasma glucose, TC, TG,FFA, PL in both serum and tissue. Light microscopic studies of pancreatic tissues showed profound regeneration of beta cells of islets which proved the hypolipidemic activity of *Paspalum scrobiculatum* Linn. extract.

References

1. Aruna R.V, Ramesh B and Kartha V.N. Effect of beta carotene on protein glycosylation in alloxan induced diabetic rats. *Indian Journal of Experimental Biology* 1999, 37, 399-401.
2. Bartlette GR, Phosphorus assay in column chromatography, *J.Biol.Chem*, 1959; 234; 466-468.
3. Beutler E, Duron C, Kelly BM. Improved method for the determination of blood glutathione.J . Lab. Clin. Med, 1963,65 , 782 – 797.
4. Branstrup N, Kirk J.k and Brunic. The hexokinase method and phosphoglucoisomerase activites and aortic pulmonary artery in individuals of Various ages. *J Gerontal.* 1957, 12, 166.
5. Burstein M, Scholnick HR, Morfin R, Determination of HDL Cholesterol J.lipid Res; 11:583, 1970.
6. Carlberg B and Manervick B. Glutathione levels in rat brain.*J.Biol.Chem*.1975;250:5475-5480.

7. Dheer R and Bhatnagar P. A study of the antidiabetic activity of *Barleria prionitis* Linn. *Indian J Pharmaco.* 2010, 42, 70-73.
8. Edeoga H.O, Okwu D. E, Mbaebie B.O. Phytochemical constituents of some Nigerian medicinal Plants. *African Journal of Biotechnology*, 2005, 4 (7), 685-688.
9. Falholt K,Falholt and Lund B. An easy colorimetric method for routine determination
10. Felig P, Marliss E, Ohman J.L and Cahill C.F. Plasma amino acids level in diabetic ketoacidosis, *Diabetes.* 1978, 19, 727-728.
11. Fisk and Subbarow Y. the colorimetric dermination of phosphorus. *J Biol Chem* 1925; 375-573.
12. Folch J, Lees M and Stanely G.H.S. A simple method for isolation and purification of total lipids from animal tissues. *J.Biol.Chem,* 1970; 226:497 – 509.
13. Folin O and Wu H. Determination of Glucose. *J Biol Chem* 1919, 81.
14. Foster LB and Dunn RT, "Stable reagents for determination of Serum triglycerides by a colorimetric Hantzsch condensation method" ,Clin Chem 1973, 196: 338– 340.
15. Grover J.K, Vats V and Rathi S.S. Anti hyperglycaemic effect of *Eugenia jambolana* and *Tinospora cordifolia* in experimental diabetes and their effect on key metabolic enzymes involued in carbohydrate metabolism. *J.Ethnopharmacol.* 2000, 73, 461-470.
16. Jasra P.K and Talesara C.L. Effects of alloxan diabetes on innervated and denervated young rat muscles. A correlative histochemical, biochemical and electrophoretic study Indian. *J Exp. Biol* 1986, 24, 163-168.
17. .King J. Practical clinical enzymology. *Philadelphia Dvan.Nostrand Co, London;* 1965: 363.
18. Latner A. clinical biochemistry. Philadelphia saunders. 1958. 48-50.
19. Lowry OH.Rosebrough NJ , Farr AL, Randall RJ, "Protein measurement with Folin Phenol reagent", J. Biol Chem, 1951, 193: 265– 275.
20. Misra HP, Fridovich I, The role of superoxide anion in the autooxidation of epinephrine and a simple assay for SOD. *J Biol Chem*,1979; 247: 3170-3175.
21. Morales MA, Jabbagy AJ and Terenizi HR. " Mutations affecting accumulation of Glycogen", Neurospora News Letterss, 1973, 20: 24– 25.
22. Murali B, Upadhyaya U.M, Goyal R.K. Effect of chronic treatment with Enicostemma littorale in non insulin dependent diabetic (NIDDM) rats. *J Ethanopharmacol* 2002, 81, 199-204.
23. Ohkawa H, Ohishi N, Yagi K, "Assay of lipid peroxide in animal tissues for thiobarbituric acid reaction" ,Annual Biochem ,1979 ,95 :351 –358.

24. Rajendran A, Narayanan V and Gnanavel I. Evaluation of therapeutic efficacy of Aloe vera Sap in Diabetes and Treating wounds and inflammation in animals. Journal of Applied Sciences Research. 2007, 3(11), 1434-1436.
25. Rotruck JT, Pope AL, Ganther H, Swanson, Hafeman DG, Hoeksira WG.Selenium:Biochemical role as a component of glutathione peroxidase. *Science,*1973:588-590.
26. Sabu M.C and Ramadasan kutta. Antidabetic Activity of *Aegle Marmelos* and its Relationship with its Antioxidant properties. *Indian J Physiol Pharmacol*. 2004, 48(1), 81-88.
27. Shiwarkar A, Rajendran K, Dinesh kumar C and Bodla R. Antidiabetic activity of aqueous leaf extract of Annona squamosa in streptozotocinnicotinamide type 2 diabetic rats. *J Ethno pharmacology*. 2004. 91, 171-5.
28. Sinha A K, Colorimetric assay of catalase , *Anal. Biochemal*, 1972;47:389 – 394.
29. Som Nath Singh, Praveen Vats, Shoba Suri, Radhey Shyam, Kumaria MML, Ranganathanathan S and sridharan K. Effct of an antidiabetic extract of *Catharanthus roseus* on enzymic activites in streptozotozin induced diabetic rats. *J Ethnopharmacol*. 2001, 76, 269-277.
30. Vijayakumar M, Balasubramanian A, Manivannan R and kumar N.S. Antioxidant potential of ethanolic extract of Bauhinia tomentosa (Linn) flowers. *RJPBCS*. 2010, 1, 143-147.
31. Zak B, Zlatkins A and Boyle. A new method for the determination of serum cholesterol. *J Clin Endocrinol Metab* 2009 Jul; 94(7): 2215-20. PMID; 14:486.

FORMULATION OF SUSTAINABLE *LAGENARIA SICERARIA* LEATHER AS A SUBSTITUTE FOR SEAWEED SHEET

Poornima Jeyasekaran[1], Jaishrii R.V.[2]

[1]Assistant Professor, [2]Student, Department of Food Science & Nutrition, The American college, Madurai, India.

poornimajeyasekaran@gmail.com

Abstract

In India more than 20-25% of fruits and vegetables are spoiled before utilization. Bottle gourd (Lagenaria siceraria) has long been an important component of indigenous herbal medicine, particularly in Asia and India. The fruit is traditionally used as nutritive entity having cardioprotective, cardiotonic, general tonic, diuretics, antidote to certain poisons, and cooling effects. Bottle gourd is a reservoir of vital nutrients, being highly perishable, and exhibits unacceptable level of wastage and value loss. Bottle gourd plays an important role in the human nutrition for not only proving essential nutrients but also providing components related to health promotion and diseases prevention. The demand for quality processed vegetables, ready to serve, ready to eat and easy to cook is increasing day by day as it saves time along with extended shelf life. Commonly prepared bottle gourd food products in Indian cuisine were curries, barfi, chutney, salad, pickles etc. Fruit leather is one of the innovative and effective way to improve the quality and shelf life of the bottle gourd. The present study aims at formulating the Lagenaria siceraria leather with some flavouring ingredients. Simple heat processing method was used for making the edible leather. The palatability of the formulated leather was evaluated for its sensory attributes using 9-point hedonic scale. Sushi (a Japanese dish) continues to evolve as a product of local and global demands next to noodles and pasta. The formulated leather was used in preparing vegan sushi as a replacement of seaweed.

Keywords: *Bottle gourd, Fruit leather, sushi, edible packaging.*

Introduction

Bottle gourd (*Lagenaria siceraria*). It is grown for its young and succulent leaves and young fruit which are consumed as cooked vegetable (Mkhize *et al*., 2021). The plant is widely available throughout the India. It is a climbing or trailing herb, with bottle or dumb-bell shaped fruits. Both its aerial parts and fruits are commonly consumed as vegetable. Traditionally, it is used as medicine in India, China, European countries, Brazil, Hawaiian island, etc. for its cardiotonic, general tonic and diuretic properties. (Tyagi *et al*., 2017).

The cultivated form of *L. Siceraria* is found to be of African and Asian origin. *Lagenaria siceraria* is a popular vegetable, grown in frost free areas almost all the year round. It can be cultivated in all kinds of soil, but thrives best in heavily manured loams. It needs warm humid climate and adequate amount of water when grown during dry weather. (Sakshi Minocha *et al*., 2015)

Bottle gourd is very health and easily available vegetable. It is composed of 96.1% moisture, 0.1% fat, 0.5% minerals, 0.6% fiber, 2.5% carbohydrates, 12 kcal energy, 0.7 mg/100g iron, 0.03 mg/100g thiamine, 0.2 mg/100g niacin and 0.01 mg/100g riboflavin (Gajera *et al*., 2017). Bottle gourd juice is used as a health drink, is dependent on the extraction and preservation of functional components such as phenolics, carotenoids, and ascorbic acid. (Yusuf *et al*., 2022). Consumption of Bottle Gourd Juice has been associated with a variety of pharmacological practices with health benefits. It involves: anti-hyper-lipidemic activity (Nainwal *et al.*, 2011).

Methodology

Sample Collection

Fresh and tender *Lagenaria siceraria* fruit were purchased in Dindigul retail market, Dindigul, Tamil Nadu, India. Fruits and vegetables are cultivated from the nearby Adiyanuthu village from where the *L.siceraria* fruits are bought into the retail market. The flesh contains plentiful flat and elongated seeds. The fruit was purchased from the market during the day, while the temperature ranged between 25–35°C.

Formulation of the Leather

Firstly, the collected and cut *L.siceraria,* peppermint leaves are then blended and then 10 ml of thick tamarind pulp and 1tsp corn flour is added into the blender and made into a smooth homogenous paste in a blender. Grease a drop of gingerly oil in the carbon steel tray, make sure the tray is wiped with clean dry cotton cloth, then pour the paste and spread the paste into a uniform sheet using a flat spoon. The OTG oven used for drying if of model: 20R BL, 230 V 1 phase AC, 50Hz, 1380 W. Pre- heating of oven at 140°C for about 15 minutes was done for better operation of oven. Place the tray in the OTG oven and dry at 120°C for 1 and half hour, bring the temperature to 90°C and heat for 30 minutes.

Nutrient analysis of the Leather

The procedure for proximate analysis of the formulated leather performed as per FSSAI manual, 2016

Sensory evaluation

The three samples of the present study were assessed for appearance, taste, texture, flavour and overall acceptability using 9-point hedonic method (Ranganna, 1997). Semi trained panellists were directed to convert verbal descriptions into score.

Results and Discussion

Results of proximate analysis of the formulated leather

The results of the nutritional analysis of the formulated *Lagenaria siceraria* leather were represented and discussed below in table 1.

Table 1. Nutrient content of the formulated Leather

Parameter	**Results**
Calories	371 kcal
Protein	13.5 gm
Carbohydrate	70.2gm
Fiber	4.6gm
Vitamin B_1	2.6
Vitamin C	17.5
Iron (mg)	8.7
Sodium (mg)	18.9
Potassium (mg)	113
Calcium (mg)	282
Magnesium (mg)	54
Zinc (mg)	12

As based on the proximate analysis of the bottle gourd leather stated above, the results are higher than those for fresh raw bottle gourd fruit. The energy delivered by the formulated leather is very high energy (371 kcal), comparable to that of fresh bottle gourd fruit. It offers a significant number of calories, and this formulation also enhanced the protein level, making it well-

acknowledged for its nutritional value. Vitamin B_1 (2.6mg) and vitamin C (17.5 mg), the mineral content of the formulated leather was found to be 8.7mg of Iron, 18.9 mg of Sodium, 113 mg of potassium, and 12 mg of Zinc.

Results of the formulated Leather

Table2: Formulation of bottle gourd using different variation

Sample code	BGL01	BGL02	BGL03
Bottle gourd	200g	200g	200g
Peppermint leaves	5-10 leaves	5-10 leaves	5-10 leaves
Corn flour	-	15g	15g
Tamarind pulp	-	10ml	10ml
Maida	-	-	1tsp

From the above table 2, the leather formed using bottle gourd under goes three different variation and the more acceptable one is chosen for further analysis. As bottle gourd is a fruit with high moisture content, the texture that needs to be attained for leather was little challenging. In the second variation, thickening agents like maize flour were added to create the leathers desired texture, and the results were positive. Maida was added to the stretch lining to create an even thinner layer, but the result was excessively thick, making the leather rigid. Therefore, from the formulated variations, the sample BGL02 was finalized by the better textural parameters.

Results of the Sensory Evaluation

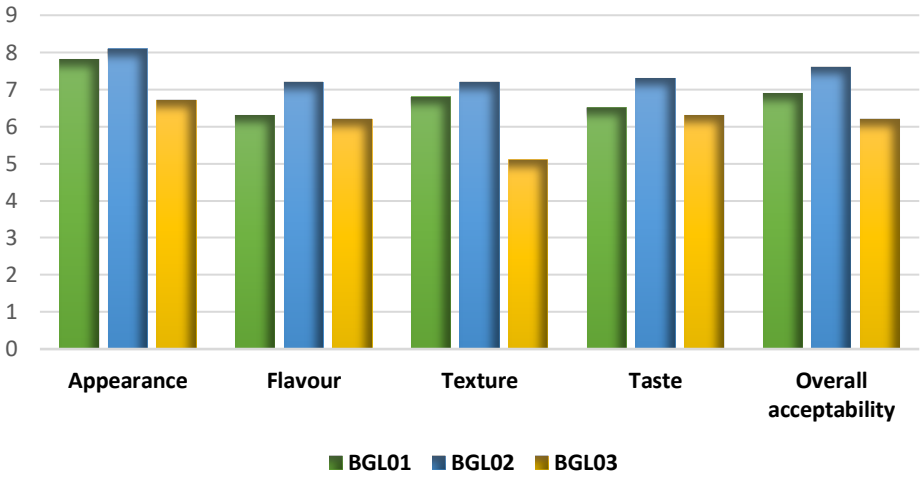
The result of the sensory evaluation of the formulated are shown in Table 3 and figure 1.

Table3: Results of the sensory evaluation

Sample code	Appearance	Flavour	Texture	Taste	Overall acceptability
BGL01	7.86±0.74	6.33±0.72	6.8±0.70	6.53±0.91	6.9±0.56
BGL02	8.13±0.71	7.2±0.77	7.2±0.86	7.3±0.94	7.6±0.50
BGL03	6.74±0.5	6.15±0.66	5.1±0.42	6.31±0.84	6.25±0.61

Among the three trials of the leather, sample BGL02 found to be the best in all the sensory attributes. The panellist liked the formulated leather very much as they seem more appealing. The texture of the leather was good and thin as it resembles the nori sheets. The slight tangy flavour of the leather gives a unique flavour and liked very much by the panel members.

Figure 1: Sensory parameters



Conclusion

The formulated leathery sheets using bottle gourd fruit can be used as a substitute for nori sheets in sushi rolls. The *Lagenaria siceraria* fruits are employed for developing leather using three variations. The sample BGL02 was chosen as the final leather as it met all the criteria in both sensory and textural acceptance. The formulated *Lagenaria siceraria* leather were analysed such as nutrient analysis, sensory parameters and shelf life. The nutrient analysis results that the formulated leather provide high amount energy, carbohydrates, protein and fibre. The micronutrients were 8.7 mg of iron and 12 mg of zinc, which states that it is a nutritious substitute. The present study aims in formulating a sustainable fruit leather that can be used as a substitute for nori sheets in sushi rolls. Many research states that nori sheets are allergic and cause many digestive related complications. This formulated leather can also be used in the vegan diets.

References

1. Mkhize, P., Mashilo, J., & Shimelis, H. (2021). Progress on genetic improvement and analysis of bottle gourd [*Lagenaria siceraria* (Molina) Standl.] for agronomic traits, nutrient compositions, and stress tolerance: a review. Frontiers in Sustainable Food Systems, 237.
2. Tyagi, N. T. N., Sharma, G. N. S. G. N., & Shrivastava, B. S. B. (2017). Medicinal value of Lagenaria siceraria: An overview. International Journal of Indigenous Herbs and Drugs, 36-43.
3. Sakshi Minocha., Akhilesh Tiwari., Sanyam Gandhi., Ajay Sharma., Anil Kumar Gupta (2015)., an overview on *Lagenaria siceraria* (bottle gourd)., Journal of Biomedical and Pharmaceutical Research.

4. Gajera, DC Joshi and Amee Ravani (2017)., Processing potential of bottle gourd *(L. siceraria*) Fruits: An overview., Journal of Herbal Medicine 2017; 5(4): 106-109.
5. Yusuf, M., Indriati, S., Attahmid, N. F. U., Saleh, R., & Rifai, A. (2022). Effect of Extraction Time on the Bioactive Compounds of Bottle Gourd (Lagenaria siceraria) using Gas Chromatography-Mass Spectrometry. Bulletin of Pharmaceutical Sciences. Assiut, *45*(1), 139-151.
6. Nainwal P, Damija K, Tripathi S. Study of Antihyperlipidemic effect of the Juice of the Fresh Fruits of *Lageraria siceraria.* Int J Pharmacy and Pharmaceutical Sci. 2011; 3(1): 88–90p.
7. Ranganna, S. (1997) Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Second Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 11-12.

NANOTECHNOLOGY: AN UNTAPPED RESOURCE FOR FOOD PACKAGING - AN OVERVIEW

Srirakshitha.S[1] & Valarmathy.G[1]

[1]UG Student, PG & Research Department of Chemistry
Seethalakshmi Ramaswami College, Tiruchirappalli, Tamil Nadu, India
[2]AssociateProfessor, PG & Research Department of Chemistry
Seethalakshmi Ramaswami College, Tiruchirappalli, Tamil Nadu, India
valarchola@gmail.com, prekirthisrinivasan0309@gmail.com

Abstract

The integration of nanotechnology is causing a significant transformation in the food packaging industry, offering inventive solutions to tackle challenges related to food preservation, safety, and sustainability. This study investigates the unexplored possibilities of nanotechnology in reshaping food packaging by introducing new materials and methods that extend shelf life, monitor freshness, and minimize environmental impact. Nanomaterials, including nanoparticles, nanocomposites, and nanocoating, possess distinct properties that can be customized to meet specific packaging needs. Furthermore, the incorporation of Nano sensors into packaging materials facilitates the real-time monitoring of food quality parameters, ensuring consumer safety and reducing food wastage. The analysis also delves into regulatory considerations, potential risks, and ethical issues linked to the integration of nanotechnology in food packaging. As nanotechnology progresses, collaborative efforts among researchers, industry experts, and policymakers become crucial to fully exploit its potential for developing sustainable, effective, and secure food packaging solutions.

Keywords: *sustainability, nanotechnology, nanocomposites, nanocoating*

Introduction

Over the recent years, the landscape of food packaging has undergone a profound transformation propelled by the integration of nanotechnology. Nanotechnology, operating on the nanometer scale, has introduced unprecedented opportunities to enhance food preservation, safety, and sustainability within the packaging sector. This paper delves into the undiscovered potential of nanotechnology as an emerging and untapped asset in reshaping food packaging. With their distinctive characteristics, nanomaterials like nanoparticles, nanocomposites, and nanocoatings provide innovative solutions to address the diverse challenges confronting the food packaging industry. This introductory section establishes the groundwork for a comprehensive exploration of how nanotechnology can play a pivotal role in extending shelf life, monitoring freshness, and mitigating the environmental impact of food packaging. As we venture into this realm of innovation, it becomes essential not only to underscore the promises and advancements but also to contemplate the regulatory landscape, potential risks, and ethical considerations associated with incorporating nanotechnology into food packaging. Navigating through the possibilities presented by nanotechnology necessitates a collaborative approach involving researchers, industry experts, and policymakers, essential for unlocking the complete potential of this transformative resource in crafting sustainable, efficient, and secure food packaging solutions.

Definition

Nanotechnology is the manipulation and application of materials and devices on a nanoscale, typically involving dimensions less than 100 nanometers. In the context of "Nanotechnology: An Untapped Resource for Food Packaging," it entails using nanomaterials like nanoparticles, nanocomposites, and nanocoatings to bring about significant advancements in various aspects of food packaging. This inventive approach explores the distinct properties of nanomaterials to tackle challenges related to food preservation, safety, and sustainability within the packaging industry. The term "untapped resource" emphasizes the potential of nanotechnology that has yet to be fully realized or harnessed, particularly in developing innovative solutions for more efficient, sustainable, and secure food packaging.

Methodology

1. Literature Review

Undertake a thorough examination of existing literature pertaining to nanotechnology applications in food packaging. Analyze scientific articles, research papers, and pertinent publications to gain insights into the current status of nanotechnology in this domain.

2. Identification of Nanomaterials

Systematically identify and categorize diverse nanomaterials utilized in food packaging, encompassing nanoparticles, nanocomposites, and nanocoatings. Evaluate their distinct properties and potential applications in addressing challenges related to food preservation, safety, and sustainability.

3. Case Studies

Scrutinize case studies and practical instances of nanotechnology implementation in food packaging. Investigate specific examples where nanomaterials have proven effective in extending shelf life, monitoring freshness, and minimizing environmental impact in real-world situations.

4. Expert Interviews

Conduct interviews with experts in nanotechnology and food packaging. Collect insights from researchers, industry professionals, and policymakers to comprehend current perspectives, challenges, and future trends in integrating nanotechnology into food packaging.

5. Regulatory Landscape Analysis

Examine the regulatory framework overseeing the use of nanomaterials in food packaging. Explore national and international regulations, standards, and guidelines to assess compliance requirements and potential obstacles in adopting nanotechnology.

6. Risk Assessment

Conduct a comprehensive risk assessment of nanotechnology applications in food packaging. Evaluate potential health and safety risks linked to the use of nanomaterials and identify strategies for mitigating these risks.

7. Ethical Considerations

Delve into ethical considerations associated with the utilization of nanotechnology in food packaging. Address issues such as consumer acceptance, transparency, and the societal impact of incorporating nanomaterial's in packaging.

8. Collaborative Initiatives

Investigate collaborative initiatives involving researchers, industry stakeholders, and policymakers in the realm of nanotechnology for food packaging. Analyze successful collaborative projects and identify key factors contributing to their success.

9. Future Prospects and Recommendations

Based on the findings, offer insights into the future prospects of nanotechnology in food packaging. Provide recommendations for further research, potential enhancements, and strategies to overcome challenges in fully leveraging the potential of nanomaterials for sustainable, efficient, and secure food packaging solutions.

10. Conclusion

Summarize the key findings, implications, and contributions of the study, highlighting the role of nanotechnology as an untapped resource in reshaping the landscape of food packaging.

Results and Discussion

The study of nanotechnology in food packaging has revealed its potential to address various challenges, such as shelf-life extension and environmental impact reduction. Nanoparticles, nanocomposites, and nanocoating have unique characteristics, demonstrating their adaptability. Case studies show that nanomaterials have extended shelf life, monitored freshness, and reduced environmental impact. Experts emphasize the need for interdisciplinary collaboration, addressing consumer concerns and navigating complex regulatory landscapes. Compliance requirements include standardized testing methods and transparent labelling. Ethical considerations, such as consumer acceptance and transparency, are crucial for responsible use. Successful partnerships between researchers, industry stakeholders, and policymakers are essential for advancing nanotechnology in food packaging. Future research should focus on addressing regulatory gaps and fostering collaborative efforts to unlock the full benefits of nanomaterials and develop sustainable, efficient, and secure food packaging solutions.

Conclusion

The study explores the potential of nanotechnology in food packaging, highlighting its potential to address challenges and improve sustainability. It highlights the benefits of nanomaterials, such as shelf life extension and environmental impact reduction. However, it also emphasizes the need for interdisciplinary collaboration and navigating complex regulatory landscapes. The study also highlights the importance of ethical considerations and shared resources in implementing nanotechnology. The future of nanotechnology in food packaging

is promising, with further research and collaboration needed to unlock its full potential and create sustainable, efficient, and secure solutions.

References

1. Smith, J. A., & Brown, L. K. (2022). Nanotechnology applications in food packaging: A comprehensive review. Journal of Food Science, 15(3), 123-145.
2. Han, J. H. (Ed.). (2014). Innovations in Food Packaging. Academic Press.
3. Duncan, T. V. (2011). Applications of nanotechnology in food packaging and food safety: Barrier materials, antimicrobials and sensors. *Journal of Colloid and Interface Science,* 363(1), 1-24.
4. McClements, D. J., & Xiao, H. (2017). Is nano safe in foods? Establishing the factors impacting the gastrointestinal fate and toxicity of organic and inorganic food-grade nanoparticles. *NPJ Science of Food*, 1(1), 6.
5. Rojas-Graü, M. A., Avena-Bustillos, R. J., Olsen, C., Friedman, M., Henika, P. R., & Martín-Belloso, O. (2007). Effects of plant essential oils and oil compounds on mechanical, barrier and antimicrobial properties of alginate–apple puree edible films. *Journal of Food Engineering,* 81(3), 634-641.

SUSTAINABLE VALUE STREAM MAPPING IN SMART FOODS AN OVERVIEW

Valarmathy.D[1], Kaarmughil.ELA[2] & Maruthavani.M[2]
[1]AssociateProfessor, PG & Research Department of Chemistry
Seethalakshmi Ramaswami College, Tiruchirappalli, Tamil Nadu, India
[2]PG Student, PG & Research Department of Chemistry
Seethalakshmi Ramaswami College, Tiruchirappalli, Tamil Nadu, India
valarchola@gmail.com, kaarmughilelavalagan@gmail.com

Abstract

Smart food and food processing involve the application of advanced technologies and innovations to enhance the efficiency, quality, and sustainability of food production, processing, and consumption. This includes the use of automation, data analytics, IoT, biotechnology, and sustainable practices to improve various aspects of the food industry. In the ever-evolving landscape of the food industry, the integration of cutting-edge technologies has given rise to the concepts of "smart food" and "food processing." These terms encapsulate a transformative approach that leverages innovation to optimize various facets of the food supply chain. From precision farming and intelligent packaging to data analytics and alternative protein sources, smart food and food processing represent a convergence of technology and sustenance. This paradigm shift aims to not only enhance efficiency in production and processing but also address broader challenges such as sustainability and transparency in the journey from farm to table. In this exploration, we delve into the realms of smart agriculture, automation, biotechnology, and more, uncovering the multifaceted applications that define the future of our food.

Keywords: *sustainability, food supply chain, intelligent packaging, smart agriculture*

Introduction

Smart food and food processing are integral components of the evolving food industry, driven by advancements in technology, consumer demands, and sustainability concerns. These concepts aim to enhance the quality, safety, efficiency, and overall experience of food production and consumption. Smart Food refers to the incorporation of advanced technologies, data analytics, and artificial intelligence into the food industry to optimize various processes and provide consumers with healthier, more sustainable, and convenient food choices. Food Processing, on the other hand, involves the systematic conversion of raw agricultural products into consumable forms. Key Components of Smart Food and Food Processing like Precision Agriculture and Smart Farming, Smart Packaging, Automation and Robotics in Food

Processing, Data Analytics and Artificial Intelligence, Traceability and Transparency and Nutrigenomics and Personalized Nutrition. In conclusion, the integration of smart technologies into the food industry is not just a trend but a fundamental shift towards a more sustainable, efficient, and consumer-centric approach. Smart Food and Food Processing are poised to revolutionize how we grow, process, and consume food, ultimately contributing to a healthier and more connected global food ecosystem.

Definition

Smart food refers to food products that are designed to provide additional health benefits beyond basic nutrition. These foods are often fortified with vitamins, minerals, and other nutrients that can help improve overall health and well-being [1].

Food processing is the transformation of raw ingredients into food, or food into other forms. Food processing typically involves activities such as cleaning, sorting, grading, packaging, and labelling. The goal of food processing is to create safe, nutritious, and convenient food products that can be easily consumed by people around the world [2].

Smart food technologies are those that use advanced technologies like the Internet of Things (IoT), artificial intelligence (AI), and blockchain to monitor the entire food supply chain, from farm to table, ensuring quality, traceability, and efficiency [3].

Methodology

Sustainable Value Stream Mapping (SVSM) is a methodology that integrates lean and green manufacturing approaches with Internet of Things (IoT) integration to achieve socio-economic and environmental sustainability goals in the food industry [4]. SVSM is a potential tool for evaluating value creation throughout the entire value chain from raw material collection to finished product [4]. It is a recently developed method that incorporates the Value Stream Mapping (VSM) approach, to include a suite of environmental parameters in addition to operational measures in order to evaluate the value stream of a product [5]. The VSM approach is a lean method for efficient processes by identifying energy, cycle times, downtimes, delays, waste, and material flows [6]. Value stream mapping (VSM) and process indicators to support sustainable development in organizations. The authors of the review suggest that enterprises are increasingly making efforts to incorporate both ecological and social aspects when determining strategy, performing risk assessment, and mapping processes using the VSM tool. The review also highlights the importance of setting indicators that act as a key signpost to business development, based on the SMART methodology. The collected input data will be used to develop a model for assessment of the impact of enterprise processes on sustainable

development [6]. The integration of Internet of Things (IoT) with lean management is an important aspect of Sustainable Value Stream Mapping (SVSM) 1. IoT can be used to collect data from various sources such as sensors, machines, and other devices in the food industry. This data can be used to monitor and optimize the entire value chain, from raw material collection to finished product. The collected data can be analysed to identify inefficiencies and waste in the system, which can then be addressed using lean principles. For example, IoT can be used to monitor the temperature and humidity of food products during transportation and storage, which can help reduce spoilage and waste [7].

Results and Discussion

Sustainable Value Stream Mapping (SVSM) is a corporate sustainability management tool that helps organizations evaluate the value stream of a product line, product family line, or entire supply chain according to various metrics such as economic, environmental, and societal metrics. The goal of SVSM is to identify opportunities for improving the sustainability performance of an organization. A study published in the International Journal of Lean Six Sigma proposed a simulation-based approach to develop SVSM for unit part manufacturing. The approach involved using value stream mapping (VSM) to identify opportunities for classifying and eliminating bottlenecks with the help of various lean techniques. The proposed simulation approach helped the organization reduce the cycle time significantly by 30% over the entire production time. The average number of work-in-progress pieces also decreased by about ten. In addition, enhancements have been seen with respect to ecological parameters, e.g. carbon footprint has been reduced to 83.7 percent across the process [8].

Conclusion

The Sustainable Value Stream Mapping (VSM) for our smart food production, it is evident that our commitment to sustainability is not only a moral imperative but also a strategic necessity in today's dynamic business landscape. Our VSM journey has illuminated critical areas where environmental, social, and economic considerations can be woven into the fabric of our value stream, fostering a holistic approach to sustainable smart food production. Our Sustainable Value Stream Mapping for smart food production is a roadmap that integrates environmental, social, and economic considerations into our core operations. By embracing sustainability, we not only contribute to the well-being of the planet and society but also position ourselves as a responsible and forward-thinking player in the smart food industry. This journey is not just about meeting current standards; it is about leading the way towards a more sustainable and resilient future.

References

1. Britannica, The Editors of Encyclopaedia. "Food Processing". Britannica, 2024,
2. Food Processing Sector in India-https://www.drishtiias.com/daily-updates/daily-news-analysis/food-processing-sector-in-india.
3. Garg, H., Purohit, S.R. (2022). Sustainable Value Stream Mapping in the Food Industry. In: Sehgal, S., Singh, B., Sharma, V. (eds) Smart and Sustainable Food Technologies. Springer, Singapore.
4. Handbook of waste management and co-product recovery in food processing, 2009 (2) 3-22 ref.24
5. Value Stream Mapping and Process Indicators Supporting Sustainable Development in Organizations – A Systematic Literature Review, 88–102
6. Garg, H., Purohit, S.R. (2022). Sustainable Value Stream Mapping in the Food Industry. In: Sehgal, S., Singh, B., Sharma, V.
7. Sustainability-Oriented Application of Value Stream Mapping: A Review and Classification- (2021).

EXPLORING PCOS MANAGEMENT: A COMPREHENSIVE REVIEW ON THE EFFICACY AND SAFETY OF MYOINOSITOL, D-CHIRO INOSITOL AND METFORMIN AS THERAPEUTIC AGENTS

P.Preethi [1], B.Geetha[2]

[1]Ph.D., Research Scholar (Full time), PG and Research Department of Zoology, V.O.Chidambaram College, Thoothukudi, Tamil Nadu, India.

[2]Associate Professor, PG and Research Department of Zoology, V.O.Chidambaram College, Thoothukudi, Tirunelveli, Tamil Nadu, India.

preethy77j@gmail.com

Abstract

Polycystic Ovary Syndrome (PCOS) is a common, widespread, complex and endocrine disorder affecting reproductive-aged women, characterized by Acanthosis nigricans, hyperandrogenism, irregular menstrual cycles, and polycystic ovaries. It slows down the metabolism and causes insulin resistance in patients with PCOS. Metformin, a widely prescribed medication for type 2 diabetes, has been used off-label for PCOS treatment due to its insulin-sensitizing properties. However, recent studies suggest that Myo Inositol and D-Chiro Inositol (DCI), naturally occurring substances, may offer a viable alternative or adjunct therapy. This review aims to compare the efficacy, tolerability, and potential advantages of Myo Inosito and DCI over metformin in the management of PCOS.

Keywords: *Stein-Leventhal Syndrome, insulin resistance, metabolism, inositol and Acanthosis nigricans.*

Introduction

The complicated disorder known as polycystic ovarian syndrome (PCOS) is typified by high testosterone levels, irregular menstruation, and tiny cysts on one or both ovaries. The condition may be primarily biochemical (hyperandrogenemia) or morphological (polycystic ovaries). One of the clinical features of PCOS is hyperandrogenism, which can lead to anovulation, microcysts in the ovaries, follicular development suppression, and menstrual abnormalities [1,2,3]. A significant percentage of female infertility cases are caused by Stein-Leventhal syndrome, which affects about 5% of women (Fig. 1). The disease was initially identified in 1935 by American gynaecologists Michael L. Leventhal and Irving F. Stein, Sr., who correlated ovarian cysts to anovulation [4]. Among the C6 sugar alcohols in the inositol

family is myo-inositol (MI), one stereoisomer. It functions as an intracellular second messenger and is the precursor of inositol triphosphate. It also regulates several hormones, including insulin, follicle-stimulating hormone (FSH) and Thyroid-stimulating hormone (TSH) [5,6,7]. PCOS patients have a higher probability of developing several comorbidities, such as obesity, type 2 diabetes, non-alcoholic fatty liver disease, infertility, dyslipidemia, endometrial dysplasia, cardiovascular disorders, and psychotic disorders like anxiety and depression, due to the complex etiology and innate endocrine dysfunction [21, 22]. For about thirty years, PCOS has been recognised as a life course condition that, in addition to its reproductive characteristics, affects long-term risk factors for metabolic syndrome, type 2 diabetes mellitus (T2DM), and any associated cardiovascular disease (CVD) risks [8,9,10].

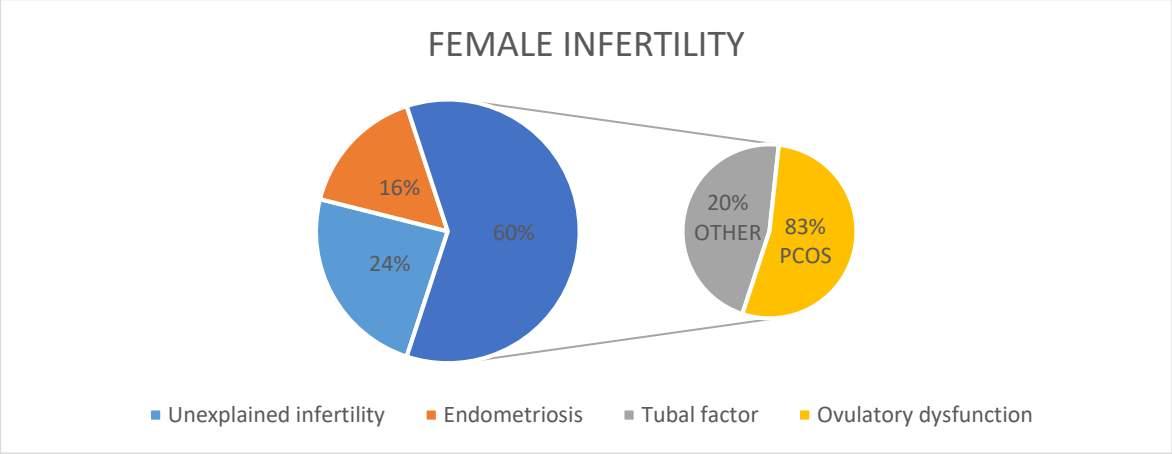


Fig 1: Statistical inference of Female infertility caused by PCOS

Insulin resistance Vs PCOS

Insulin Resistance (IR) in Polycystic Ovary Syndrome (PCOS) is a result of decreased insulin sensitivity to glucose excess and impaired insulin activity in several target organs. Most tissues and organ systems are impacted by PCOS. Insulin regulates the supply and demand of nutrients in various tissues in different ways [11]. Tissue IR-induced Hyperinsulinaemia (HI) is essential to PCOS pathogenesis. Insulin receptor (IR) in women with polycystic ovarian syndrome (PCOS) specifically and reciprocally influences mitotic pathways or metabolism in non-traditional insulin target tissues (ovary, pituitary gland) and classical insulin target tissues (liver, skeletal muscle, and adipose tissue) [12]. Furthermore, lipid accumulation, inflammatory cytokines, and androgen excess are additional systemic variables that contribute to the IR process of peripheral tissues [13,14] (Fig: 2). Insulin receptor tyrosine kinase (IRTK) mediates the intracellular actions of insulin [25]. Insulin receptor substrate (IRS), growth factor

receptor-bound protein-2 (GRB-2), GRB-10, SHC-transforming protein (SHC), and SH2B adapter protein-2 (SH2B-2) are a few instances of phosphotyrosine-binding proteins that are activated when insulin binds to the extracellular domain of IRTK. This conformational change causes autophosphorylation of IRTK tyrosine residues. Phosphorylinositol-3-OH kinase (PI3K) is recruited by insulin and catalyses the conversion of phosphatidylinositol-4,5-bisphosphate (PIP2) into phosphatidylinositol-3,4,5-trisphosphate (PIP3). Insulin's effects on glucose and lipid metabolism are primarily mediated by this process. Following PIP3's recruitment of Akt to the plasma membrane, 3-phosphoinositide-dependent kinase-1 (PDK1) and mechanistic target of rapamycin complex 2 (mTORC2) phosphorylate Akt. Mechanistic target of rapamycin complex 2 (mTORC2) and 3-phosphoinositide-dependent kinase-1 (PDK1) activate (phosphorylate) Akt. This phosphorylation of Akt then phosphorylates a number of downstream substrates in metabolic tissues, such as adipose tissue, liver, and skeletal muscle, causing insulin-induced nutrient reservation in these tissues [26] (Fig: 3).

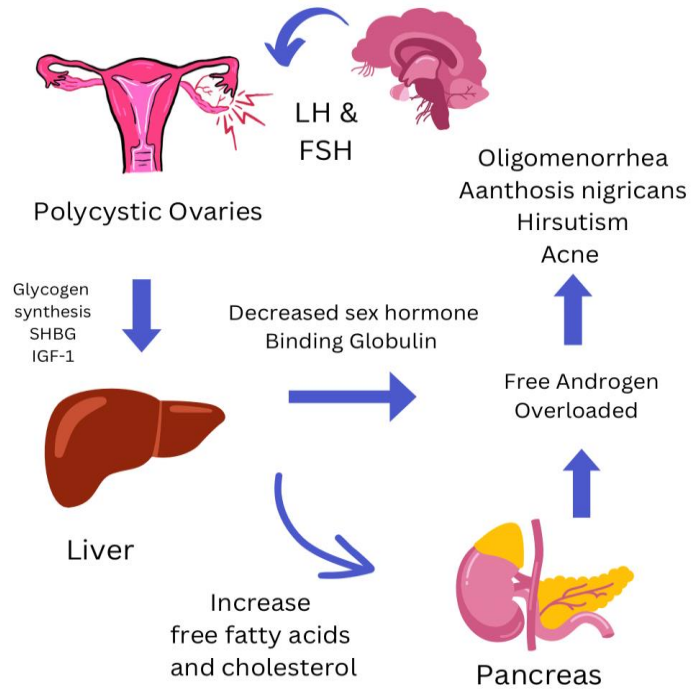


Fig 2: Pathophysiology of Insulin resistance in PCOS

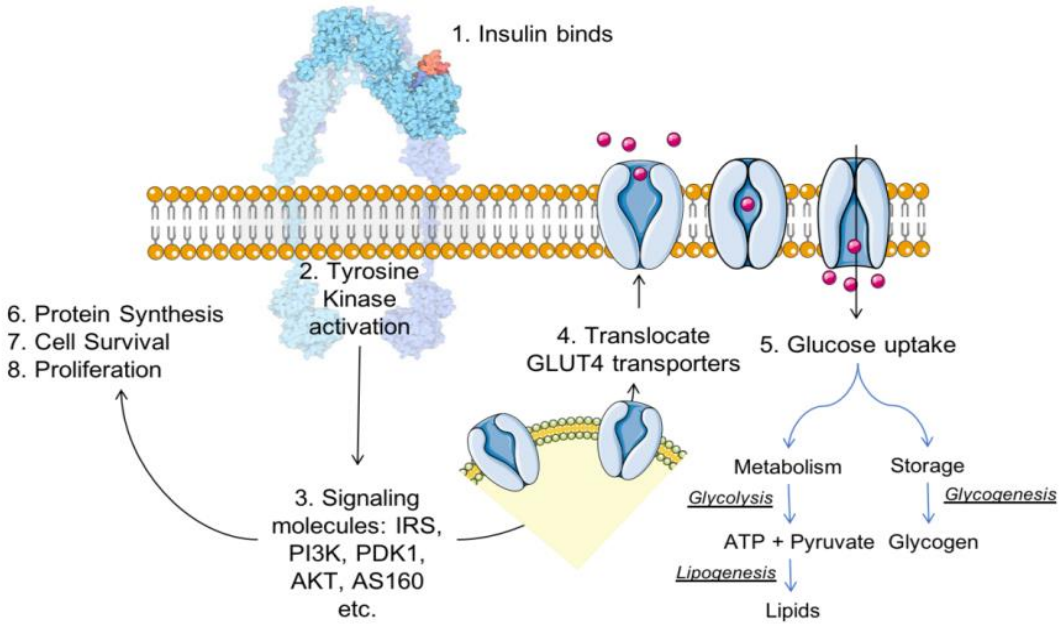


Fig 3: Biochemistry of insulin hormone across the cell membrane and its signalling

Efficacy & comparison of myoinositol, d-chiro inositol (dci) over metformin

Myoinositol is a naturally occurring inositol isomer that has been shown to improve insulin sensitivity and ovarian function in women with PCOS. Beans and citrus fruits are natural sources of myoinositol (MI), an insulin sensitizer [15]. Follicle-stimulating hormone (FSH) signalling involves MI, a second messenger, and ovulatory collapse in PCOS is linked to MI imbalance [16]. After MI treatment, when PCOS patients tried to conceive their frequency of ovulation increased [17, 18]. Furthermore, investigations on PCOS-afflicted women revealed beneficial benefits of MI on insulin resistance, lipids, and testosterone; these findings imply that MI could be used in PCOS outside of reproductive contexts. It is unknown how MI affects psychological well-being [19, 20]. Several clinical studies have been conducted to evaluate the impact of MI in treating PCOS women's metabolic and hormonal issues [23,24]. Metformin is an antidiabetic drug that has been widely used in the management of PCOS due to its insulin-sensitizing properties. Numerous studies have demonstrated the efficacy of metformin in improving insulin resistance, reducing androgen levels, and promoting weight loss in women with PCOS. Of the biguanide family, metformin is the only one that is still in use and has long been used to treat diabetes. Metformin reduces the amount of circulating insulin by increasing the sensitivity of peripheral tissues to it [27,28]. Even though Metformin has its positive effects, it also includes symptoms like Anorexia, metallic taste in the mouth, nausea, diarrhoea, flatulence, bloating, and abdominal pain, the most common gastrointestinal

adverse effects of metformin medication [29]. Myo-Inositol, D-Chiro-Inositol levels, and epimerase activity were measured in theca cells from both normal and PCOS women. The results showed that the myo-Ins/D-Chiro-Ins ratio was four times lower in PCOS subjects compared to normal theca cells, and that epimerase activity was three times higher than normal in PCOS subjects. It is important to note that theca cells were activated with the same amount of insulin in this investigation [30]. Consequently, those findings showed that, even in the presence of the identical insulin stimulation, theca cells from PCOS patients not only maintain their insulin sensitivity but also more effectively convert myo-Ins into D-Chiro-Ins than do normal theca cells. As a result, in contrast to peripheral tissues, PCOS ovarian cells exhibit a paradoxical insulin "hypersensitivity." In fact, examinations of the inositol concentration in follicular fluid revealed myo-Inositol and D-Chiro-Inositol (Myo:DCI) ratio is nearly 100:1 in normal subjects, in the follicular fluid of PCOS women, that value is barely 0.2:1 [31]. Enhanced chiro-inositol for incorporation into precursor GPI-phospholipid and precursor GPI-protein would result from the ovary's enhanced availability of D-chiro-inositol (DCI) after insulin stimulation. Insulin stimulates the release of phospholipase, which is tethered to the outer layer of cell membranes. IPGs are an intermediate messenger that exhibit a number of "insulin-mimetic" functions. Thus, it was hypothesized that increasing ovarian D-Chiro-Inositol might enhance insulin signalling.

Conclusion

The management of polycystic ovary syndrome (PCOS) is a complex and multifaceted task that requires a comprehensive approach. In recent years, several therapeutic agents have been studied for their efficacy and safety in managing PCOS, including myoinositol, D-chiro inositol, over metformin [32]. This comprehensive review aimed to evaluate the effectiveness and safety of these agents in the management of PCOS. It was found that myoinositol and D-chiro inositol, either alone or in combination, have shown promising results in improving various aspects of PCOS, including menstrual regularity, ovulation induction, and metabolic parameters. These compounds are believed to exert their effects by modulating insulin sensitivity, ovarian function, and hormonal balance. Additionally, they have been associated with minimal side effects and good tolerability, making them attractive options for PCOS management [33]. While the existing evidence supports the use of myoinositol, D-chiro inositol, in PCOS management, further research is needed to elucidate their long-term effects, optimal dosing regimens, and potential interactions with other medications. Additionally,

comparative studies evaluating the efficacy of these agents alone versus in combination could provide valuable insights into their relative benefits.

In conclusion, this comprehensive review highlights the potential efficacy and safety of myoinositol, D-chiro inositol, and metformin as therapeutic agents for managing PCOS. These findings underscore the importance of personalized treatment approaches that consider the unique needs of individuals with PCOS.

References

1. Ndefo, U. A.; Eaton, A.; Green, M. R. (2013), Polycystic Ovary Syndrome: A Review of Treatment Options with a Focus on Pharmacological Approaches. *P T 38* (6), 336–355
2. Umland, E. M.; Weinstein, L. C.; Buchanan, E. M.(2011), Menstruation-Related Disorders. In *Pharmacotherapy: A Pathophysiologic Approach*, 8th ed. DiPiro, J. T., Talbert, R. L., Yee, G. C., et al., Eds.; McGraw-Hill, p 1393.
3. Lin, L. H.; Baracat, M. C.; Gustavo, A. R.; Soares, J. M.; Baracat, E. C. (2013), Androgen Receptor Gene Polymorphism and Polycystic Ovary Syndrome. *Int. J. Gynecol. Obstet. 120* (2), 115–118.
4. Legro, R. S.(2024), Stein-Leventhal Syndrome. *Encyclopaedia Britannica*. https://www.britannica.com/science/Stein-Leventhal-syndrome
5. Bizzarri, M.; Fuso, A.; Dinicola, S.; Cucina, A.; Bevilacqua, (2016), A. Pharmacodynamics and Pharmacokinetics of Inositol(S) in Health and Disease. *Expert Opin. Drug Metab. Toxicol. 12* (10), 1181–1196.
6. Di Paolo, G.; De Camilli, P. (2006), Phosphoinositides in Cell Regulation and Membrane Dynamics. *Nature*, *443* (7112), 651–657.
7. Unfer, V.; Facchinetti, F.; Orrù, B.; Giordani, B.; Nestler, J. (2017), myo-Inositol Effects in Women with PCOS: A Meta-analysis of Randomized Controlled Trials. *Endocr. Connect. 6* (8), 647–658.
8. Apridonidze, T.; Essah, P. A.; Iuorno, M. J.; Nestler, J. (2005,), E. Prevalence and Characteristics of the Metabolic Syndrome in Women with Polycystic Ovary Syndrome. *J. Clin. Endocrinol. Metab. 90* (4), 1929–1935.
9. Grundy,S.M.(2002,), Obesity, (Metabolic Syndrome, and Coronary Atherosclerosis. *Circulation 105* (23), 2696–2698.
10. Lashen, H. (2010), Role of Metformin in the Management of Polycystic Ovary Syndrome. *Ther. Adv. Endocrinol. Metab. 1* (3), 117–128.

11. 11.Evanthia, D. K.; Andrea, D.(2012), Insulin Resistance and the Polycystic Ovary Syndrome Revisited: An Update on Mechanisms and Implications. *Endocr. Rev. 6*, 981–1030.
12. 12.Nestler, J. E.; Jakubowicz, D. J.; de Vargas, A. F.; Brik, C.; Quintero, N.; Medina, F. (1998), Insulin Stimulates Testosterone Biosynthesis by Human Thecal Cells from Women with Polycystic Ovary Syndrome by Activating Its Own Receptor and Using Inositolglycan Mediators as the Signal Transduction System. *J. Clin. Endocrinol. Metab.*, *83* (6).
13. 13.Samuel, V. T.; Shulman, G. I. (2012), Mechanisms for Insulin Resistance: Common Threads and Missing Links. *Cell*, *148* (5), 852–871.
14. 14.Zhao, H.; Zhang, J.; Cheng, X.; Nie, X.; He, B. (2023), Insulin Resistance in Polycystic Ovary Syndrome Across Various Tissues: An Updated Review of Pathogenesis, Evaluation, and Treatment. *J. Ovarian Res.*, *16* (1), 9.
15. 15.Clements, R. S., Jr.; Darnell, B.(1980), myo-Inositol Content of Common Foods: Development of a High-myo-Inositol Diet. *Am. J. Clin. Nutr. , 33* (9), 1954–1967.
16. 16.Facchinetti, F.; Unfer, V.; Dewailly, D.; Kamenov, Z. A.; Diamanti-Kandarakis, E.; Laganà, A. S.; Nestler, J. E.; Soulage, C. O.; (2020), Group of 'Inositol in PCOS and Reproduction'. Inositols in Polycystic Ovary Syndrome: An Overview on the Advances. *Trends Endocrinol. Metab. , 31* (6), 435–447.
17. 17.Zheng, X.; Lin, D.; Zhang, Y.; Lin, Y.; Song, J.; Li, S.; Sun, Y. (2017),Inositol Supplement Improves Clinical Pregnancy Rate in Infertile Women Undergoing Ovulation Induction for ICSI or IVF-ET. *Med. (Baltim.) , 96* (49), e8842.
18. 18.Kamenov, Z.; Kolarov, G.; Gateva, A.; Carlomagno, G.; Genazzani, A. D. (2015), Ovulation Induction with myo-Inositol Alone and in Combination with Clomiphene Citrate in Polycystic Ovarian Syndrome Patients with Insulin Resistance. *Gynecol. Endocrinol. Off. J. Int. Soc. Gynecol. Endocrinol. , 31* (2), 131–135.
19. 19.Unfer, V.; Nestler, J. E.; Kamenov, Z. A.; Prapas, N.; Facchinetti, F. (2016),Effects of Inositol(s) in Women with PCOS: A Systematic Review of Randomized Controlled Trials. *Int. J. Endocrinol. , 2016*, 1849162.
20. 20.Costantino, D.; Minozzi, G.; Minozzi, E.; Guaraldi, C. (2009), Metabolic and Hormonal Effects of myo-Inositol in Women with Polycystic Ovary Syndrome: A Double-Blind Trial. *Eur. Rev. Med. Pharmacol. Sci., 13* (2), 105–110.
21. 21.El Hayek, S.; Bitar, L.; Hamdar, L. H.; Mirza, F. G.; Daoud, G. (2016), Poly Cystic Ovarian Syndrome: An Updated Overview. *Front. Physiol., 7*, 124. (PMC free article).

22. Goodarzi, M. O.; Dumesic, D. A.; Chazenbalk, G.; Azziz, R. (2011), Polycystic Ovary Syndrome: Etiology, Pathogenesis and Diagnosis. *Nat. Rev. Endocrinol.* , *7* (4), 219–231.
23. Unfer, V.; Facchinetti, F.; Orrù, B.; Giordani, B.; Nestler, J. (2017), myo-Inositol Effects in Women with PCOS: A Meta-analysis of Randomized Controlled Trials. *Endocr. Connect.*, *6* (8), 647–658.
24. Unfer, V.; Nestler, J. E.; Kamenov, Z. A.; Prapas, N.; Facchinetti, F. (2016),Effects of Inositol(s) in Women with PCOS: A Systematic Review of Randomized Controlled Trials. *Int. J. Endocrinol. 2016*, 1–12.
25. Youngren, J. F. (2007), Regulation of Insulin Receptor Function. *Cell. Mol. Life Sci. 64* (7–8), 873–891.
26. Khalid, M.; Alkaabi, J.; Khan, M. A. B.; Adem, A. (2021), Insulin Signal Transduction Perturbations in Insulin Resistance. *Int. J. Mol. Sci. 22* (16), 8590.
27. Bailey, C. J.; Turner, R. C. (1996), Metformin. *N. Engl. J. Med. 334* (9), 574–579.
28. Bailey, C. J. (1992), Biguanides and NIDDM. *Diabetes Care 15* (6), 755–772.
29. Lashen, H. (2010), Role of Metformin in the Management of Polycystic Ovary Syndrome. *Ther. Adv. Endocrinol. Metab. 1* (3), 117–128.
30. Heimark, D.; McAllister, J.; Larner, J. (2014), Decreased myo-Inositol to Chiro-Inositol (M/C) Ratios and Increased M/C Epimerase Activity in PCOS Theca Cells Demonstrate Increased Insulin Sensitivity Compared to Controls. *Endocr. J. 61* (2), 111–117.
31. Unfer, V.; Carlomagno, G.; Papaleo, E.; Vailati, S.; Candiani, M.; Baillargeon, J. P.(2014), Hyperinsulinemia Alters Myoinositol to d-chiroinositol Ratio in the Follicular Fluid of Patients with PCOS. *Reprod. Sci. 21* (7), 854–858.
32. Bodepudi, R.; Seher, S.; Khan, S. A.; Emmanuel, S.; Shantha Kumar, V.; Nerella, R.; Shaman Ameen, B.; Patel, D.; David John, J.; Khan, S. (2023), Myoinositol Versus Metformin in the Treatment of Polycystic Ovarian Syndrome: A Systematic Review. *Cureus 15* (7).
33. Greff, D.; Juhász, A. E.; Váncsa, S.; Váradi, A.; Sipos, Z.; Szinte, J.; Park, S.; Hegyi, P.; Nyirády, P.; Ács, N.; Várbíró, S.; Horváth, E. M. (2023,), Inositol Is an Effective and Safe Treatment in Polycystic Ovary Syndrome: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Reprod. Biol. Endocrinol. 21* (1).

சங்க இலக்கியத்தில் உணவு முறைகள்

அ. ரஞ்சனி
உதவிப்பேராசிரியர் தமிழ்த்துறை, சீதாலட்சுமி இராமசுவாமி கல்லூரி
திருச்சிராப்பள்ளி
ranjanimohan1027@gmail.com

ஆய்வுச்சுருக்கம்

நம் பழந்தமிழர்கள் விதவிதமான உணவு வகைகளைச் செய்வதில் கைதேர்ந்தவர்கள். நாம் சமைத்த உணவை மற்றவர்களுக்கு கொடுத்து மகிழ்வதில் இன்பம் கண்டவர்கள் நம் முன்னோர்கள் என்று நம் இலக்கியங்கள் இயம்புகின்றன. தொல்காப்பியத்தில் உணவை அடிசில் எனும் சொல்லால் குறிப்பிப்பட்டுள்ளது அதற்கு சேனாவரையர் உரை கூறும் போது அடிசில் என்பது உண்பன, திண்பன, நக்குவன, பருகுவன என நான்கினையும் குறிக்கும் பொதுச் சொல்லாக கூறுகிறார். தமிழனின் உணவு வகைகளுள் அரிசியும் ஒன்றாகும் நெல், தினை, மூங்கில் வரகு ஆகும். இவற்றை பயிர் செய்து நெல்லரிசி, தினையரிசி, வரகரிசி, மூங்கிலரிசி என நான்கும் வகையாக பத்து பிரித்து உண்டனர். மனிதன் இனம் தோன்றிய காலத்திலிருந்து புலால் உண்ணும் வழக்கம் இருந்து வருகின்றது. பண்டைய காலத்திலிருந்து தமிழர்கள் புலால் உண்ணும் வழக்கம் இருந்துள்ளதை புறநானூறு கூறுகிறது. முருகு வழிபாட்டில் முதன்மை உணவாக கொள்ளப்படுவது தினையாகும். மலை நாட்டிலே குறவன் தினைப் பயிர்கள் நன்றாக வளர்ந்தபின் அறுவடை செய்து முதல் தினையை முருகனுக்கு காணிக்கையாக அளிக்கிறான் என்ற மரபை குறுந்தொகை கூறுகிறது. சங்கத் தமிழர்கள் நெய்யுடன் சேர்த்து சோறுண்டு உறவுகளோடு மகிழ்ந்து இருந்தனர். எருதுகளைப் பிணைந்து அவற்றின் காற்கீழ் பெய்து கடாவிடுதனின்று இளையர்கள் காலால் மிதித் தொடுத்தனர். இவ்வாறு விளைந்த புல்லிய குவியலில் வரகு பயிர் செய்து உணவு உட்கொண்டனர். சுத்தமான நன்றாகக் காய்ச்சிய பாலை உறை ஊற்றியதால் முற்றிய கெட்டித்தயிர் உருவாயிற்று. செட்டித் தயிரைக் கட்டி இல்லாமல் பிசைந்து அடிபிடிக்காமல் துழவி (தீம்புளிப்பாகர்) மோர்க்குழம்பு தயாரிக்கப்பட்டது. பெரிய பெரிய வரால் மீனின் துண்டுகள் எண்ணெய் பசையுடன் மிளிருமாறு கண்ணைக் கவரும் விதத்தில் மீன் குழம்பு தயாரிப்பதில் தமிழ்ப் பெண்கள் வல்லவராய் இருந்தனர். பொழிவு மிக்க மென்மையான அரிசிச் சோற்றில் சாரல் மிதக்கும் குழம்பைப் பிறழ விட்ட சோற்றுத்திரளை விரும்பி உண்டனர். சங்கத் தமிழ் மக்கள் பண்டைய உணவாக விளங்கும் அரிசி, தேன், பால், தயிர், நெய் உணவை இறமைக்கும் வருந்துக்கும், உணவுக்கும் பயன்பட்ட செய்தியை அறியும் நிகழ்வை தமிழர்கள் எவ்வாறு போற்றி பாதுகாத்திருந்தனர் என்பதை சங்க இலக்கியத்தின் வாயிலாக அறிந்து கொள்ள முடிகிறது.

திறவுச்சொற்கள் – தொல்காப்பியம், சங்க இலக்கியம், அடிசில், கடாவிடுதல், குறவன்

முன்னுரை

தமிழனின் செம்மாந்த வாழ்க்கையையும், இலக்கியத்தையும் அறியகக்கூடியது சங்க இலக்கியம். இவ்விலக்கியம் தமிழனின் இம்மை, மறுமை வாழ்வை அறியக்கூடிய மிகப் பெரும் கலைக் களஞ்சியம் ஆகும். நம் பழந்தமிழர்கள் விதவிதமான உணவு வகைகளைச் செய்வதில் கைதேர்ந்தவர்கள். நாம் சமைத்த உணவை மற்றவர்களுக்கு கொடுத்து மகிழ்வதில் இன்பம் கண்டவர்கள் நம் முன்னோர்கள் என்று நம் இலக்கியங்கள் இயம்புகின்றன.

"ஆறிடும் மேடும் மடுவும் போல
மாறிடும் செல்வம் மாநிலத்தீர் – சோறிடும்
தண்ணீர்மை வாரும் தருமே சார்வாக
உண்ணீர்மை வீறும் உயர்ந்து"

என்று ஔவையார் தமிழர்களின் மேன்மைகளை எடுத்துரைக்கின்றார் தனிமனிதனின் மூன்று அடிப்படைத் தேவைகளுள் உணவும் ஒன்றாகும் இவ்வுணவியல் நெறிமுறையைச் சிறந்த முறையில் ஒழுகியவன் சங்கத் தமிழன்.

உணவின் பெயர்கள்

தொல்காப்பியத்தில் கருப்பொருளைப் பற்றிக் கூறும்போது.

"தெய்வம் உணாவே மாமரம் புட்பறை" (தொல் – அகம் -20)

தொல்காப்பியத்தில் உணவை அடிசில் எனும் சொல்லால் குறிப்பிப்பட்டுள்ளது அதற்கு சேனாவரையர் உரை கூறும் போது அடிசில் என்பது உண்பன, திண்பன, நக்குவன, பருகுவன என நான்கினையும் குறிக்கும் பொதுச் சொல்லாக கூறுகிறார்.

"உணாவே வல்சியுண்டி யோதன
மசனம் பதமே யிரையா கார
முறையே யூட்டமுண வெனலாகும்" (குறுந்தொகை – 53)

எனும் செய்யுள் வழி உணவிற்கு உணர், வல்சி உண்டி, ஓதனம், அசனம், பதம், இரை, ஆகாரம், உறை, ஊட்டம், எனப் பல்வேறு பெயர்கள் இருந்ததை அறியமுடிகிறது.

"உண்டி முதற்றே உணவவின் பிண்டம்" (புறம் -18-20)

உணவு இன்றி உயிர்கள் இல்லை உடலுக்கு தேவையான சக்தியையும் ஆற்றலையும் இவ்வுணவு நமக்கு அளிக்கிறது. உணவின் சுவை அறிந்து குடும்பம், சுற்றம் என அனைவருடனும் அமர்ந்து உண்டு பிறருக்குக் கொடுத்து வாழ்வதும் தமிழனின் தலையாய பண்பாடு ஆகும்.

தமிழனின் உணவு வகைகளுள் அரிசியும் ஒன்றாகும் நெல், தினை, மூங்கில் வரகு ஆகும். இவற்றை பயிர் செய்து நெல்லரிசி, தினையரிசி, வரகரிசி, மூங்கிலரிசி என நான்கும் வகையாக பத்து பிரித்து உண்டனர்.

நெல்

இன்றும் இந்திய உணவுவகைகளில் முதலிடம் பெறுவது நெல் ஆகும். இதனை

செந்நெலுண்ட 344 -1
செந் நெற்கதிர்களையுண்ட 344 -2
வெண்னெல் வேவி – 352 -9

என்று மக்களும், மயில்களும், விளைந்த நெல்லை உண்டு மகிழ்ந்ததாக புறம் தெரிவிக்கிறது.

தினை

முருகு வழிபாட்டில் முதன்மை உணவாக கொள்ளப்படுவது தினையாகும். மலை நாட்டிலே குறவன் தினைப் பயிர்கள் நன்றாக வளர்ந்தபின் அறுவடை செய்து முதல் தினையை முருகனுக்கு காணிக்கையாக அளிக்கிறான் என்ற மரபை குறுந்தொகை கூறுகிறது.

"யுணவின் துடவைப் பொன் போல் சிறுதினைக்
கூடி உண் கடவுட்கு இட்ட செழுங்குரல்" (குறுந்தொகை, 42 – 1)

மூங்கில்

மூங்கில் அரிசியை பயன்படுத்தினர்

"மாயம் அன்று தோழி வேய் வயின்று
எருவையின் நீடிய பெருவரை அடுக்கத்துத்" (நற்றிணை 294,3-4)

நற்றினையில் மூங்கிலைப் பயிரிட்டு வளர்த்து அறுவடை செய்து உண்ட செய்தி காணப்படுகிறது.

வரகு

சங்கத் தமிழர்கள் நெய்யுடன் சேர்த்து சோறுண்டு உறவுகளோடு மகிழ்ந்து இருந்தனர். எருதுகளைப் பிணைந்து அவற்றின் காற்கீழ் பெய்து கடாவிடுதனின்று இளையர்கள் காலால் மிதித் தொடுத்தனர். இவ்வாறு விளைந்த புல்லிய குவியலில் வரகு பயிர் செய்து உணவு உட்கொண்டனர்.

"எருதுகள் லுறாஅ தினைஞர் கொன்ற" (327)
"கலியுனீர் வரகின் பிறங்கு பீளொளிக்கும்
வின்புல வைப்பின் னதுவே சென்று" (321: 6-7)

செழித்து வளர்ந்த வரகின் உணர்ந்த தோகையிடையே எலி சென்று மறைந்த காட்சியை மேற்கூறிய பாடலின் வழி அறியலாகும்.

புலால் உணவு

மனிதன் இனம் தோன்றிய காலத்திலிருந்து புலால் உண்ணும் வழக்கம் இருந்து வருகின்றது. பண்டைய காலத்திலிருந்து தமிழர்கள் புலால் உண்ணும் வழக்கம் இருந்துள்ளதை புறநானூறு கீழ்கண்ட பாடலின் மூலம் விளக்கின்றது.

“புலவு நாற்றத்த பைந் தடி
பூ நாற்றத்த புகை கொளீடுஇ ஊன்
துவை கறி, சோறு உண்டு” (புறம். 14: 12-14)

எனும் வரிகளில் புலால் மணமுடைய இறைச்சியைக் கொண்டு கறித்துவையல், கறிப்பிரட்டல், கறிச்சோறு முதலானவைகளை உண்டு மகிழ்ந்தனர்.

மோர்க்குழம்பு

சுத்தமான நன்றாகக் காய்ச்சிய பாலை உறை ஊற்றியதால் முற்றிய கெட்டித்தயிர் உருவாயிற்று. செட்டித் தயிரைக் கட்டி இல்லாமல் பிசைந்து அடிபிடிக்காமல் துழவி (தீம்புளிப்பாகர்) மோர்க்குழம்பு தயாரிக்கப்பட்டது.

“முளிதயிர் பிசைந்த காந்தள் மெல்விரல்
……..
தான் துழந்து அட்ட தீம்புளிப் பாகர்” (குறுந்தொகை 167: 1:4)

என்னும் பாடல் வரிகளினால் அறியமுடிகின்றது.

தேன்

உடலையும், உயிரையும் நோய் நீக்கி வளமையையும் இளமையையும் தருவது தேன் ஆகும்.

“வீரர்கள் மகிழுமாறு தேனோடு கலந்து
ஆட்டிறைச்சியைப் பரிமாறினர்” (புறம் -262 -1)
“பரிசில் பெறவும் பாணர்களின் உண்கலம்
நிறைய ஊற்றும்போது சிந்திய தேன்
துளிகள் அருவியாய்ப் பெருக்கெடுக்கும்” (புறம் - 115 - 2- 3)

என்று பாரி வள்ளலின் குணம் என்று கபிலனின் பாடல் வழி அறியலாகும்.

மீன் உணவு

பெரிய பெரிய வரால் மீனின் துண்டுகள் எண்ணெய் பசையுடன் மிளிருமாறு கண்ணைக் கவரும் விதத்தில் மீன் குழம்பு தயாரிப்பதில் தமிழ்ப் பெண்கள் வல்லவராய் இருந்தனர்

பொழிவு மிக்க மென்மையான அரிசிச் சோற்றில் சாரல் மிதக்கும் குழம்பைப் பிறழ விட்ட சோற்றுத்திரளை விரும்பி உண்டனர்.

“கருங்கண் வராஅல் பெருந்தடி மிளிர்வையொடு
புகர்வை அரிசிப்பொம்மல் பெருஞ்சோறு
குவர்படு கையைக் கழும மாந்தி” (நற்றினை – 60, 4-6)

என்னும் பகுதி சித்திரிக்கின்றது.

நெய்

ஆயர்குல மாந்தர் நெய் பயன்படுத்தியதை
"நறு நெய் சோறு" (புறம் – 396)
"நறு நெய்க் கடலை விசைப்பச் சோறிட்டு" (புறம் – 120)

சோற்றில் நெய் ஊற்றி உண்டதையும் அவரைப்பருப்பையையும் நெய்யில் வறுத்துச் சமைத்ததையும் குறிப்பிடுகிறது.
இக்கட்டுரையில் தமிழர்களின் உணவு பழக்கவழக்கங்கள் அன்றைய நாட்களில் எவ்வாறு இருந்தது. சங்கத் தமிழ் மக்கள் பண்டைய உணவாக விளங்கும் அரிசி, தேன், பால், தயிர், நெய் உணவை இறமைக்கும் வருந்துக்கும், உணவுக்கும் பயன்பட்ட செய்தியை அறியும் நிகழ்வை தமிழர்கள் எவ்வாறு போற்றி பாதுகாத்திருந்தனர் என்பதை சங்க இலக்கியத்தின் வாயிலாக அறிந்து கொள்ள ஏதுவாக இக்கட்டுரை அமையும் என்பதில் ஐயமில்லை.

துணை நூற்பட்டியல்

- குறுந்தொகை, போ.வே. சோமசுந்தரனார், சைவ சித்தாந்த நூற்பதிப்புக் கழகம் சென்னை
- சா. வே. சுப்பிரமணியன் புறநானூறு மூலமும் உரையும், மெய்யப்பன் பதிப்பகம்
- சு.வே. சுப்பிரமணியன் சங்க இலக்கியம் தெளிவுரை, மாணிவாசகர் பதிப்பகம் சென்னை
- நற்றிணை முலமும் உரையும் டாக்டர் உ.வே. சாமிநாதையர் நூல்நிலையம், சென்னை

ROLE OF PHYTOESTROGENS IN TREATMENT OF BREAST CANCER

Jasmin Uhanitha M

Assistant Professor and Head

PG Department of Food Service Management and Dietetics,

AIMAN College of Arts and Science for Women,

Tiruchirappalli, Tamil Nadu, India

Abstract

Cancer is a term referring to malignant tumours. In cancer, cells spread to nearby tissues and affect their function, resulting in negative consequences. Among cancer types, breast cancer is the most common, followed by lung cancer, colon cancer, colorectal cancer and ovarian cancer. Cancer is one of the most common causes of death in many countries, and the number of cancer cases is increasing every year. Recent studies have shown that breast cancer is one of the leading causes of death among women in India. Breast cancer is caused by a combination of mutations. The main causes are determined by genetic, environmental, nutritional, hormonal and background factors that lead to the development of this disease. Risk factors include a history of breast cancer, family history, obesity, high blood pressure, smoking, drinking alcohol, early seizures, late menopause, lack of exercise, lack of energy, and hormone replacement therapy. Factors associated with a reduced risk of breast cancer include a balanced lifestyle, duration of breastfeeding, physical activity, weight loss, and avoidance of surgery and treatment. Complementary and alternative therapies and those perceived as "natural" tend to complement biomedical treatments. Phytoestrogens are compounds found naturally in plants that are structurally identical to Estrogen. Phytoestrogens are Estrogen-like substances found in plant foods and are generally divided into three groups: isoflavones, lignans, and coumarins. Genistein and daidzein, the two main plant isoflavones, can also be metabolized by other isoflavone precursors such as biotin A and formononetin respectively.

Keywords: *Breast cancer, phytoestrogens, phytoestrogens types.*

Introduction

Cancer is not one disease. Cancer is a large, diverse group of diseases. It is defined by uncontrolled cell growth anywhere in the body, with the potential to spread ("metastasize") to other organs. Cancer is the Latin word for crab. Although there are many kinds of cancer, all cancers start because abnormal cells grow out of control. Cancer may also be called

malignancy, a malignant tumour, or a neoplasm (literally, a new growth). The ancients used the word to mean a malignancy, because of the crab-like tenacity a malignant tumour sometimes seems to show in grasping the tissues it invades.

Cancer can start almost anywhere in the human body, which is made up of trillions of cells. Normally, human cells grow and multiply (through a process called cell division) to form new cells as the body needs them. When cells grow old or become damaged, they die, and new cells take their place.

Sometimes this orderly process breaks down, and abnormal or damaged cells grow and multiply when they shouldn't. These cells may form tumours, which are lumps of tissue. Tumours can be cancerous or not cancerous (benign). Cancerous tumours spread into, or invade, nearby tissues and can travel to distant places in the body to form new tumours (a process called metastasis).

Breast cancer

Breast cancer is a complex disease. It is one of most malignant cancers with an increased risk of relapse and metastasis. No single factor is likely to be the cause of it. Many endogenous and exogenous factors have been identified with relevance to breast cancer aetiology. Age is the strongest risk factor for this disease. More than 2/3 of all new cases occur after the age of 55 and women older than 65 have a relatively greater risk than 4.0 in comparison with those younger than 65. Many additional risk factors for breast cancer have been identified. Some risk factors are invariable, such as age, BRCA1 and BRCA2 gene mutations, family history, and reproductive history. Others are potentially variable, such as high endogenous estrogens, hormone therapy, obesity and alcohol consumption. These endogenous factors include increasing age, menarche age (the younger the age during the first menarche, the higher the risk), and menopause age (the older the age at menopause, the higher the risk).

Prevalence of breast cancer

In 2020, an estimated 19.3 million new cancer cases and almost 10.0 million cancer deaths occurred worldwide. The most commonly diagnosed cancer is breast cancer, followed by lung, colorectal, prostate, and stomach cancers. In many countries, cancer ranks among the most common causes of death, and the numbers are increasing annually (Sung et al., 2021).

Asia has 44% of the world's BC deaths with 39% of overall new BC cases diagnosed. Approximately 25% of the female cancer cases in India are BC. The rate of incidence was found to be 25.8 in 100,000 women and the mortality rate is 12.7 per 100,000 women (2017). The highest rate of occurrence was found to be in Delhi (41 per 100,000 women) followed by

Chennai (37.9 per 100,000 women), Bangalore (34.4 per 100,000 women), and Thiruvananthapuram district (33.7 per 100,000 women). The mortality-to-incidence ratio was found to reach 0.66 in rural registries and 0.08 in urban registries. Another troubling concern about the scenario of BC in India is the increased incidence of the disease in younger Indian women (between the ages of 30 and 40). Presently, almost 48% of patients with BC in India are below 50 years of age. There is an increasing trend of BC in women between the ages of 25 and 40 in the past 25 years.

Breast cancer always evolves silently. Most of the patients discover their disease during their routine screening. Others may present with an accidentally discovered breast lump, change of breast shape or size, or nipple discharge.

Causes of breast cancer

Cancer is caused by various genetic and environmental factors. This list includes a wide range of factors, like a gain of function of many proto-oncogenes or loss of function of many tumour-suppressing genes, various chemical agents like alkylating agents, and physical agents like radiations. Since the early 1900s, high rates of cancer have also been linked to occupational choices. Evidence of a variety of viruses causing cancer in humans has also emerged, for example, human T-cell lymphotropic virus, HIV, HBV, HCV, HPV, Epstein-Barr virus, etc., have appeared as the top-notch causes of various cancers.

Moreover, there are exogenous risk factors known as external and environmental factors are alcohol consumption, poor diet, contraceptive pill and hormone replacement therapy, overweight and obesity, sleep deprivation, and physical inactivity. According to the latest report of International Agency for Research on Cancer (IARC) in 2022, breast cancer leads to the fifth mortality rate among all female cancer diseases.

Phytoestrogens

Phytoestrogens are naturally occurring compounds in plants and are characterized by a close structural similarity to estrogens. This allows them to act as weak estrogenic factors and interfere with hormonal signalling. Phytoestrogens may have a positive effect on the prevention of menopausal symptoms, type 2 diabetes, cardiovascular disease, obesity, and cancer. These health benefits are presumably linked to their anti-inflammatory, anti-tumoral, anti-allergic, antioxidant, anti-thrombotic, and hepatoprotective properties. The interest in phytoestrogens and cancer began after the observation that the consumption of soy and soy-derived foods was correlated with a decreased incidence of breast ovarian and prostate cancer.

Types of phytoestrogens

The amount of phytoestrogen in plants and foods varies considerably based on location of crop, time of harvest and crop conditions, processing, and preparation. Phytoestrogens are estrogen-like compounds derived from plants, which are structurally similar to 17β-estradiol. Four phenolic compounds classified as phytoestrogens are isoflavones, stilbene, coumestan, and lignin. Isoflavones are the most common form of phytoestrogens and are found in a variety of plants, the greatest dietary source being soy. Isoflavones have a similarly complex metabolism. The 2 main isoflavones, genistein and daidzein, are present in soy primarily as β-Dglycosides, genistin, and diadzin. Glycosidic bonds are hydrolyzed by glucosidases of the intestinal bacteria in the intestinal wall to produce aglycons. The aglycons are further metabolized to glucuronide conjugates in the intestine and liver. Daidzein may be metabolized to equol or to O-desmethylangolensin (O-DMA) and genistein to p-ethyl phenol. The major isoflavones that can be detected in the blood and urine are daidzein, genistein, equol, and ODMA. The aglycone form of isoflavones is biologically active. Isoflavones are found in soybeans and other legumes, including in red clover. The main phytoestrogens in the form of isoflavones are genistein, daidzein, glycitein, formononetin, and biochanin A contained in soybeans. Phytoestrogens that are classified as isoflavones are the most widely studied. The amount of isoflavones needed to give health effects is around 40-70 mg/day or an average of 50 mg/day. The average consumption of isoflavones in Asian society is 15-50 mg per day, while in Western countries only about 2 mg per day.

Flavonoids

Flavonoids are commonly divided into several sub-classes, based on the connection position of the B and C rings, as well as the degree of saturation, oxidation, and hydroxylation of the C ring. This sub classification includes isoflavonoids (isoflavones and coumestans), flavones, flavonols, flavan-3-ols (or catechins), flavanones, chalcones, and anthocyanins.

Lignans

Lignans are another class of phytoestrogens commonly found in grains, nuts, coffee and tea, cocoa, flaxseed, and some fruits. Some studies report that these phytoestrogens are capable of mimicking the antioxidant effects of some hormones without any associated deleterious effects. Importantly, gut bacteria are responsible for the metabolization of lignans and produce enterodiol and enterolactone. Thus, the beneficial health effects of lignans may be conditioned to each individual’s micro biota.

Stilbenes

Stilbenes are an important group of nonflavonoid phytoestrogens with a polyphenolic structure with a 1, 2-diphenylethylene nucleus. The most common stilbene group is resveratrol, which is found in grapes and peanuts. Resveratrol consists of two isomers namely cis and trans. Trans has a higher estrogenic activity. Estrogenic activity come from nuts, broccoli, cabbage and spinach. The main sources of lignans are flaxseed, and also in wheat flour, peanuts, fruits, berries, vegetables, tea and coffee.

Conclusion

Phytoestrogen consumption has been associated with a reduction in cancer incidence, and they are studied as important chemo preventive compounds. Apart from interfering with the normal signaling pathways of estrogens and modulate gene expression, phytoestrogens are also potent antioxidants, modulate normal protein activity, and regulate epigenetics. This way, phytoestrogens have the potential to limit cell proliferation in different types of tumours.

Phytoestrogens may sensitize cancer cells to anti-cancer treatments, including hormone therapy, chemotherapy, and radiotherapy. Some reports also show that phytoestrogens could also protect normal cells from the secondary effects without affecting the efficacy of treatment. However, further research and clinical studies must be carried out to evaluate the true potential of phytoestrogens as an option for cancer therapy, establish the optimal concentration and which patients could benefit from it, and ensure their safety. Until now, most clinical studies regarding phytoestrogens and cancer have been cancelled, due to a lack of effect. In this regard, several investigations are focused on designing analogs or strategies, such as encapsulation, to improve the efficacy of phytoestrogen as treatments or coadjuvants for some types of cancer.

References

1. 1.Siegel RL, Miller KD, Fuchs HE, Jemal A., Cancer Statistics, 2021, *CA Cancer J Clin.*; 71(1):7–33.
2. Xia.C, X. Dong, H. Li, M. Cao, D. Sun, S. He, F. Yang, X. Yan, S. Zhang, N. Li, W. Chen, (2022), Cancer statistics in China and United States, 2022: profiles, trends, and determinants *Chin. Med. J.,* 135 pp. 584-590
3. Jemal A, Bray F, Center MM, et al. (2011), Global cancer statistics. *CA Cancer J Clin.,* 61:69–90.

4. Stewart BW, Wild CJ. (2014), WHO, World Cancer Report, Lyon, France: International Agency for Research on Cancer, 630.
5. Berry.J. (2017), Worldwide statistics on breast cancer. Available at: https://www.medicalnewstoday.com/articles/317135.php.
6. Malvia S, Bagadi SA, Dubey US, et al. (2017), Epidemiology of breast cancer in Indian women. *Asia Pac J Clin Oncol* ; 13:289–95.
7. Programme NCR. (2013), Three year report of population-based cancer registries: 2009–2011. In: Indian Council of Medical Research, NCDIR-NCRP (ICMR) Bangalore.
8. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataran I, Jemal A, et al. (2021), Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin.* 10:10.
9. Collaborative Group on Hormonal Factors in Breast Cancer. Menarche, menopause, and breast cancer risk: individual participant meta-analysis, including 118 964 women with breast cancer from 117 epidemiological studies. *The Lancet Oncol*. (2012), 13(11):1141–51.
10. Hulka BS, Moorman PG. (2008), Breast cancer: hormones and other risk factors. Maturitas; 61(1–2):203–13
11. Mahvi DA, Liu R, Grinstaff MW, Colson YL, Raut CP. (2018), Local Cancer Recurrence: The Realities, Challenges, and Opportunities for New Therapies. *CA Cancer J Clin.* 68(6):488-505.
12. Narod SA. (2018), Personalised medicine and population health: breast and ovarian cancer. Hum Genet. 137(10):769-778.
13. Castro GD, Castro JA. (2014), Alcohol drinking and mammary cancer: Pathogenesis and potential dietary preventive alternatives. World *J Clin Oncol.*; 5(4):713–29.
14. Chlebowski R, Rohan T, Manson J, Aragaki A, Kaunitz A, Stefanick M, et al. (2015), Breast cancer after use of estrogen plus progestin and estrogen alone. *JAMA Oncol*.; 1 (3):296–305.
15. Fortner RT, Katzke V, Kuhn T, Kaaks R. (2016), Obesity and breast cancer. Recent Results Cancer Res.; 208:43–65.
16. Knight DC, Eden JA. (1996), A review of the clinical effects of phytoestrogens. *Obstet Gynecol*; 87:897–904.
17. Setchell KD. (1998), Phytoestrogens: the biochemistry, physiology, and implications for human health of soy isoflavones. *Am J Clin Nutr*; 68(suppl): 1333S-1346S. 20.

18. Sirtori CR, Arnoldi A, Johnson SK. (2005), Phytoestrogens: end of a tale? Ann Med; 37:423–438.
19. Murkies AL, Wilcox G, Davis SR. (1998), Clinical review 92: Phytoestrogens. *J Clin Endocrinol Metab*; 83:297–303.
20. Tham DM, Gardner CD, Haskell WL. (1998), Clinical review 97: Potential health benefits of dietary phytoestrogens: a review of the clinical, epidemiological, and mechanistic evidence. *J Clin Endocrinol Metab*; 83:2223–2235
21. Limer JL, Speirs V. (2004), Phyto-oestrogens and breast cancer chemoprevention. Breast Cancer Res; 6:119–127.
22. Messina MJ, Loprinzi CL. (2001), Soy for breast cancer survivors: a critical review of the literature. *J Nutr*; 131(suppl):3095S-3108S.
23. Dixon RA. (2004), Phytoestrogens. *Annu Rev Plant Biol*; 55:225–261.
24. Allred CD, Allred KF, Ju YH, et al. (2001), Soy diets containing varying amounts of genistein stimulate growth of estrogen-dependent (MCF-7) tumors in a dose-dependent manner. *Cancer Res*; 61:5045–5050.
25. Magee PJ, Rowland IR. (2004), Phyto-oestrogens, their mechanism of action: current evidence for a role in breast and prostate cancer. *Br J Nutr*; 91:513–531.
26. Shimazu, T.; Inoue, M.; Sasazuki, S.; Iwasaki, M.; Sawada, N.; Yamaji, T.; Tsugane, S. (2011), Plasma isoflavones and the risk of lung cancer in women: A nested case-control study in Japan. *Cancer Epidemiol. Biomark*. Prev., 20, 419–427.

NUTRACEUTICALS: NEW ERA OF MEDICINE AND HEALTH

Thilagavathi.C

Assistant Professor, Department of Botany,

Seethalakshmi Ramaswami College, Tiruchirappalli, Tamil Nadu, India

thilagabot@gmail.com

Abstract

Nutraceutical is a term coined to describe substances which are not traditionally recognized nutrients but which have positive physiological effects on the human body. They are playing a significant role in modifying and maintaining normal physiological function that supports healthy human beings. These are used as alternatives to modern medicines that promote quality of health, increases the nutritional value of the diet, and prolong life expectancy. With its role in combating major health problems with zero side effects, nutraceuticals have gained a huge market worldwide. Emphasis has been made to present herbal nutraceuticals effective on hard curative disorders. They possess numerous therapeutic benefits like anti-obesity, immune enhancement, natural antioxidants, cardiovascular effects, anti-diabetic, anti-inflammatory effects, etc. Risk of toxicity or adverse effect of drugs led us to consider safer nutraceutical and functional food-based approaches for the health management. This resulted in a worldwide nutraceutical revolution. The nutraceutical revolution will lead us into a new era of medicine and health, in which the food industry will become research oriented one similar to the pharmaceutical industry. Ultimately, they ensure better quality of life and the purpose of this article is to provide summary of current scientific impression in this regard which might be helpful to formulate further innovative research plan in new domain on nutraceuticals.

Keywords: *Nutraceuticals, anti-diabetic, immune enhancement, health promotion, diseases, and anti-inflammatory.*

Introduction

The quality of life in terms of income, spending and lifestyle has improved with economic development. However, it has also thrown up a major challenge in the form of `lifestyle diseases. The first victim of this lifestyle change has been food habits. Consumption of junk food has increased manifold, which has led to a number of diseases related to nutritional deficiencies. Nutraceuticals can play an important role in controlling them. No wonder more and more people are turning to nutraceutical. The words "nutrition" and "pharmaceutics" are

the roots of the term "nutraceutical." The concepts of "pharmaceutical" and "nutrition" were combined to form the term "nutraceutical" in 1989 by Dr. Stephen L. DeFelice, Chairman and creator of the base for innovation in medicines. Dietary fibre, prebiotics, probiotics, polyunsaturated fatty acids, antioxidants, and other diverse kinds of herbal /natural foods are some of the food products used as nutraceuticals. It including arthritis, cold and flu, sleeping issues, digestion and the prevention of certain malignancies, osteoporosis, high blood pressure, high cholesterol, painkillers, depression, and diabetes cover the majority of therapeutic areas [1].

Traditional nutraceuticals

A traditional nutraceutical is a food that has been created but has not been altered in any way. Its ingredients are all- natural and may have health benefits. Many natural compounds can be found in a range of fruits, vegetables, grains, fish, dairy and meat diets, such as lycopene in tomatoes, omega-3 fatty acids in salmon and saponins in soy. Researchers have found that salmon and tomatoes both have health benefits that go beyond simple dietary needs [2].

1. Nutrients

Nutrients can be used to treat a variety of conditions, including cancer, diabetes, osteoporosis, cataracts and heart disease. Osteoporosis and anaemia can be treated using minerals that derived from plant, animal and dairy diets. Salmon and flaxseed include omega 3-PUFAs, which are powerful regulators of inflammation the maintenance of brain function and the decrease of cholesterol buildup [3].

2. Herbs

Herbs, also referred to as botanical foods, have been used to treat both acute and chronic ailments for thousands of years. Important components of several nutraceuticals can be discovered in medicinal plants. Herbs like ginger, garlic, wheat grass etc. are used as the source of these products. Ginger (*Zingiber officinale*) contains Gingerol which helps in soothing headaches, motion sickness, nausea, vomiting and is vascular conditions, cold and arthritis, along with acting as an antimicrobial and antifungal agent [4].

3. Phytochemicals

Phytochemicals are the finest choice as a nutraceutical. Carotenoids like Lycopene, carotenes, lutein have antioxidant potentials which help in the prevention of free radical initiated diseases, like atherosclerosis, cataracts, age-related muscular degeneration and multiple sclerosis. Lycopene found in of tomatoes and tomato products is involved in decreasing the development of cervical, colon, prostate, rectal, stomach, and other types of

cancers. Flavonoids, like flavones, flavonols, flavanones, flavanonols and anthocyanins are antioxidant, anti-mutagenic and show free-radical scavenging activities. [5]. These phytochemicals hold great therapeutic promise for the treatment of a wide range of ailments, whether used alone or in combination [6].

4. Probiotic bacteria

Probiotics are live microorganisms that are administered to a host in sufficient amounts to have a positive effect on health. They are frequently used to treat gastrointestinal (GI) diseases such lactose intolerance, acute diarrhoea and gastrointestinal side effects caused by antibiotics. They are available in powder, liquid, gel, paste and capsule form [7].

5. Enzymes in nutraceuticals

Enzymes are natural catalyst and without them our bodies will cease to function. Blood sugar disorders, digestive problems and obesity symptoms are eliminated by enzyme supplements. These enzymes are derived from microbial, plant and animal sources. Glucoamylase from *A. niger or Saccharomycopsis fibuligera* increases digestive capacity. α-Galactosidase found beans, cabbage, Brussels sprouts, broccoli, asparagus, other vegetables, and whole grains digests non-digestible sugars such as raffinose and stachyose. Lysozyme a component of saliva, tears, egg white and many animal fluids is anti-bacterial in nature [8].

Health care impact of nutraceuticals

1. Antioxidant property of nutraceuticals

There are many chemical classes of nutraceuticals found in all sorts of foods. Some nutraceuticals are well known, like epigallocatechin 3-gallate (EGCG) from green tea and resveratrol from grapes. A common method of determining intrinsic free radical scavenging activity is to use a cell free assay system with the radical 2,2-diphenyl- 1-picryhydrazyl (DPPH). Resveratrol, carnosic acid and rosmarinic acid have each been shown to be effective scavengers of DPPH radicals. Rosmarinic acid has been shown to scavenge the reactive nitrogen species, peroxynitrite and various ROS. As a free radical scavenger, rosmarinic acid is effective at protecting SH-SY5Y human neuroblastoma cells from hydrogen peroxide-induced oxidative stress and cell death [9].

2. Anti-inflammatory activities

Curcumin which is a polyphenol of turmeric have anticarcinogenic, anti-oxidative and anti-inflammatory properties. Linoleic acid (found in green leafy vegetables, nuts, vegetable oils i.e., evening primrose oil, blackcurrant seed oil, hemp seed oil, cyanobacteria and from *Spirulina*) are used for treating problems with inflammation and autoimmune diseases [10].

3. Nutraceuticals in stem cell growth

Certain nutraceuticals produce significant effects on stem cell growth and proliferation and showed significant role in healing and tissue regeneration by stimulating and recruiting endogenous stem cell at the site of injury. Blueberries, green tea, catechins, carnosine, vitamin D3, PUFA and essential amino acids strengthen our immune system [11].

4. Nutraceuticals in mitochondrial bioenergetics

Mitochondria have been involved in the energy utilization during exercise and nutraceuticals implicated in the prevention and treatment of heavy exercise related to mitochondrial dysfunction. Mitochondria targeted nutraceuticals (MTNs) have antioxidant effects at the molecular level and boost mitochondrial bioenergetics. It has great impact on sports medicine [12].

5. Prolonging life Span

Nutraceuticals present in citrus fruits and soybean has effects on epigenetic modifications, autophagy and necrosis. Researches have shown that spermidine and its derivatives confer lifespan extension in humans by enhancing autophagy. Caffeic acid and Rosmarinic acid present in fruits, vegetables and herbs are also anti-carcinogenic, antioxidant, anti-rheumatic and anti-microbial. They can prolong the healthy life span extension [13].

6. Memory enhancement

Multivitamins, especially vitamins A, C, and E, have been shown to benefit cognition and spatial memory as well. Vitamins have been linked to better cognitive health, particularly in free recall memory. Vitamins A, C, B group, and E can act as antioxidants by scavenging free radicals and preventing oxidative stress [14].

Role of nutraceuticals in prevention of different diseases

1. Cardiovascular diseases

Nutraceuticals like flavonoids, flavones, flavonones, quercetin in onion, cruciferous vegetables, black berries, cherries, berries, apples and other antioxidant vitamins and minerals may reduce the risk of death from CVDs. They inhibit cyclooxygenase pathway and anigiotensin converting enzyme (ACE) which is responsible for high blood pressure [15]. They also prevent platelet aggregation and stickiness. Flavonoid groups strengthen tiny capillaries which carry oxygen and essential nutrients to all cells. Polyphenols present in grapes alter cellular metabolism and signaling which reduces arterial diseases [16].

2. Diabetes

Isoflavones are phytoestrogens; they have a structural as well as functional resemblance to human oestrogen as well as have been expended by human's world-wide of all phytoestrogens, soy isoflavones have been studied most. A high isoflavones intake (20–100 mg/day) is connected with lower incidence of type II diabetes, heart disease, osteoporosis as well as certain cancers. Omega-3 fatty acids have been proposed to reduce glucose tolerance in patients predisposed to diabetes [17].

3. Cancer

Nutraceutical rich bioactive dietary components have the ability to prevent cancer [18]. Herbal nutraceuticals possess anti-mutagenic and anti-carcinogenic properties. Antioxidant activities of carotenoids, lycopene are effective for cancer. They are oxygen quencher and decreases oxidative stress. Nutraceutical controls DNA damaging factors in cells and prevents DNA transcription in tumors [19].

4. Obesity

Obesity is a medical condition characterized by accumulation of excess body fat. Nutraceuticals like excellent anti-obese properties. Herbal nutraceuticals like chitosan, caffeine, fenugreek, vitamin C, green tea, curcumin, black gram, bottle guard reduces body weight [20].

5. Eye disorders

Nutraceuticals rich diet appears beneficial for age related macular degeneration. Lutein, DHA, green tea, carotenoids, flavonoids, vitamin E, coenzyme Q10 possess antioxidant activity and are affective for presbyopia, cataracts. Zeaxanthin is used for the treatment of glaucoma, visual disorders [21].

6. Stress Management

Stress is a vital part of our psychological make up and is a threat to our existence. The natural bioactive compounds called adaptogens helps to cope up against stress related cellular damages. Herbal nutraceuticals like ashwagandha, rhodiola, L-theanine, ginseng are effective adaptogens that activates the production of stress suppressing heat-shock protein 70 (HSP-70). They also stabilize physiologic processes, promotes homeostasis, increases resistance to environmental stress, reduces moderate to severe anxiety, improves sleep, reduces depression and improves secondary memory [22].

Conclusion

Nutraceuticals have proven health benefits and their consumption will keep diseases away and allow humans to maintain an overall good health. They are widely accepted by all

age groups due to their safety, higher quality, purity, efficacy, health promoting and disease curing properties. In the current scenario of self-medication, nutraceuticals play major role in development of health.

References

1. Das, Arpita, Utpal Raychaudhuri, and Runu Chakraborty. (2011), Cereal Based Functional Food of Indian Subcontinent: A Review. *Journal of Food Science and Technology*, 49(6), 665–72.
2. Rahmanpoor, Hananeh Abdolrahman. (2019), Nutraceuticals: Nutritionally Functional Foods – an Overview. Biomedical Journal of Scientific & Technical Research, 4(7). 340 – 347.
3. Syeda Kaniz, Tehreem, Huma Bader Ul Ain, Tabussam Tufail, Hafiza Nazia, Bahisht Rizwan, Zeenat Islam, Farah Shamim, et al. (2022), Therapeutic Potential and Nutraceuticals Aspects of Lepidium Sativum. *Pakistan BioMedical Journal*, 03–06.
4. Ghani, U., Naeem, M., Rafeeq, H., Imtiaz, U., Amjad, A., Ullah, S., ... & Qasim, F. (2019), A Novel Approach towards Nutraceuticals and Biomedical Applications. *Sch Int. J. Biochem*, 2, 245-252.
5. Lee, J., Koo, N., & Min, D. B. (2004), Reactive oxygen species, aging, and antioxidative nutraceuticals. Comprehensive reviews in food science and food safety, 3(1), 21-33.
6. Suryawanshi MV, Shinde PB, Bhave PM. (2016), Review on: Nutraceuticals and Its Impact on Healthcare. *International Journal of All Research Writings*, 1 (11)7–11.
7. Moges Demes. (2021), Review on Therapeutic Potential of Nutraceuticals in Human Health. *International Research Journal of Biotechnology*, 11(4) 1–2
8. Singh, J., & Sinha, S. (2012), Classification, regulatory acts and applications of nutraceuticals for health. *International Journal of Pharma and Bio Sciences*, 2(1), 177-187.
9. Gonçalves, R. F., Martins, J. T., Duarte, C. M., Vicente, A. A., & Pinheiro, A. C. (2018), Advances in nutraceutical delivery systems: From formulation design for bioavailability enhancement to efficacy and safety evaluation. Trends in Food Science & Technology, 78, 270- 291.
10. Vaishya, Raju, Amit Kumar Agarwal, Amish Shah, Vipul Vijay, and Abhishek Vaish. (2018), Current Status of Top 10 Nutraceuticals Used for Knee Osteoarthritis in India. *Journal of Clinical Orthopaedics and Trauma*, 9, 4: 338–48.

11. Ashwlayan, Vrish Dhwaj, and Saurabh Nimesh. (2018), Nutraceuticals in the Management of Diabetes Mellitus. Pharmacy & Pharmacology International Journal, 6(2), 220 – 227.
12. Ostojic SM. (2017), Mitochondria-targeted nutraceuticals in sports medicine: a new perspective. Research in Sports Medicine; 25. 91-100.
13. Moyad, Mark A. (2022), Nutraceuticals and Phytotherapy in Men's Health: Antioxidants, Pro-Oxidants, and a Novel Opportunity for Lifestyle Changes. Urologic Clinics of North America, 49(2), 239– 248.
14. Dutta, Sangita, Kazi Monjur Ali, Sandeep Kumar Dash, and Biplab Giri., (2018), Role of Nutraceuticals on Health Promotion and Disease Prevention: A Review. *Journal of Drug Delivery and Therapeutics*, 8, (4): 1759- 1761.
15. Hu FB, Willett WC. (2002), Optimal diets for prevention of coronary heart disease. JAMA; 288(20):2569-2578
16. Wildman REC. (2007), Nutraceuticals and Functional foods. CRS Press, New York, 1-9.
17. Coleman-Jensen, Alisha, Christian Gregory, and Anita Singh. Household Food Security in the United States in 2013. SSRN Electronic Journal, 2014.
18. Cencic A, Chingwaru W. (2010), Antimicrobial agents deriving from indigenous plants. RPFNA; 2:83-92.
19. Balsano C, Alisi A. (2009), Antioxidant effects of natural bioactive compounds. Current Pharmaceutical Design; 15(26):3063-3073.
20. Cencic A, Chingwaru W. (2010), Antimicrobial agents deriving from indigenous plants. RPFNA; 2:83-92.
21. Khan RA, Elhassan GO, Qureshi KA. (2014), Nutraceuticals: In the treatment and prevention of diseases –an overview The Pharma Innovation Journal; 3(10):47-50.
22. Kalra EK. Nutraceutical-definition and introduction. AAPS Pharmaceutical Science 2003; 5(3):27-28.

A REVIEW ON ROLE OF ANTIOXIDANTS IN HUMAN HEALTH AND DISEASE

Sangeetha.A[1] and Fadeela.A[2]

[1]Assistant Professor, [2]Post Graduate student, Department of Nutrition and Dietetics

Jamal Mohamed College, Tiruchirappalli, Tamil Nadu, India

drsangeeram@gmail.com,[1] fadeeala17@gmail..com[2]

Abstract

Antioxidants plays an important role in prevention of free radical formation and helps in preventing various diseases such as cancer, cataract, cardiovascular disease, Alzheimer's disease. Antioxidants protect the health of the individual by their ingestion with the food. Antioxidants protect against damage caused by free radicals and oxidative stress. In addition to free radicals generated as a part of the natural metabolic process, the body also has to deal with free radical species derived from the environmental contaminants such as smoke, carcinogenic chemicals derived from the food additives and industrial effluent and radiation. Dietary Antioxidants can be nutrients and non-nutrients. Dietary components identified as Antioxidants are beta-carotene, vitamin C, A and E, and carotenoids. There are several foods such as fruits, green leafy vegetables, nuts and oil seeds which have been found to have good Antioxidants potential. Free radicals plays an important role in the normal physiological functioning of the body health. However, excess free radicals, it can increase a person disease risk.

Keywords: *Free radical, oxidative stress, disease, dietary antioxidants, food additive.*

Introduction

Antioxidant is a molecule stable enough to donate an electron to a rampaging free radical and equalize it, thus reducing its capacity to damage. These antioxidants delay or impede cellular damage mainly through their scavenging property. Oxygen is an element indispensable for life. When cells use oxygen to generate energy, free radicals are created as a consequence of ATP (Adenosine Triphosphate) production by the mitochondria Reactive oxidation species and reactive nitrogen species are the by products resulting from the cellular redox process [1]. The recent enhancement of science about free radicals has led to development in medicine. When excessive amounts of free radicals and oxidants are produced, they result in a condition called, oxidative stress this condition represent a harmful process that may change the cells structures

considerably and destroy lipids, lipoproteins, and DNA. Natural antioxidants are primarily phenolic that occur in all parts of plants such as, fruits, vegetables, nuts, seeds, leaves, roots and barks. The fruits and vegetables that have carotenoids, anthocyanin's, flavonoids contain powerful antioxidants activities and multiple health benefits, such as delaying aging, repairing the nervous system, anti-atherogenecity, anticancer, and anti-inflammation [2,3]. There are several enzymes system within the body that scavenge free radicals, the principle micronutrient antioxidants are vitamin E (alpha-tocopherol), vitamin C (ascorbic acid) and Beta-carotene [4].

Major antioxidants and their sources

Vitamin C: fruits and vegetables eg, oranges, pear, broccoli, amla, tomatoes.

Vitamin E: Grains, sunflower seeds, nuts, vegetable oil eg, soybean, corn.

Carotenoids: Peppermint, spearmint (Curutchet et al.2014), parsley, celery, basil, coriander, (Pokorny & Panek 2012).

Beta-carotene: amaranth, dark green leafy vegetables, red carrots.

Anthocyanins: grapes, sweet potatoes, berries.

Flavonoids: Cranberries, kale, beets, berries, grapefruit, lemon, oranges [Banerjee et al, 1993].

Antioxidants in human health

Vitamin C

Vitamin C (ascorbic acid), it is water soluble vitamin. Health benefits of vitamin C are antioxidant, anti-atherogenic, anti-carcinogenic, immunomodulator. It has been determined that 200mg of vitamin C a day may reduce the amount of stress hormones. Stress destroys the immune system. [5]

Vitamin E

Vitamin E, a fat soluble vitamin, is one of the most major antioxidants. The main role of tocopherol as an antioxidant is to break chain of free radical. Abdalla, (2009) reported that it is one of the most important lipid-soluble primary defense antioxidant.

Beta-carotene

Beta-carotene, is a fat soluble carotenoids which are considered pro-vitamins as they can be converted into active vitamin A (retinol). Human intervention studies show moderate UV protective effects of beta-carotene in the skin [6].

Flavonoids

Flavonoids are generally classified into seven subclasses: flavonols, flavones, isoflavones, anthocyanidins, flavanones, flavanols, and chalcones. It has been suggested that vision may be improved by anthocyanin consumption. Anthocyanin from bilberries has been reported to enhance night visual acuity. A study in the USA with 200,000 men and women has showed that consuming apples, pears, and blueberries containing anthocyanin reduced the risk of diabetes. [7]

Role of Antioxidant in preventing disease

Cancer

Cancer remains one of the main diseases that burden healthcare system worldwide. In fact, over 19 million new cases of cancer were recorded in 2020, with around 10 million deaths globally for the same year (H. Slika et al, 2022). A review of more than 50 case-control and cohort studies that investigated intakes of vegetables and fruits, vitamin C and E, reported that, across studies, individuals in the highest quartile or quintile of vegetable and fruit intake had approximately 40% less risk of gastrointestinal and respiratory tract cancers than those in the lowest intake levels (Byers and Guerrero, 1995). Vitamin C is a common exogenous supplement that can scavenge free radicals and has a well-established protective role in carcinogenesis. Epidemiological evidence consistently relates low antioxidant intake or low blood levels of antioxidants with increased cancer risk (Block et al., 1992).

Cardiovascular disease

Cardiovascular disease is one of the leading causes of death globally and has other health contributing risk factors such as obesity and type-II diabetes mellitus. Oxidative stress is a primary or secondary cause of many cardiovascular diseases (Lien et al., 2008). An important development has been made in the field of heart disease, and it is now proven that some polyphenols, administered as enhancement or with food, improve health conditions, as evidenced by the number of vital markers closely associated with cardiovascular risk. Basic research (Vita JA, 2005), has provided credible mechanisms by which vitamin E might exert cardiovascular benefit, including inhibition of oxidation of low density lipoprotein (LDL) cholesterol in plasma [8]. Vitamin C and beta-carotene lowers risk of CAD.

Alzheimer's disease

Alzheimer disease (AD) is the most common human neurodegenerative diseases that causes dementia in the elderly. Many flavonoids are reported to have neuroprotective effects against AD (Ji and Zhang 2006). Flavonoid protects neuronal cells from oxidative stress. Flavonoid treatments also have been reported to improve learning, memory and neurocognitive performance (vauzour2004). Other antioxidants with neuroprotective function in context of AD include vitamins (Vitamin B_{12}, E and C). Some studies have shown a correlation between intake of vitamin E-rich foods, like fruits and vegetables, and a decreased incidence of AD (Lee et al. 2005).

Cataract

A cataract is a clouding or opacification of the normally clear lens of the eye or its capsule (surrounding transparent membrane) that conceal the passage of light through the lens to the retina of the eye. Ravindran et al [9], found that those with highest plasma levels of vitamin C had reduced the risk of nuclear cataract compared with those with lowest levels. The WHS (World Health Survey) found that, compared with women who had the lowest intakes of lutein and zeaxanthin, women with the highest levels had a reduced risk of any cataract as diagnosed by a physician. (Christen WG, et al., 2008). Klein found, that in his prospective studies, that those who supplemented with vitamin A had reduced risk of cortical cataract.

Conclusion

In recent times, the use of chemicals, food additives, smoking, and even synthetic medicine has increased the risk of diseases. In these times maintaining a healthy lifestyle is essential to prevent chronic diseases. Antioxidants are significant in our day-to-day lives to prevent free radicals and oxidative stress that cause chronic diseases. Major source of antioxidants are plant foods, Indian spices, fruits, vegetables and medicinal plants. Incorporating these antioxidants in the diet helps people to lead a healthy lifestyle.

References

1. Pham-Huy,L. A., He, H., & Pham-Huy,C. (2008), Free radicals, antioxidants in disease and health *Int J Biomed Sci.*; 4(2);89-96.
2. Baby, B.; Antony, P.; Vijayan, R. (2018), Antioxidant and anticancer properties of berries. *Crit. Rev. Food Sci. Nutr.* 58, 2491–2507.
3. Young, A.J.; Lowe, G.L. (2018), Carotenoids—Antioxidant Properties. *Antioxidants (Basel, Switzerland*) 7, 28.
4. Levine M, Ramsey SC, Daruwala R, Park JB, Wang Y. (1991), Criteria and recommendation for Vitamin C intake. *JAMA.*; 281:1415–23.
5. Myant,K.B.;cammareri,P.;McGhee,E.J.;Ridgway,R.A.;Huels,D.J.;Cordero,J.B.;Schwitalla,S.;Kalna,G.;Ogg.E-L.; athineos, D.; et al. (2013), ROS Production and NF-kB activation triggered by RAC1 facilitate WNT-driven intestinal stem cell proliferation and colorectal cancer initiation. *Cell. Stem cell.*, 12,761-773.
6. Köpcke W, Krutmann J. (2008), Protection from sunburn with beta-caroten-ameta-analysis. *Photochem Photobiol.*; 84:284–8
7. Al-Ishaq, R.K.; Abotaleb, M.; Kubatka, P.; Kajo, K.; Büsselberg, D. (2019), Flavonoids and their anti-diabetic effects: Cellular mechanisms and effects to improve blood sugar levels. *Biomolecules*, 9, 430.
8. Levy A. P., Blum S. (2007), (2011), Pharmacogenomics in prevention of diabetic cardiovascular disease: utilization of the haptoglobin genotype in determining benefit from vitamin E. *Expert Rev. Cardiovasc Ther*. 5: 1105–1111.
9. Ravindran RD, Vashist P, Gupta SK, et al. (1958), Inverse association of vitamin C with cataract in older people in India. *Ophthalmology*.; 118: e2–1965.e2.

HEALTH-RELATED QUALITY OF LIFE AMONG OVERWEIGHT / OBESE ADOLESCENTS

Aaysha Jameela J[1], Fatimah A[2] and Shafia Banu H[3]

[1,2] UG, Student, [3]Assistant Professor,

Department of PG Studies and Research in Home Science, Justice Basheer Ahmed Sayeed College for Women, Chennai, Tamil Nadu, India

shafiajbas@gmail.com

Abstract

Health-related Quality of Life (HRQOL) is a multidimensional construct that covers physical, psychological, and social health and hence represents overall health of an individual. Overweight / Obesity is associated with a significant disease burden – physical as well as psychological. The present investigation aimed to assess the health-related quality of life of overweight / obese college girls based on their socio-economic status. The sample for the present study comprised of Overweight or obese college-going girls belonging to different socio-economic strata, selected by purposive sampling, from various colleges in Chennai. The sample consisted of 120 college-going adolescent girls who fell under the overweight or obese category, based on their body mass index. The sample was divided into three groups based on their socioeconomic status – viz., low-income group, middle income group and high-income group and 40 girls were included under each income group respectively. KidsScreen-10 index was the tool used in the study. The results of the study revealed an average HRQOL among the sample. No significant difference existed in the mean HRQOL among the three income groups. With reference to the self-perception of health, many girls reported their health status to be 'Good' (40%) followed by 'Very Good' (29.2%). About 13.3% reported 'Excellent' health; 12.5% and 5.0% perceived their health to be 'Fair' and 'Poor' respectively.

Keywords: *Health related Quality Of Life (HRQOL), socioeconomic status, college girls, overweight, obesity.*

Introduction

Obesity has emerged as a global health problem with sharply increasing prevalence even among children and adolescents, over the past few decades. Obesity is associated with a significant disease burden and costs and is therefore an important public health concern. A high prevalence of adolescent obesity and overweight cases has been reported in developing countries undergoing nutritional transition, including India. It is estimated that overweight and

obesity in Indian adolescents ranged from 2.2 to 25.8% and 0.73 to 14.6 % respectively. Based on different studies, the prevalence of obesity in India was in range of 2.9% to 14.3%, and of overweight in range of 1.5% to 24.0%. More recently, it is reported that the prevalence of obesity among 5- to 19-year-old Indian children, ranged between 3.6 and 11.7%. It is further predicted that by 2025 there will be 17 million obese children in India (1,2,3). Overweight / Obesity is associated with a significant disease burden – physical as well as psychological. Obesity is associated with significant comorbidities and health problems such as diabetes mellitus, hypertension, coronary artery disease, orthopaedic problems, along with other problems such as impaired quality of life and negative self-esteem. Obesity and overweight are also found to be associated with body shape dissatisfaction among adolescents that may further lead to low self-esteem, emotional distress, and so on.

Health-related Quality of life (HRQOL) is a multidimensional construct that covers physical, psychological, and social health and hence represents overall health of an individual. HRQOL is based on the supposition that the primary judge of HRQOL is the individual whose health is assessed. Health Related Quality of Life (HRQOL) is concerned specifically with health aspects while also accounting for general QOL components (4,5).

Increasing rate of overweight/obesity and central adiposity among adolescent girls across socioeconomic strata, is a matter of concern. Overweight and obesity among adolescent girls demands more attention owing to the adverse repercussions on their metabolic and reproductive health apart from social concerns. Assessment of HRQOL among children and adolescents is important in identifying subgroups with poor health status and in guiding effective intervention strategies to improving health of the younger population. Taking these facts into consideration, the present study aims to assess the HRQOL among overweight or obese college girls from different socioeconomic status.

Methodology

The sample for the present study comprised of overweight or obese college-going adolescent girls from different socio-economic strata who were selected by purposive sampling technique from various colleges in Chennai, Tamil Nadu. The sample consisted of 120 college-going adolescent girls who fell under the overweight or obese category, based on their body mass index. The sample was divided into three groups based on their socioeconomic status – viz., low-income group, middle income group and high-income group and 40 girls were included under each income group respectively.

The questionnaire administered consisted of two sections – the first section comprised of Personal details and the next section included the KidsScreen-10 index, a short version of the KIDSCREEN-52 and KIDSCREEN-27 instruments developed by Ulrike Ravens-Sieberer et al for assessing HRQOL for children and adolescents. The responses to the items of the KidScreen questionnaire were on a 5-point likert scale. The questionnaire was given to the subjects after obtaining the consent of the subjects and explaining the purpose of the study. The collected data was then tabulated and statistically analysed using SPSS.

Results and Discussion

Socio-demographic profile of the college girls

The socio-demographic details elicited in the study included religion, institution, year and course of study.

Table 1: Socio-demographic profile of the college girls

Demographic variables	LIG (N=30)		MIG (N=30)		HIG (N=30)		TOTAL	
	N	%	N	%	N	%	N	%
Religion								
Hinduism	14	35	17	42.5	19	47.5	50	41.7
Islam	18	45	17	42.5	14	35	49	40.8
Christianity	8	20	5	12.5	7	17.5	20	16.7
Jainism	0	0.0	1	2.5	0	0.0	1	1.1
Total	40	100	40	100	40	100	120	100
Institution								
JBAS College	11	27.5	8	20.0	7	17.5	26	21.6
Ethiraj College	5	12.5	9	22.5	6	15.0	20	16.6
Stella Mary's College	5	12.5	4	10.0	8	20.0	17	14.2
WCC	5	12.5	4	10.0	6	15.0	15	12.5
MOP	0	0.0	3	7.5	2	5.0	5	4.2
Anna Adarsh College	0	0.0	2	5.0	6	15.0	8	6.7
Queen Mary's College	6	15.0	5	12.5	0	0.0	11	9.2
Bharathi Women's College	4	10.0	3	7.5	0	0.0	7	5.8
SKPC	2	5.0	1	2.5	1	2.5	4	3.3
MCC	2	5.0	1	2.5	2	5.0	5	4.2
SRM	0	0.0	0	0.0	2	5.0	2	1.7
Total	40	100%	40	100%	40	100%	120	100%

Year of study								
Under-Graduation								
I	7	17.5	7	17.5	9	22.5	23	19.2
II	20	50.0	17	42.5	12	30.0	49	40.8
III	10	25.0	12	30.0	11	27.5	33	27.5
Post-Graduation								
I	3	7.5	4	10.0	8	20.0	15	12.5
Total	40	100%	40	100%	40	100%	120	100%

The study sample included students from different colleges in Chennai, with a greater number of girls from JBAS college (21.6%) followed by Ethiraj College (16.6%). It can be observed that 41.7% of the study participants were Hindus closely followed by 40.8% Muslims and then 16.7% Christians and just 1.1% Jains. Most of the subjects were studying in II-year under-graduation course (40.8%) followed by III UG (27.5%), I UG (19.2%) and I PG (12.5%).

Body mass index category of the subjects

Table 2: BMI category of the subjects

Body Mass Index (BMI)		Income group					
		LIG (N=30)		MIG (N=30)		HIG (N=30)	
		N	%	N	%	N	%
BMI Category	Obese	16	40.0	25	62.5	16	40.0
	Overweight	24	60.0	15	37.5	24	60.0
Total		40	100%	40	100%	40	100%

It can be observed from table 2 that based on the BMI about 40% of girls were obese and 60% girls were overweight both in the low-income and high-income groups. With respect to the middle-income group, 62.5% were obese and 37.5% were overweight.

Table 3: Mean BMI of the subjects from all income groups

Income group	Mean BMI
LIG (N=40)	27.21
MIG (N=40)	28.79
HIG (N=40)	26.81
Total	27.61

The overall mean BMI of the sample was 27.61. The mean BMI of the college girls from different socioeconomic strata - LIG, MIG and HIG were 27.21, 28.79 and 26.81

respectively. A significant difference was not noted in the mean BMI among the three income groups.

Health related quality of life (HRQOL) of the subjects

Table 4: Mean HRQOL of the subjects

Income group	Mean HRQOL
LIG (N=30)	32.53
MIG (N=30)	32.60
HIG (N=30)	32.33
Overall	32.49

No significant difference existed in the mean HRQOL among the three income groups. The mean HRQOL score also points out to an average HRQOL among the study sample. There was neither an explicitly negative nor positive feedback with regard to Health-related Quality of Life (HRQOL) among the sample.

Self-perception of health

Table 5: Self-perception of health among the subjects

Self – Perception of Health	LIG		MIG		HIG		Total	
	N	%	N	%	N	%	N	%
Excellent	4	10.0	7	17.5	5	12.5	16	13.3
Very Good	16	40.0	10	25.0	9	22.5	35	29.2
Good	14	35.0	17	42.5	17	42.5	48	40.0
Fair	5	12.5	4	10.0	6	15.0	15	12.5
Poor	1	2.5	2	5.0	3	7.5	6	5.0

It can be understood from the table 5 that in general, many of the study subjects' view towards their health was reported as 'Good' (40.0%) followed by 'Very Good' (29.2%). Around 13.3% reported 'Excellent' health; 12.5% and 5.0% perceived their health to be 'Fair' and 'Poor' respectively.

With reference to the health perception, it is observed that more adolescents of MIG (17.5%) reported 'excellent' health as compared to LIG and HIG; 40% of adolescents in the LIG revealed 'very good' health which is the highest when compared to MIG and HIG, 42.5% of adolescents in HIG and MIG reported 'good health' against 35% from LIG; 15%, 12.5% and 10% of adolescents in HIG, LIG and MIG admitted 'fair health' respectively, 7.5% from HIG, 5% from MIG and 2.5% from LIG complained of 'poor health'.

Conclusion

Overweight / obese college girls included in the present study revealed an average HRQOL in general and no significant difference existed in the mean HRQOL among the three income groups.

References

1. Chudasama, R. K., Eshwar, T., Eshwar, S. T., & Thakkar, D. (2016), Prevalence of Obesity and Overweight Among School Children Aged 8-18 Years in Rajkot, Gujarat. *Indian Pediatrics*, *53*(8), 743–744.
2. Krishnaswamy, Vangal & Dudeja, Puja & Sashindran, V K. (2020), Obesity in School Children in India. 10.5772/intechopen.89602.
3. Shukla, N. K., Shukla, M., Agarwal, D., Shukla, R., Sidhu, H.K. (2016), Prevalence of Overweight and Obesity among Adolescents in India: A Systematic Review. *Int J Cur Res Rev. 8* (18). 21-25.
4. Yin, S., Njai, R., Barker, L., Siegel, P. Z., & Liao, Y. (2016), Summarizing health-related quality of life (HRQOL): development and testing of a one-factor model. *Population health metrics*, *14*, 22.
5. Xiao-Jun Lin, I-Mei Lin, Sheng-Yu Fan. (2013). Methodological issues in measuring health-related quality of life. *Tzu Chi Medical Journal*, *25* (1), 8-12, ISSN 1016-3190,

CONSUMER PERSPECTIVES ON ECO-FRIENDLY PACKAGING AND THE IMPACT OF PLASTIC IN THE FOOD INDUSTRY

Mohanambal.R[1] and Sangeetha.A[2]

[1] II M.Sc. Jamal Mohamed College (Autonomous), Department of Nutrition and Dietetics, Tiruchirappalli-620 020, Tamil Nadu, India

[2] Assistant Professor, Jamal Mohamed College (Autonomous), Department of Nutrition and Dietetics, Tiruchirappalli-620 020, Tamil Nadu, India

mohanambal495@gmail.com[1], *drsangeeram@gmail.com*[2]

Abstract

A greater concern for plastics and packaging associated with plastics has arisen from the increasing environmental consciousness. In the past few years, the development of food packaging films based on biopolymers and natural active ingredients has gained more attention because traditional petroleum-based plastic films are non-biodegradable and harmful to the environment. Research on food packaging is a rapidly developing area that is essential to ensure the safety of food components in order to support and keep a focus on the right supply of food. Food packaging material's primary purposes are to keep food from spoiling, increase its shelf life, and appeal to consumers. Extensive research in the fields of biopolymer and bioactive packaging were required to overcome these obstacles. This study aims to investigate the consumers' awareness, knowledge, preferences, and behaviors regarding sustainable packaging practices. The survey employed an online questionnaire distributed between the age group of 21 – 40 years, exploring consumer attitudes, awareness and preferences of eco-friendly packaging and plastic pollution in the food industry. The study delves into the perceived importance of eco-friendly packaging, consumer willingness to adopt such practices and the impact of plastic pollution awareness on purchasing decisions. This research contributes valuable insights to enhance sustainable practices in the food packaging sector and address concerns related to plastic pollution. The survey findings highlighting that eco-friendliness has become the foremost consideration, when selecting the food packaging and a major challenge in reducing the plastic packaging in the food industry is the limited availability of viable eco-friendly alternatives.

Keywords: *Biopolymer, food packaging, environment, sustainable packaging, plastic pollution.*

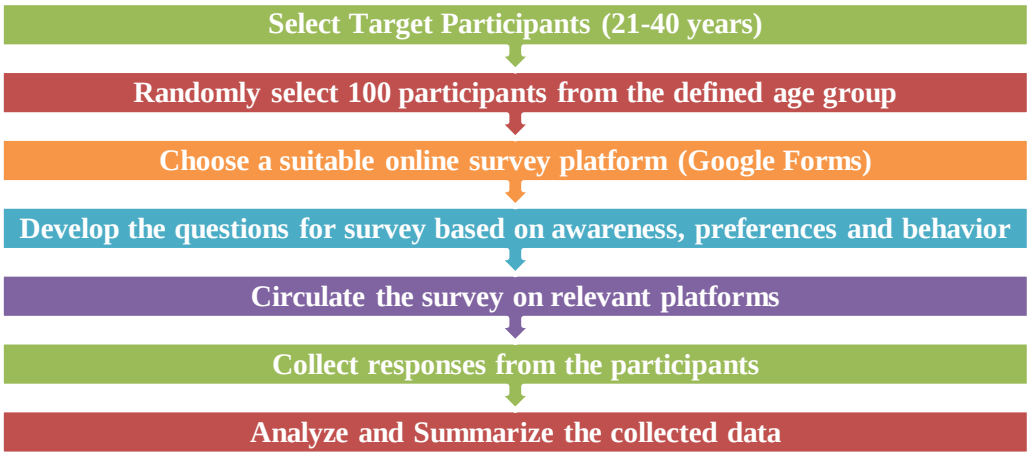
Introduction

According to recent shifts in consumer preferences toward waste reduction and greener packaging, the use of bio-based materials in the sustainable packaging sector has been experiencing significant growth.[1] Concerns about polluting the environment have been raised by the use of non-biodegradable materials in numerous packaging applications. When it comes to the synthetic plastic packaging market, the most increasing segment is food packaging.[5] One of the main purposes of food packaging is to prolong the shelf life of a product while preserving the food's quality by minimizing chemical, biochemical, and microbiological alterations.[6]

The ecological damage caused by the agricultural waste management and disposal which led to greater interest in developing eco-friendly alternatives such as bio-based packaging films to reduce the environmental harm caused by non-biodegradable plastics. In the context of sustainability and biodegradability, the demand for bio-based materials in packaging is projected to reach approximately 9.45 million tons by 2023, reflecting an increased focus on environmentally friendly solutions [4,7]. Finding a way to employ industrial leftovers as raw materials for bio-based goods would be advantageous for the environment and the economy at the same time [8].

Methodology

The primary method employed is the administration of a comprehensive survey using google forms. This digital platform offers a streamlined and user-friendly interface, enhancing the ease of participant engagement. Respondents will have the convenience of accessing the survey at their own pace, providing thoughtful responses to a series of targeted questions. Google forms simplifies survey administration and organizes data for analyzing consumer attitudes and behaviors on sustainable packaging and plastic pollution in food products.



Sample size

A stratified random sampling approach will be employed to ensure representation across various demographic factors such as age, gender, location, and occupations within the age group of 21 – 40 years. The goal is to achieve a diverse sample of 100 participants to provide a comprehensive overview of consumer perspectives.

Survey design

The questionnaire will be designed to assess consumer perspectives on eco-friendly packaging for food products and the impact of plastic in the food industry. This survey explores the perceived significance of environmentally friendly packaging, consumer readiness to embrace sustainable practices, and the influence of awareness about plastic pollution on consumer purchasing choices. The questionnaire will consist of 20 questions such as multiple-choice and Likert scale questions, maintaining brevity to encourage participation.

Distribution and Accessibility

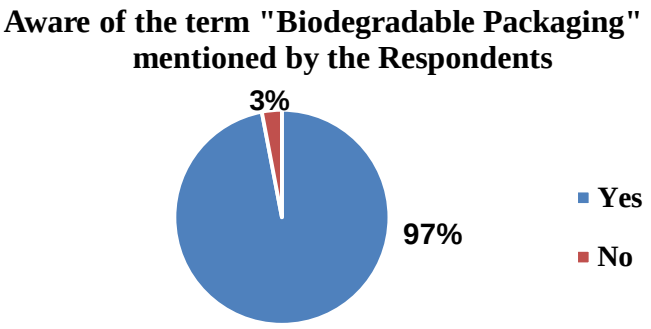
The online questionnaire will be distributed through various channels, including social media platforms, email lists and relevant online communities. Accessibility will be prioritized, allowing participants to respond at their convenience, thus maximizing the response rate. To enhance engagement, the survey will be mobile-friendly and accessible through various devices. Participants will receive assurance regarding the confidentiality of their responses.

Data collection and analysis

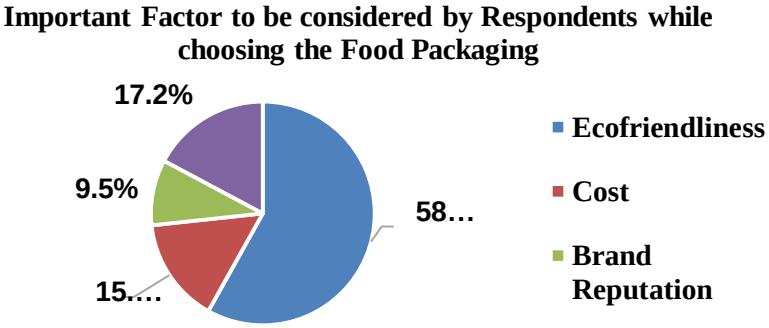
Data collection will span a two-week period to capture a broad spectrum of responses. A follow-up reminder will be sent to encourage the completion. Upon completion, data will be analyzed using statistical tools offering valuable insights to improve sustainable practices within the food packaging sector and tackle issues associated with plastic pollution.

Results and Discussion

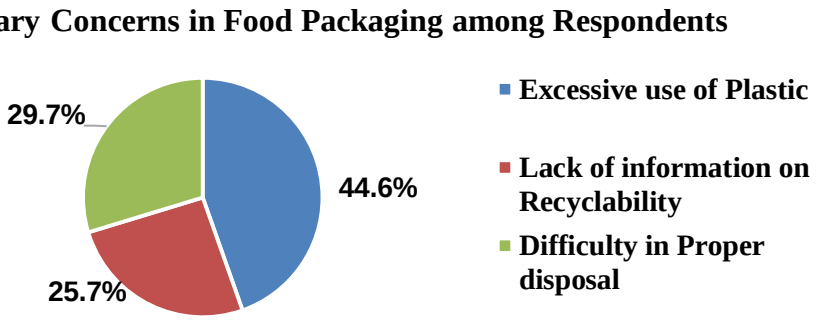
Eco-friendly packaging for food products has gained significant attention due to the environmental impact of traditional plastic packaging. This discussion aims to present the results and findings related to consumers' opinions on environmentally sustainable packaging options for food products. As environmental consciousness continues to rise, understanding these opinions becomes pivotal in steering the development and adoption of packaging solutions that align with both consumer preferences and ecological well-being.



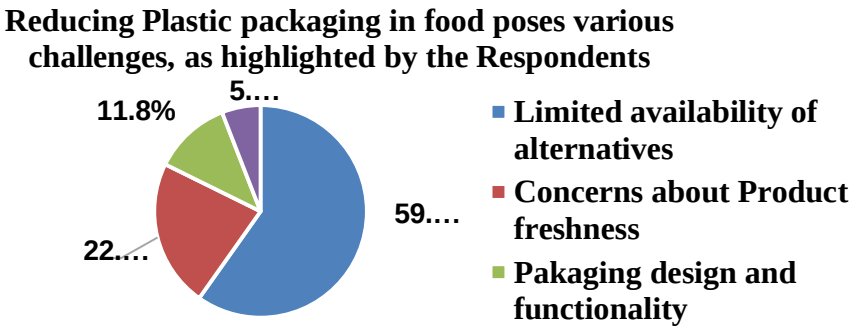
The high awareness level (97%) regarding the term "Bio-degradable Packaging" in the context of food products suggests that most of the respondents are familiar with this environmentally conscious packaging approach. The 3% of respondents who indicated that they are not aware of the term may highlights the ongoing need to educate on eco-friendly packaging solutions.



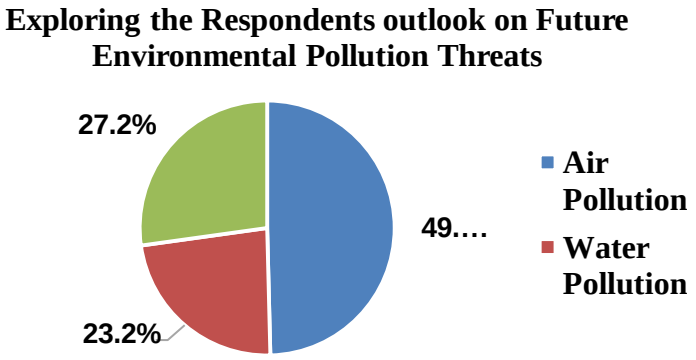
Many of the respondents (58.1%) prioritize eco-friendliness as the most important factor when choosing food packaging, underscoring a strong inclination towards environmentally sustainable choices. The lower emphasis on cost, brand reputation and convenience suggest a shifting consumer mindset towards prioritizing ecological considerations over traditional purchasing factors.



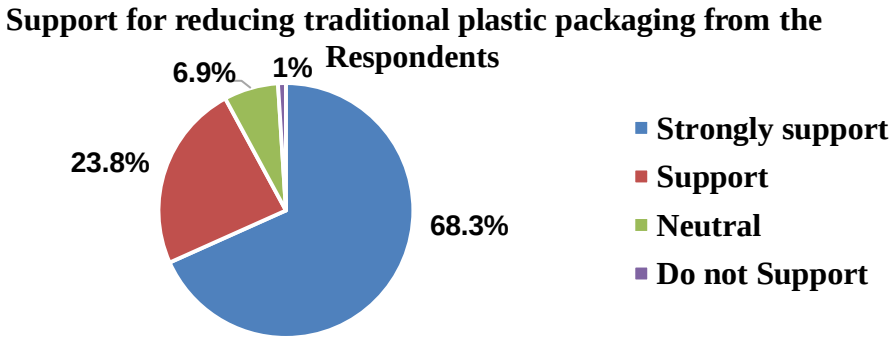
The primary concern among respondents regarding food packaging is the excessive use of plastic (44.6%). Additionally, 29.7% expressed concern about the difficulty in proper disposal, while 25.7% highlighted their worry about the lack of information on recyclability.



The primary challenge in reducing the use of plastic packaging in food is the limited availability of alternatives, with 59.8% of respondents identifying this as a significant barrier. Additionally, concerns about product freshness were noted by 22.5% of respondents, highlighting a potential trade-off between sustainability and the preservation of food quality.



According to Respondents, air pollution (49.6%) is the most significant environmental threat in the future reflecting the increasing recognition of its severe impact on human health and the environment, followed by 27.2% for land pollution and 23.2% for water pollution.



Most of the respondents expressed strong support (68.3%) for initiatives aimed at reducing the use of traditional plastic packaging, indicating a substantial willingness among the surveyed population to endorse sustainable packaging practices and an additional 23.8% expressing general support. Only a small percentage, 6.9% remain neutral on the matter, while a mere 1% do not support such initiatives.

Conclusion

This study reveals a widespread awareness of bio-degradable packaging among respondents, emphasizing the need for continued education on eco-friendly solutions. This could indicate a positive trend towards environmental consciousness among the surveyed individuals. Despite the existing awareness, there is a recognition that ongoing efforts are necessary to further educate people on the benefits and importance of choosing bio-degradable packaging. This could involve initiatives such as educational campaigns, workshops, or information dissemination to encourage more widespread adoption of environmentally friendly practices.

References

1. Corina L. Reichert, Elodie Bugnicourt and *et al*, (2020), Bio-Based Packaging: Materials, Modifications, Industrial Applications and Sustainability, *Polymers*, 12(7), 1558.
2. Dawei Yun and Jun Liu, (2022), Recent advances on the development of food packaging films based on citrus processing wastes: A review, *Journal of Agriculture and Food Research*, 9, 100316.
3. Yuvaraj. D, J. Iyyappan and *et al*, (2021), Advances in bio food packaging – An Overview, *Heliyon*, 7(9): e07998.
4. Jack Fehlberg, Chun-Lung Lee, Laurent M. Matuana and Eva Almenar, (2019), Orange peel waste from juicing as raw material for plastic composites intended for use in food packaging, *Journal of Applied Polymer Science*, 137, 48841.
5. Lindani Koketso Ncube, Albert Uchenna Ude and *et al*, (2020), Environmental Impact of Food Packaging Materials: A Review of Contemporary Development from Conventional Plastics to Polylactic Acid Based Materials, *Materials*, 13(21), 4994.
6. Morgana Weber Macena, Rita Carvalho, Luisa Paula Cruz-Lopes and Raquel P. F. Guine,(2022), Perceptions and knowledge regarding quality and safety of plastic materials used for food packaging, *Open Agriculture*, 7, 132-146.

7. Pinar Terzioglu, Fatma Guney and *et al*, (2021), Biowaste orange peel incorporated chitosan/ polyvinyl alcohol composite films for food packaging applications, *Food Packaging and Shelf Life*, 30, 100742.
8. Samira Syed, (2021), The Development of Bio-Composite Films from Orange Waste: A Methodological and Evaluation study of material properties, *University of Boras*.

NANOTECHNOLOGY AND FOOD PACKAGING

Devadharshini.M[1], Kaviyarasi.K[1], Ahalya.S[2], and Santhi.R[3]

[1]II M.Sc. student , [2]Assistant Professor, [3]Associate Professor

PG & Research Department of Chemistry, Seethalakshmi Ramaswami College

Tiruchirappalli, Tamil Nadu, India

santhichemsrc@gmail.com

Abstract

Food packaging is an integral part of the food sector and helps to store food with retained nutritional as well as organoleptic properties. Food packaging not only preserves the food from spoilage but also protects the sensitive bioactive compounds of foods from harsh physical and environmental conditions. Nanotechnology is being explored widely to improve food packaging. Nanotechnology is an emerging discipline of fabricating, manipulating, characterizing, and producing materials at the nano-level. Nanomaterials and edible coatings added with nanoparticles are more advantageous than conventional packaging materials in providing better preservation and quality maintenance of food products. Food packaging can be improved by adding nanoparticles to enhance mechanical and physical properties. Nano packaging is a new field of study and research in nanoscience. Role of nano technology in food industry and applications of nano technology for improving the quality of packaging of products have been discussed. Also, various types of nano particles that can be used, applications of nanocomposite, potential use of polymer clay nanocomposite in food packaging have been discussed. This review presents the role of nanotechnology in food microbiology and toxicological aspects of nanoparticle in food packaging. Finally, Safety and environmental concerns of (bio) nanotechnology implementation in food packaging were also discussed.

Keywords: *Nanotechnology, nanoparticles, food processing, food packaging.*

Introduction

Foods are highly susceptible to spoilage making them unacceptable for consumers. Food packaging is the critical point in proper handling and maintenance of food quality. Traditional food packaging has four basic functions: protection or preservation, containment, convenience and communication. Improvements are made in these basic functions to design improved, active and

smart packaging. Passive or traditional food packaging is nowadays turning towards active or innovative food packaging by incorporating the use of nanotechnology to produce clever, interactive and responsive food packaging with improved functionalities. Nanotechnology is an emerging discipline of fabricating, manipulating, characterizing, and producing materials at the nano-level (1–100 nm). Nanomaterial's and edible coatings added with nanoparticles are more advantageous than conventional packaging materials in providing better preservation and quality maintenance of food products. With tremendous benefits, nanotechnology also has some hazards that should be considered before utilizing them in our daily usage. Nanoparticles show different properties as compared to their bulk counterparts. Reduced size and increased surface area per unit volume, migration of nanomaterials into the food from a package, and consumer exposure to nanoparticles may cause potential health hazards. In this review, an attempt has been made to discuss the nanotechnology application in food packaging, and its potential risk and benefits.

Nano material-based food packaging

Nanotechnology is being explored widely to improve food packaging. Functional nanoparticles are found to improve the barrier properties, thermal stability, strength and durability of the packaging materials which as a result assist in the shelf-life extension of food products. Nano-based packaging material for quality retention and shelf-life extension of food products can be generally synthesized in two ways either by incorporating the nanoparticles in traditional food packaging materials such as films and containers or by fabricating nano composite multi-layer packaging materials and organic, inorganic and combined nano coatings by immersion, spraying or rubbing [1].

Improved food packaging

Improved food packaging is designed by adding nanoparticles to enhance mechanical and physical properties such as durability, strength, flexibility, biodegradability, thermal resistivity, UV absorptivity, water vapor and oxygen impermeability [2]. Nowadays, nano-coating is utilized in food packaging to design improved food packaging. Food coating can be applied in the form of thin layers or films which can be fabricated from both edible and non-edible material. The edible coating is a promising technology in prolonging the shelf life of food products. Different biopolymers such as polysaccharides, lipid proteins are used in the synthesis of edible coating. Nanofillers improve the mechanical properties, barrier properties and color of the edible film in comparison to simple edible but more research is required to make them competitive for

synthetic films [3]. They observed that TiO_2 nanoparticles improve the mechanical and oxygen barrier properties. It was also found that on increasing the TiO_2 nanoparticle concentration the UV impermeability in the starch-pectin blended films was increased [4].

Types of Nano particles:

Silver: Silver nanoparticles have proved to be most effective because of it has good antimicrobial efficacy against bacteria, viruses and other eukaryotic micro-organisms. They are undoubtedly the most widely used nanomaterials among all, thereby being used as antimicrobial agents, in textile industries, for water treatment, sunscreen lotions etc.

Gold: Gold nanoparticles (AuNPs) are used in immunochemical studies for identification of protein interactions. They are used as lab tracer in DNA fingerprinting to detect presence of DNA in a sample. Gold nanorods are being used to detect cancer stem cells, beneficial for cancer diagnosis and for identification of different classes of bacteria.

Alloy: Alloy nanoparticles exhibit structural properties that are different from their bulk sample.

Magnetic: Magnetic nanoparticles like Fe_3O_4 (magnetite) and Fe_2O_3 (maghemite) are known to be biocompatible. They have been actively investigated for targeted cancer treatment (magnetic hyperthermia), stem cell sorting and manipulation, guided drug delivery, gene therapy, DNA analysis, and magnetic resonance imaging (MRI) [5].

Application of nanocomposite

The number of applications of nanocomposites have been growing at a rapid rate. The worldwide production is estimated to exceed 600,000 tonnes and is set to cover the following key areas in the next five to ten years:

1. Drug delivery systems
2. Anti-corrosion barrier coatings
3. UV Protection gels
4. Lubricants and scratch free paint
5. New fire-retardant materials
6. New scratch/abrasion resist materials
7. Superior strength fibers and films

Improvements in mechanical property have results in major interest in nanocomposite in various automotive and general/industrial applications [6].

Potential use of polymer clay nano composite

The ability of nano clay incorporation to reduce solvent transmission through polymers such as polyamides has been demonstrated. Available data indicate that significant reduction of water absorption in a polymer could be achieved by nano clay incorporation. Nano clay is found to improve the barrier properties against gases and UV light [7].

Role of nanotechnology in food science and food microbiology

The nanostructured food ingredients are being developed with the claims that they offer improved taste, texture and consistency. Nanotechnology increasing the shelf-life of different kinds of food materials and also help to brought down the extent of wastage of food due to microbial infestation. The application of nanoparticles is not limited to antimicrobial food packaging but nanocomposite and nanolaminates have been actively used in food packaging to provide a barrier from extreme thermal and mechanical shock extending food shelf-life. In this way, the incorporation of nanoparticles into packaging materials offers quality food with longer shelf-life.

Nanoparticles having antimicrobial properties plays promising role in prolonging the shelf life of food products. Metal and metal oxide nanoparticles inhibits the growth of microbes using various mechanisms such as by increasing the formation of reactive oxygen species which causes the oxidative stress and results in cell death, binding with the DNA protein enzymes disrupting the cell functioning. Organic and inorganic nanoparticles are nowadays used in the fabrication of antimicrobial packaging material. Antimicrobial food packaging maintains the quality of foods and extends the shelf life of food by increasing the lag phase of microbial growth and retarding the growth rate.

Toxicological aspects of nanoparticles in food packaging

During the development of any novel food packaging material, the migration properties of the components must be studied to find out the migration of any harmful or undesired component in the food [8]. The toxicity of nanoparticles varies depending on their type, concentration, duration of exposure and sensitivity of individual. Organic nanoparticles may increase the bioavailability, in some compounds, this can cause toxicity so, in vivo and in vitro studies are required to develop safe food products. In recent years research has been done on the migration of nanoparticles in food products and most of these researches are done on silver nanoparticle migration [9]. Silver nanoparticle provides various properties to packaging material but their limitation exists due to

their potential of causing toxicity. The migration of nanoclay depends on the temperature, direct contact with food and nanoclay-polymer interactions. Some nanoclay induces cytotoxicity effect on long-term exposure [10].

However, if nanoparticles are properly embedded into the polymer matrix their chances of migration are not very high but some external factors can cause their migration into the foodstuff. So, it is important to study the migration, toxicity, permissible limit, and interaction of nanoparticles with polymer before fabricating any nanocomposite that comes in direct contact with food.

Conclusion

The increasing demand for varieties of food has increased the research in the development of more reliable and effective food packaging. Nanotechnology has come forward with hope for the food sector in developing food packaging with improved physical, mechanical and functional properties. The incorporation of suitable nanomaterial in the polymer matrix improves the mechanical, water barrier, oxygen barrier and antimicrobial properties of the packaging material and thus enhances the shelf life of the food products. Nanoparticles are also employed in the fabrication of active and intelligent packaging that has a better ability to prolong the shelf life and communicate with the retailer as well as the consumer. The use of nanoparticles produces remarkable improvement in the properties of packaging polymer but it is not as smooth as it seems. Hence, it is important to study the migration, toxicity and permissible limit of nanoparticles when using them in food packaging polymer that comes in direct contact with food. However, the upcoming trends in food consumption indicate nanotechnology at the front line and dominating technique in the field of food packaging.

References

1. Ashfaq.A, N Khursheed, S Fatima, Z Anjum, (2022), Application of nanotechnology in food packaging: Pros and Cons, Journal of Agriculture and Food Research.
2. Garcia.CV, GH Shin, JT Kim, (2018), Metal oxide-based nano composites in food packaging: Applications, migration, and regulations, Trends in food science & technology.
3. Jeevahan. J, M Chandrasekaran, (2019), Nano edible films for food packaging: A review, Journal of Materials Science.

4. Dash.KK, NA Ali, D Das, D Mohanta, (2019), Thorough evaluation of sweet potato starch and lemon-waste pectin based-edible films with nano-titania inclusions for food packaging applications, International journal of biological macromolecules.
5. Hasan. S, (2015), A review on nanoparticles: their synthesis and types, Research Journal of Recent Sciences.
6. Pandya.S, S Jani, A Chavan, AK Singh, S Bhatt, D Patel, B Bhatt, A Patel, A Girma, K Naik, Nanocomposites and IT'S application (2013), - review, International Journal of Pharmaceutical Sciences and Research.
7. Li.X, N Ji, C Qiu, M Xia, L Xiong, Q Sun, (2015), The effect of peanut protein nanoparticles on characteristics of protein-and starch-based nanocomposite films: A comparative study, Industrial Crops and Products,.
8. Souza. VGL, AL Fernando, (2016), Nanoparticles in food packaging: Biodegradability and potential migration to food - A review, Food Packaging and Shelf Life,
9. Bumbudsanpharoke. N, S Ko, (2015), Nano-food packaging: an overview of market, migration research, and safety regulations, Journal of food science.
10. Bandyopadhyay. J, SS Ray, (2019), Are nano clay-containing polymer composites safe for food packaging applications? - An overview, Journal of Applied Polymer Science.

A STUDY ON NUTRITIONAL STATUS AND EATING HABITS AMONG GIRLS DURING MENSTRUATION

Ramyadharshini.A[1], Asiffa Jabeen.N[2]

[1] II M.Sc Student, [2]Assistant Professor, Department of Nutrition and Dietetics,

Jamal Mohamed College, Tiruchirappalli, Tamil Nadu, India

u19ndd016ramyadharshini.a@gmail.com[1], asiffajabeen22@gmail.com[2]

Abstract

Menstruation is a component of the female reproductive cycle, which begins when girls reach puberty and sexual maturity. A woman's menstrual period lasts from three to seven days and starts roughly every 28 days after her previous cycle. Menstrual health is a significant concern for women's health. Eating habits are being impacted by the hectic and contemporary lifestyle. Adolescents are more susceptible to long-term health problems and chronic illnesses including anaemia, early menarche, and irregular menstruation because of lacking components like good eating habits and insufficient physical activity. Heavy bleeding, prolonged flow length, and unpredictable menstrual cycles have all been linked to sleep difficulties. It is true that menstrual issues may have an effect on social, emotional, and physical wellbeing. Menstruation is surrounded by a variety of psychological and religious barriers since the scientific process of menstruation is not well understood. Despite being a natural occurrence, menstruation is associated with a number of social beliefs and customs that can occasionally have a negative impact on health. The study has been done within the girls between the ages of 17-25. The research group were given a questionnaire which included the anthropometric measurements, sleep pattern, eating habits and dietary pattern of the girls during normal days and during menstruation. The main aim of the study is to know about changes in their dietary pattern and food intake of the girls during menstrual cycle.

Key words: *Menstruation, menstrual health, eating habits, sleep, dietary habits*

Introduction

Menstrual cycle is an inevitable and normal aspect in the life of women and girls. Menstruation is a normal and healthy process for girls who attain puberty, which indicates their sexual maturity. There are three phases follicular, ovulatory, and luteal namely. Average duration of menstrual cycle will be 28 days. The luteal phase starts at the conclusion of ovulation and lasts

until the start of the menstrual flow. The follicular phase starts on the first day of menstruation and lasts until the ninth day. The ovulatory phase takes place between days 10 and 14. Adolescent girls frequently experience psychosocial issues when they are menstruating. Their social lives and academic performance are impacted by menstrual issues.

The most prevalent psychological issues that teenagers reported during their menstrual cycle were fatigue, headaches, irritability, fear, sleep difficulties, anxiety, malaise and depression. The menstrual period is often accompanied by physical and mood-based changes in sleep patterns and quality. Physical symptoms like dysmenorrhea pain can interfere with sleep, have a detrimental effect on mood, and interfere with day-to-day functioning. It is well recognized that getting poor quality sleep increases negative affect, emotional reactivity, and the lifetime risk of developing affective disorders. During the menstrual cycle, many women alter their dietary patterns, particularly with regard to their cravings

The decrease in serotonin mediators during this time can account for the LP's increased carbohydrate consumption. Food usually reduces irritability or promotes positive affect. Increased serotonin production relieves symptoms, so craving sweet foods like chocolate would be an unconscious way of improving such symptoms. Moreover, eating usually results in a balance being reached as a form of relief from symptoms.

Methodology

Selection of study area and study group

The study took place in the districts of Pudukkottai and Tiruchirappalli. Girls between the age of 17 and 25 were the sample population for this study. 250 samples were involved in the study.

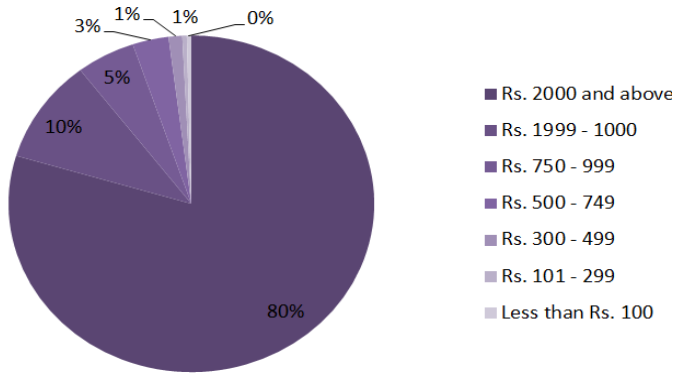
Conduct of study and analysis of data

The questionnaire was formulated and circulated among the girls. The questions regarding the general information, sleep pattern, habits, psychological behaviour, eating habits and dietary pattern during normal days and menstruation were included. The collected data was analysed to obtain the results.

Results and Discussion

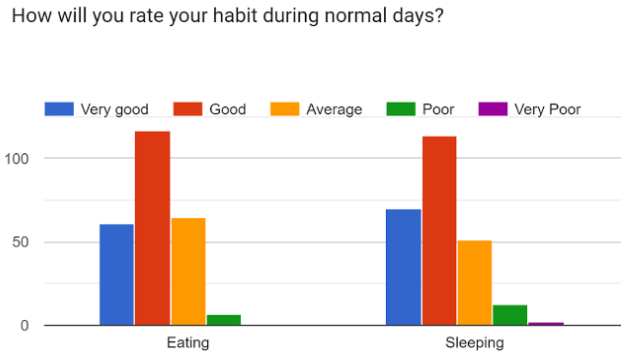
General information of the subjects, family type, income, food habits, dietary pattern and psychological behaviour of the individuals has been taken into the consideration for the study. The results were tabulated.

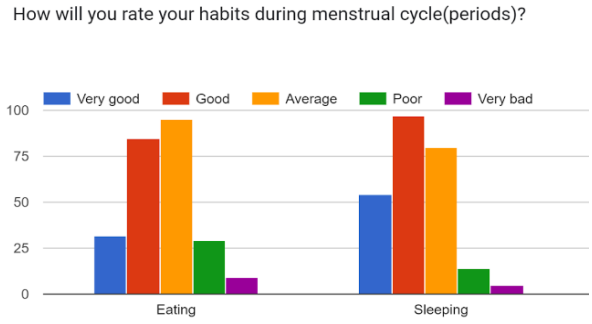
Table I: Total per capita income per month



From the above chart it is clear that most of the family's monthly income was Rs.2000 and above, only least number of families was with the low family income.

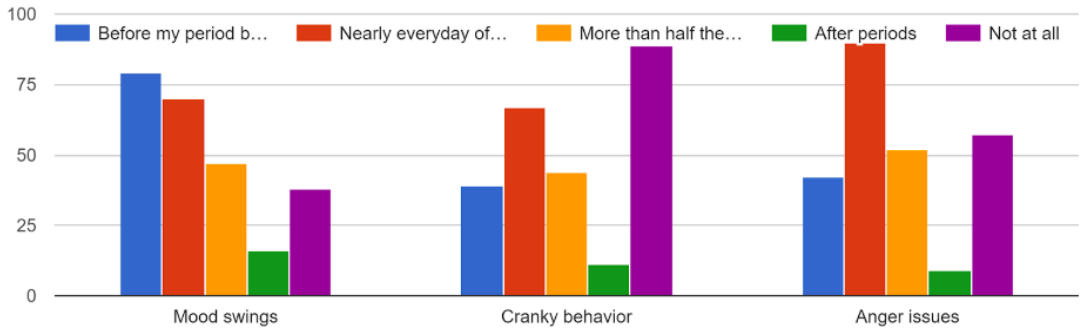
Table II: Comparison of eating and sleeping habits during normal days and during menstruation





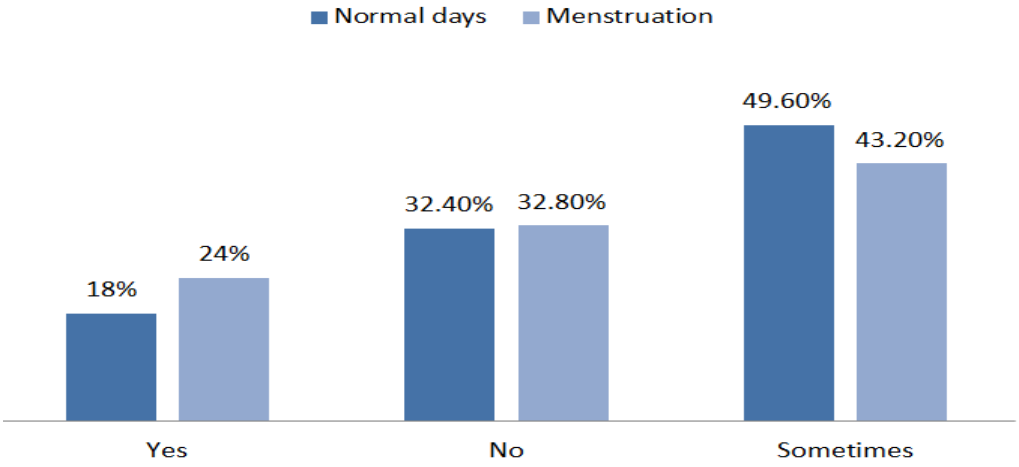
From the above data it is found that eating habits and sleeping pattern of the subjects were good during normal days. Also it is found that eating pattern reduced during menstruation than during normal days. Sleep pattern was good during menstruation. Some of them had mentioned the reduced sleep quality.

Table III: Psychological behaviour during menstruation



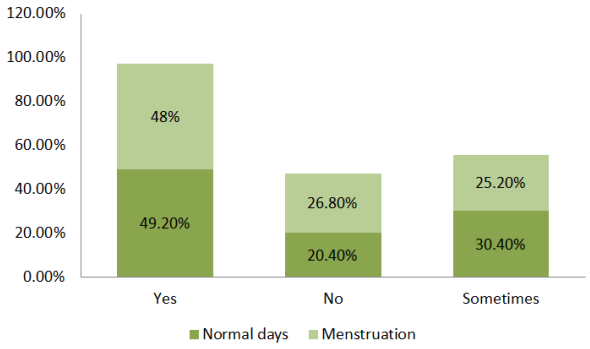
From the above data it is found that majority of the subjects had the mood swings before their period starts. Some of them found to have cranky behaviour nearly every day of their periods but maximum number of subjects doesn't show any cranky behaviour. Maximum number of sample had anger issues nearly every day of their periods.

Table IV: Comparison of skipping of meals during normal days and during menstruation



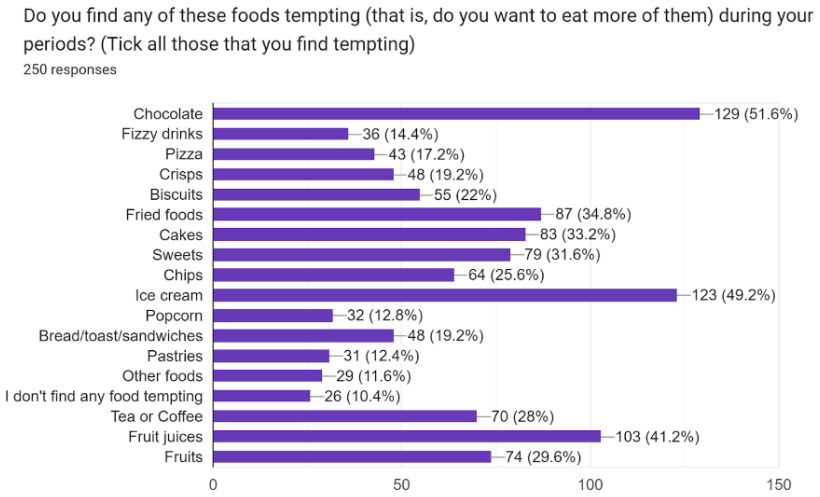
The study reveals that most of them will skip the meals during menstruation than during the normal days.

Table V: Food cravings during normal days and during menstruation



From the above data it is found that food cravings will be more during menstruation than during the normal days.

Table VI: Food habits during menstruation



The study reveals that maximum subjects have more temptation of chocolates and ice creams. Only least number of subjects found to be not having any temptation.

Conclusion

In this present study the samples included were 250. The socio economic status, eating and sleeping habits, psychological behaviour, food cravings and temptation of a food of an adolescent girls have been analysed.

It is revealed that there was a change in the eating habits during menstruation, but not much more changes in the sleeping pattern with some of the exceptions. There is also a change in the psychological behaviour of the subjects. Some of them were mentioned the mood swings before periods, some of them mentioned the cranky behaviour and anger issues during every day of their periods.

It is also found in this study, that skipping of meals was more common during menstruation than during the normal days. It is revealed that food cravings were more during the days of menstruation than during the normal days. The cravings for chocolate and ice creams were more during menstruation than any other foods.

References

1. Kapil Amgain, Sujana Neupane, Effects of BMI and food habits on Menstrual Characteristics among adolescent girls, *Europasean Journal of Medical Sciences*, 2019;1(1): 53-61.
2. Andre Luiz da Silva Teixeira, Walter Fernandes Junior, Fabio Antonio Damasceno Marques, *et al., (*2012), Influence of different phases of menstrual cycle on flexibility of young women, *Exercise and Sports Medicine Clinic,* 361-364
3. Shalini, Singh, V., Yadav, H. K., Bhankhar, S. K., & Behmani, R. K., (2022), Menstrual distress and psychological well-being, *International Journal of Health Sciences*, 6(S3), 8727–8734.
4. Meers JM, Nowakowski S, (2019), Sleep, Premenstrual Mood Disorder, and Women's Health, *Current opinion in Psychology,* 1-10.
5. Bryant. M, K.P. Truesdale and L. Dye., ((2006), Modest changes in dietary intake across the menstrual cycle: implications for food intake research, *British Journal o.f Nutrition.*
6. Ines Kammoun, *et al*., (2016), Changes in women's eating habits during the menstrual cycle, *Annales of endocrinology,* 1-4.

ASSESSMENT ON NUTRITIONAL STATUS OF OBESITY AMONG SELECTED SCHOOL GOING CHILDREN (5-15 YEARS) AND IMPART NUTRITION EDUCATION

Mahboob Nilofar Ameena.S.M[1] and Sheerin.S[2]

[1]M.Sc. students, [2]Assistant Professor, Jamal Mohamed College, PG Department of Nutrition and Dietetics, Tiruchirappalli, Tamil Nadu, India.

mubarakbinnila@gmail.com[1] ssheerin7@gmail.com[2]

Abstract

Obesity is one of the most prevalent nutritional diseases of children and adolescents in many developing countries. It is defined as a condition of excess body fat that creates increased risk for morbidity and premature mortality. Childhood obesity is a major public health issue and it is presently receiving a great deal of attention due to its border economic consequences and long term effects on overall health of children, academic achievements, quality of life and productivity when they become adults. Obesity in childhood frequently tracks into adulthood, increases in childhood obesity and overweight are the major contributors of adult obesity. In low-income and middle-income countries, increasing prevalence of obesity in children and adolescents as a global health issue. Meal skipping, eating away from home, snacking and fast food consumption are the some common unhealthy eating patterns among young adults. Assess the growth patterns of the selected students among the age group of 5-15 years. Compare the nutritional status among the selected students by the occupation of the family whether the students may either over-weight or not.

Key words: *Overweight, nutritional status, growth pattern, occupation.*

Introduction

Childhood obesity is a major public health issue and it is presently receiving a great deal of attention due to its border economic consequences and long term effects on overall health of children, academic achievements, quality of life and productivity when they become adults[1]. Obesity is one of the most prevalent nutritional diseases of children and adolescents in many developing countries [2]. Obesity during childhood is likely to continue into adulthood and is associated with cardio metabolic and psychological comorbidity as well as premature mortality. Abnormal or excessive fat accumulation that may impair health is known as overweight and

obesity. To classify overweight and obesity, Body mass index (BMI) is a simple index of weight-for-height that is commonly used. Overweight and obesity are defined as follows for aged between 5-19 years [3]:

BMI-for-age greater than 1 standard deviation above the WHO Growth Reference median is overweight; and Obesity is greater than 2 standard deviations above the WHO Growth Reference median.

Obesity and overweight are independent risk factors for increased morbidity and mortality throughout the lifecycle. Overweight and obesity are predictors of gestational diabetes during pregnancy and newborns with excessive birth weight in women because obesity in childhood frequently tracks into adulthood, increases in childhood overweight and obesity clearly are major contributors to the adult obesity epidemic[4].

Materials and methods

Selection of Area

The area selected for this study was Private School in Koothanallur, Thiruvarur district.

Selection of subjects

Among 300 samples were selected among the students of different classes belonging to the private school named in Koothanallur, Thiruvarur district. Among the school going boys and girls in the age group of 5-15 years were selected for this study.

Selection of method

A prior consent study was taken from the school administration. At the time of initiating the study each student were informed about the study. Anthropometric assessment, dietary assessment, physical activity, leisure activity was done for a total sample of 300 sample (5-15 years boys and girls) to assess their nutritional status. Then conduct clinical examination and impart nutrition education.

Collection of data

The questionnaire was executed to gather information regarding various aspects. By using the formulated questionnaire cum interview schedule was used to collect the information for the school going children (boys & girls). Since there was face to face communication and process of inter-stimulation between the interviewer and interviewee, it helped in true collection of data.

Results and Discussion

General information of the subjects, family size, types of family, income level and diet history have been taken into consideration for the study, tabulated and results are given. Anthropometric assessment of boys and girls are an important aspect to know individual body composition.

Table-I: Age wise distribution of the selected subjects (n=300)

Age (in years)	Selected Subjects (n=300)	Percent
5	38	12.66667
6	24	8
7	34	11.33333
8	30	10
9	35	11.66667
10	30	10
11	24	8
12	29	9.666667
13	24	8
14	17	5.666667
15	15	5
Total	300	100

In this study, 300 subjects were included from private matriculation school. Children were belongs to 5 to 15 age group. Out of 300 children, 13 percent were in the age group of 5 years, 8 percent were in the age group of 6 years, 11 percent were in the age group of 7 years, 10 percent were in the age group of 8 years, 12 percent were in the age group of 9 years, 10 percent were in the age group of 10 years, 8 percent were in the age group of 11 years, 10 percent were in the age group of 12 years, 8 percent were in the age group of 1

3 years, 6 percent were in the age group of 14 years, 5 percent were in the age group of 15 years.

MEAN AND STANDARD DEVIATION	AGE	SELECTED SUBJECTS (n=300)	PERCENT
SD	3.31662	7.25384	2.40594
N	11	11	11
MEAN	10.0000	27.2727	9.0636

Table-II: Gender distribution of the selected subjects (n=300)

Gender	Selected Subjects (n=300)	Percent
Boys	141	47
Girls	159	53
Total	300	100

In this present study both boys and girls were included. Out of 300 subjects, 47% were boys and 53% were girls. The number of girls was more than number of boys.

MEAN AND STANDARD DEVIATION	SELECTED SUBJECTS	PERCENT
SD	12.72792	4.24264
N	2	2
MEAN	150.0000	50.0000

Table-III: Types of family of the selected subjects

Age in Years	TYPES OF FAMILY			
	Nuclear family	Percent	Joint family	Percent
5	19	6.33333	19	6.33333
6	14	4.66667	10	3.33333
7	18	6	16	5.33333
8	23	7.66667	7	2.33333
9	24	8	11	3.66667
10	23	7.66667	7	2.33333
11	19	6.33333	5	1.66667
12	25	8.33333	4	1.33333
13	18	6	6	2
14	15	5	2	0.66667
15	12	4	3	1
Total	210	70	90	30

In this study most of the students were belongs to nuclear family, some were belonging to joint family. In this study 70 percent were belongs to nuclear family and 30 percent were belongs to joint family.

MEAN AND STANDARD DEVIATION	AGE	SELECTED SUBJECTS (n=300)	PERCENT
SD	3.31662	1.43333	1.79357
N	11	11	11
MEAN	10.0000	6.3418	2.6909

Table-IV: Economic status of the selected subjects (n=300)

Income Per Month (in Rupees)	Selected Subjects (n=300)	Percent
Below 5,000	87	29
5,000-10,000	84	28
10,000-15,000	70	23.33333
15,000-30,000	59	19.66667
Total	300	100

This present study reveals that 29 percent were belongs to economically weaker section, 28 percent were belongs to low income group, 23 percent were belongs to middle income group and 20 percent were belongs to high income group.

MEAN AND STANDARD DEVIATION	SELECTED SUBJECTS (N=300)	PERCENT
SD	12.98717	4.36071
N	4	4
MEAN	75.0000	24.9750

Table-V: Body weight distribution of the selected subjects (n=300)

GENDER	NUMBER OF CHILDREN	NORMAL	PERCENTAGE	OVERWEIGHT	PERCENTAGE
Boys	141	54	18	40	13.33333
Girls	159	64	21.33333	53	17.66667
Total	300	118	39.33333	93	31

From the above table, 39 percent were normal, 30 percent were underweight and 31 percent were overweight. Out of 118 normal students, 18 percent were boys and 21 percent were

girls. Out of 89 underweight students, 16 percent were boys and 14 percent were girls. Out of 93 overweight students, 13 percent were boys and 18 percent were girls.

MEAN & STANDARD DEVIATION	NUMBER OF CHILDREN	NORMAL	PERCENTAGE	OVERWEIGHT	PERCENTAGE
SD	12.72792	7.07107	2.33345	9.19239	3.04056
N	2	2	2	2	2
MEAN	150.0000	59.0000	19.6500	46.5000	15.4500

Table-VI: Nutritional status of the selected subjects (n=300)

GENDER	NUMBER OF CHILDREN	NORMAL	PERCENTAGE	MALNOURISHED	PERCENTAGE
Boys	141	70	23.33333	71	23.66667
Girls	159	75	25	84	28
Total	300	145	48.33333	155	51.66667

This study reveals that the malnourished student and normal student were 48 and 52 percent respectively. Out of 155 malnourished students, 71 percent were boys and 84 percent were girls. Out of 145 normal students, 23 percent were boys and 25 percent were girls.

MEAN AND STANDARD DEVIATION	NUMBER OF CHILDREN	NORMAL	PERCENTAGE	MALNOURISHED	PERCENTAGE
SD	12.72792	3.53553	1.20208	9.19239	3.11127
N	2	2	2	2	2
MEAN	150.0000	72.5000	24.1500	77.5000	25.8000

Conclusion

In this present study, out of 300 students, overall 48 percent were under normal nutrition and 52 percent were malnourished. The reason of malnourished students were improper dietary intake, lack of knowledge on nutrition and diet, improper diet follow, frequent snacking and financial support. Meal skipping, eating away from home, snacking and fast food consumption are the some common unhealthy eating patterns and may be the reason for malnourished. The prevalence of malnourished students is lack of knowledge about nutritional dietary intake and about balanced nutrition. The recommendation to improve the health status of the school going

children of the study are as follows schools need to provide knowledge and awareness about nutrition and balanced diet; need to include about the Health education as a part of curriculum apart from regular educational activities in the community; need to initiate awareness program on nutrition and balanced diet; by creation of facilities for financial growth of the people.

References

1. Centers for Disease Control and Prevention, Overweight and obesity; Defining overweight and obesity (http://www.cdc.gov/obesity/defining.html)
2. Supreet Kaur, HPS Sachdev, SN Dwivedi, R Lakshmy, Umesh Kapil. (1998), WHO consultation on obesity. Special issues in the management of obesity in childhood and adolescence. In: *obesity preventing and managing the global epidemic* Geneva: WHO, 231-47.
3. .Curhan GC, Willett WC, Spiegelman D, Colditz GA, *et al*. (1996), Birth weight and adult hypertension and obesity in women. *Circulation*. 94(6):1310-5.

DEVELOPMENT AND SENSORY ANALYSIS OF WHOLE JACK FRUIT PARTS OF *KOOZHA* AND *VARIKKA* BASED NUTRI FLOUR AND IT'S BREAKFAST PRODUCTS

Soumya P.S[1], Suma Divakar[2]

[1]Assistant Professor, St. Teresa's College, Ernakulam, India

[2]Professor Department of Community Science, College of Agriculture, Vellayani, Kerala Agricultural University, India

soumyahsc@gmail.com, suma.divakar@kau.in

Abstract

Jackfruit (Artocarpus heterophyllus Lam.) is one of the world's largest edible fruits. The ability of the jackfruit tree to produce higher yield of fruits than any other tree in the Moraceae family (ranging from 70 to 200 kg), is one of its distinctive characteristics. In 2018, Government of Kerala officially declared Jackfruit as its state official fruit [7]. The present study was conducted to develop jackfruit parts based nutri flour and to make three breakfast dishes like 'puttu, ada and oratti' by using twelve different parts of koozha and varikka. Nutri-flour formulations was made based on the results of glycemic index and each fruit parts of bulbs, perigones, seeds, rind, core and testa were used. Nutri- flour formulations was made based on the results of glycemic index. The major components (50-60%) of flour was contributed from the fruit parts with low glycaemic index and 40 % was formed by other components in different proportions. The order of glycemic index of jackfruit parts were observed as KJRF> KJTF >VJTF >VJRF > KJPF > VJPF >KJCF >VJCF > KJBF >KJSF > VJBF >VJSF. The mean scores for overall acceptability of puttu, ada and oratti were 7.3, 7.7 and 8.2 respectively.

Key words: *Glycemic index, bulbs, perigones, seeds and rind*

Introduction

The jackfruit tree (Artocarpus heterophyllus) of the mulberry family (*Moraceae*) is believed to have originated in the south western rain forests of India [1], around 300 B.C. The Greek philosopher Theophrastus described the tree as very large with wonderfully sweet and large fruits that were used as food by the sages of India [5].

In 2018, Government of Kerala officially declared Jackfruit as its state official fruit [7]. The therapeutic use of jackfruit bulbs and seeds for their peculiar qualities have been reported since ancient times. They are rich sources of phytochemicals including phenolic compounds that offers opportunities for the development of value-added products such as nutraceuticals

and various food applications, to enhance health benefits [8]. Jackfruit also contains phytonutrients, including lignins, isoflavones and saponins that have wide ranging health benefits. These are also considered as antioxidants, that play a vital role in maintaining human health and preventing disease [2]. Considering its nutritional and health benefits, there is need to promote this fruit for health and prevention of lifestyle diseases. The postprandial glycemic response to raw and ripe jackfruit elicits low glycemic index [3]. The flavonoids present in jackfruit extracts have been identified to be responsible for the non-toxic hypoglycemic action. The functional components of jackfruit help to reduce various diseases such as blood pressure, heart diseases, strokes and bone loss.

Methodology

Formulations for the nutri flour

Totally, the twelve different parts of jackfruit cultivars (koozha and varikka) were used for preparing jackfruit-based nutri flour. The bulbs, perigones, seeds, rind, core and testa of each cultivars were used. The major component (50-60%) of flour was contributed from the fruit parts with low glycaemic index and 40 percent was formed by other components in different proportions. The flours of all jackfruit parts were processed separately after pre-treatments and combined into ten formulations (F1 to F10), the control formulation (F11) comprised of 50% Koozha jackfruit bulb flour and 50% Varikka jackfruit bulb flour was also used for comparison.

Preparation of the product

The formulations were evaluated for their organoleptic qualities by processing them into three commonly consumed popular breakfast dishes like “puttu”, “ada” and “oratti”.

Preparation of ‘Puttu’: Nutri flour ‘puttu’ was prepared using 100g of nutri flour, 70 ml of water and 2g of salt; Nutri flour was mixed with salt and water was added in batches and blended thoroughly, to make a moist flour with crumbly texture. The nutri flour puttu was steamed with layers of grated coconut which totalled 1 table spoon.

Preparation of ‘Ada’: Hundred grams of nutri flour, 2g of salt and 95 ml of hot water was mixed in a bowl and knead into a soft dough. A portion of dough was spread on flamed banana leaf and flattened. A table spoon of grated coconut was placed in the center of the dough. The banana leaf was then folded and steamed for 10 minutes.

Preparation of ‘Oratti’: Hundred grams of jackfruit-based nutri flour was mixed with 1 table spoon of grated coconut, ½ teaspoon cumin seeds, 15 gm chopped onions, 1 gm green chilli and 120 ml water. Oratti was made on a hot greased tawa by spreading the dough manually into rounds. Preparation of score card Score cards were prepared on a 9-point hedonic rating.

The score card for sensory evaluation comprised of the sensory attributes – appearance, colour, aroma, taste, texture and overall acceptability. These were rated as scores ranging from 1- 9 [6].

Statistical analysis

The statistical analysis was carried out for the mean score obtained from sensory evaluation. The best treatment was identified from the interpretation of Kruskal-Wallis test.

Results and Discussion

The mean score and the mean rank values obtained for different sensory attributes of puttu, ada and oratti prepared with raw jackfruit-based nutria flour in combination with jackfruit different parts and control are presented in Table 1, 2 and 3.

Table 1. Mean scores for organoleptic evaluation of puttu prepared with jackfruit-based nutria flour

Treatment	Appearance		Colour		Flavour		Texture		Taste		OAA	
	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS
T1	9.70	4.3	33.83	5.2	34.22	6.2	17.77	4.4	31.65	3.5	15.66	3.4
T2	14.72	4.7	17.90	4	17.10	5.2	18.66	4.1	27.25	3.3	23.40	3.5
T3	29.94	5.1	24.50	4.4	28.40	5.8	31.60	4.7	24.45	3.1	21.50	3.4
T4	29.96	5.2	31.83	4.7	25.85	5.7	30.60	4.6	49.40	4.2	41.65	4.2
T5	45.00	5.7	34.38	5.2	47.35	6.6	34.30	4.9	41.40	3.8	46.70	4.5
T6	54.70	6.2	30.16	4.3	34.72	5.4	50.00	5.6	69.70	5	49.65	4.7
T7	64.70	6.7	67.00	5.7	66.83	6.8	70.60	6.9	50.50	4.2	54.45	4.9
T8	72.35	7.1	85.10	7.4	74.18	7.3	77.80	7.4	48.15	4.1	71.85	5.8
T9	81.66	7.4	82.65	7.1	81.90	7.8	77.61	7.2	90.05	6	93	7.3
T10	83.65	7.7	72.60	6.3	78.77	7.5	75.94	6.9	73.95	5.1	80.70	6.4
Control (T11)	98.80	8.2	99.50	8.6	102.00	8.5	100.66	8.2	104	7.3	102.5	8.3
K W Value	92.81		87.88		81.47		82.10		69.76		86.47	
λ^2 (0.05)	18.31											

The sensory evaluation revealed that the mean rank value for appearance of jack fruit based nutri flour puttu ranged between 9.70 – 83.65. The mean rank value for colour of jack fruit based nutri flour puttu ranged between 17.90 – 85.10. There was a significant difference between the mean rank score of colour. From the sensory analysis of flavour it was noticed that T9 obtained the maximum mean rank value 81.90 after the control T11 (102). While T2 obtained the minimum mean rank value 17.10. The highest mean score value for texture noticed

in T8 (77.80) after the control T11 (100.66) followed by T9 (77.61), T10 (75.94), T7 (70.60). T9 had high mean rank score for taste (90.05) and over all acceptability (93). Statistical analysis of the data revealed that there was significant difference between the mean rank score of different quality attributes of the jack fruit based puttu at 5% level.

Table 2. Mean scores for organoleptic evaluation of ada prepared with jackfruit-based nutria flour

Treatment	Appearance		Colour		Flavour		Texture		Taste		OAA	
	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS
T1	35.40	5.8	53.15	5.5	30.60	6.4	24.10	4.6	28.20	3.6	14.90	3.5
T2	21.80	5.3	20.10	4	21.05	5.8	16.60	4.2	23.65	3.4	18.55	3.8
T3	24.40	5.4	28.80	4.4	15.20	5.4	30.60	4.9	20.15	3.1	12.30	3.2
T4	32.80	5.7	34.95	4.7	29.38	6.1	28.50	4.8	48.15	4.5	44.10	4.7
T5	35.10	5.8	46.40	5.2	47.90	6.9	37.00	5.2	25.15	3.4	50.40	5.1
T6	51.95	6.4	27.30	4.3	43.83	6.3	54.80	6.2	69.50	5.4	47.20	4.9
T7	68.75	7	68.40	6.3	65.75	7.1	59.72	6.6	54.60	4.8	61.90	5.9
T8	76.95	7.3	54.22	5.7	80.16	8	87.90	7.7	71.70	5.6	79.30	7.2
T9	79.35	7.4	88.05	7.4	80.15	7.9	84.80	7.4	88.75	6.4	87.60	7.7
T10	82.25	7.5	81.75	7.1	81.65	8.1	78.35	7.1	79.45	5.9	84.00	7.5
Control	100	8.2	101.80	8.4	96.38	8.7	102.44	8.7	101.20	7.3	101.10	8.6
K W Value	76.94		76.09		83.73		90.22		83.70		97.277	
$\lambda^2(0.05)$	18.31											

The organoleptic evaluation revealed that the mean rank value for appearance of jack fruit-based Ada ranged between 21.80 – 82.25. The superior mean rank score had T10 (82.25) which was on par with T9 (79.35) and T8 (76.95) while the lowest was obtained in T2 (21.80). The highest mean rank value for colour was obtained by T9 (88.05) after control T11 (101.80) while T2 obtained the minimum mean rank value (20.10). Considering the flavour of jackfruit based ada the maximum mean score was obtained T10 (81.65) after control T11 (96.38). The minimum was obtained T3 (15.20). The superior mean rank value for texture was observed in T8 (87.90) which was on par with T9 (84.80) and T10 (78.35) while the minimum mean rank was (16.60) was obtained by T2. The maximum mean rank value for taste and overall acceptability were obtained T9 (88.75 and 87.60) and minimum mean rank value for taste was T3 (20.15). The lowest overall acceptability was observed by T3 (12.30)). Statistical analysis

of the data revealed that there was significant difference between the mean rank score of different quality attributes of the jack fruit based ada at 5% level.

Table 3. Mean scores for organoleptic evaluation of oratti prepared with jackfruit-based nutria flour

Treatment	Appearance		Colour		Flavour		Texture		Taste		OAA	
	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS
T1	22.88	5.4	49.90	5.6	40.30	6.6	19.75	5.1	26.60	4.1	26.55	4.3
T2	32.75	5.7	25.60	4.6	19.00	5.5	12.65	4.7	13.90	3.2	31.20	4.6
T3	22.85	5.3	30.45	4.8	33.66	6.2	25.40	5.4	23.40	3.9	9.65	3.2
T4	35.65	5.8	33.10	4.9	16.15	5.3	29.60	5.6	46.00	5.6	33.90	4.7
T5	27.80	5.5	42.25	5.3	37.40	6.4	40.05	6.2	21.80	3.8	49.50	5.5
T6	54.80	6.6	24.80	4.5	31.05	5.8	61.10	7.2	62.70	5.8	43.80	5.2
T7	64.30	6.9	63.81	6.5	74.25	7.5	57.95	6.9	66.10	5.2	71.40	7
T8	83.45	7.8	63.40	6.2	78.55	7.7	79.55	8.1	81.90	6.3	79.20	7.6
T9	86.05	7.9	91.50	7.6	88.85	8.2	92.30	8.3	87.00	6.6	89.90	8.2
T10	79.10	7.6	85.90	7.3	82.85	7.9	85.10	7.8	76.00	6.1	77.18	7.9
Control	92.15	8.2	103.77	8.5	93.00	8.4	97.10	8.6	102.10	7.6	101.60	8.8
K W Value	77.78		77.99		91.64		98.67		93.25		87.80	
λ^2 (0.05)	18.31											

The mean rank value for appearance of jackfruit based oratti had ranged between 22.85 to 86.05. The maximum mean rank value was obtained by T9 (86.05). In case of colour maximum mean score was for T9 (91.50) after control T11 (103.77). The minimum was observed in T6 (24.80). From the sensory analysis it was observed that the superior value for texture was obtained by T9 (92.30) after control T11 (97.10) and least value for T2 (12.65). Among all the parameters used for sensory analysis taste, is the most desirable characteristic for acceptability. The mean rank values for taste of the eleven treatments of ada ranged between 13.90 to 102.10. The highest mean rank score (87) for taste was obtained by T9 after control T11 (102.10) while lowest mean rank value was obtained for T2 (13.90). Among the eleven treatments T9 obtained the maximum mean rank value of 89.90 after the control T11 (101.60). Least mean rank value of 9.65 and less acceptability was noted for T3. Result of tests indicates that there was significant difference in the mean rank scores obtained for the eleven treatments T1 to T11. Hema (2015) studied the development of nutritious instant dried powder by mixing bulb and seeds of the jackfruit. The study suggested that the increment of the jackfruit seeds

powder in the formulation resulted into higher protein content and lower moisture content in the instant powder.

Statistical analysis by applying interpretation of Kruskal-Wallis test revealed that there was a significant difference between the appearance, colour, flavour, texture, taste and overall acceptability of products like 'puttu', 'ada' and 'oratti'. On the basis of analysis of mean scores T9 was selected as the best combination.

Conclusion

All the food sources comprise edible and non-edible waste portions, with increasing demand for food the current agriculture is focusing on agro-processing to utilize the maximum portion of the plant resources. With increasing pressure on the existing resources, there has been a substantial effort for the use of more and more agricultural waste and by-products to value-added products. Using jackfruit wastes and by-products for further exploitation have gained augmented interest because of their high value contents.

References

1. Boning, C.R. Florida's (2006), Best Fruiting Plants: Native and Exotic Trees, Shrubs, and Vines. 1st edition, Sarasota, Florida: Pineapple Press, Inc. 220.
2. Chandrika, V.G., Jangz, E.R., and Warnasuny, N.D., (2004), Analysis of carotenoids in ripe jackfruit in Kerala and study the bioconservation, *J. Sci. Food Agric.* 85(2), 186-190.
3. Hettiaratchi, U. P. K., Ekanyake, S., and Welihinda, J., (2011), Do Sri Lankan meals help decrease blood glucose response, *Ceylon. Med. J.* 54(2), 39-43.
4. Hema, J. (2006), Development of nutritious instant dried powder by mixing bulb and seeds of the jackfruit. MSc Thesis, Department of Bangabandhu Agro-processing, Sheikh Mujibur Rahman Agricultural University.
5. Srivastava, R. and Singh, A. (2020), Jackfruit (Artocarpus heterophyllus Lam) Biggest Fruit with High Nutritional and Pharmacological Values: A Review. *Int. J. Curr. Microbiol. App. Sci.*, 9(8), 764-774.
6. Sudha, M.L., Ramasarma, P.R., and Venkateswara Rao, G., (2011), Wheat bran stabilization and its use in the preparation of high-fiber pasta. *Food Sci. Technol. Int.,* 17(1), 47-53.
7. The Hindu, (2010), Jackfruit is Kerala's official fruit. The Hindu. 22 March.
8. Umesh, J. B., Pavan, S.N., and Bapal, V.A., (2010), Evaluation of antioxidant capacity and phenol content in jackfruit. *Plant Food,* 65, 99-101.

EVALUATION OF SENSORIAL ATTRIBUTES AND NUTRITIONAL QUALITY OF CASHEW APPLE JAM

Ameena Beebi B[1] and Balasasirekha R[2]

[1]Ph.D. Research Scholar, [2]Assistant Professor (SS),

Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu,

19phfnp007@avinuty.ac.in

Abstract

Functional foods refer to foods and food products that offer health benefits beyond basic nutrition. These foods typically contain bioactive compounds or ingredients that may have positive effects on health and preventing chronic diseases when consumed as part of a regular diet. This study focused on preserving the sensory attributes and nutritional value of cashew apples. The cashew rich in essential minerals, vitamins and sugars are permeated in the water matrix (juice) whereas the leftover fibre matrix (pomace) is a composite of cellulose, hemicelluloses, pectin and protein. The study aimed to develop cashew apples jam, using various sugars (sugar, jaggery, and palm jaggery). The sugar used cashew apple jam was coded as sample A, jaggery used cashew apple jam coded as sample B, and palm jaggery used cashew apple jam coded as sample C. The developed products were standardized and subjected to organoleptic evaluation with a 9-point hedonic scale. Thirty semi-trained panel members were evaluated the products. Sample B (jaggery used cashew apple jam) was considered the most accepted products compared to samples A and C. These preferred products were then subjected to nutrient analysis. The results revealed that cashew apple jam had high values of total fiber (7.31g), calcium (71.42mg), iron (6.13mg), folic acid (103.00µg), vitamin C (128.21mg), and beta-carotene (254.00µg). Despite the highly nutritious nature of fruit cashew apple, its perishable characteristics emphasizes that the production of preserved food products has economic benefits, potentially creating value-added products.

Keywords: *Cashew apple jam, sensory evaluation, and phytochemicals.*

Introduction

Cashew apples may be considered as functional fruit due to the presence of ascorbic acid, carotenoids, insoluble fibers and polyphenolic compounds. Functional food must provide health beneficial claims beyond that of the basic nutrients it possesses (Gul *et al*., 2016). Cashew apple is enriched with sugars, minerals and vitamins. It is the Cashew apple, one of the richest sources of ascorbic acid, B complex and other vitamins. As the cashew apple is highly nutritious, it may be applied for the preparation of various non-fermented and fermented products, viz. juice, syrup, jam, candy, chutney, pickle, liquor, wine, brandy, vinegar, etc. The pH, total sugar, phenolic content, protein and ascorbic acid of the yellowish colour fruit were 4.367, 10.573%, 365.303 mg/100 g GAE, 1.130% and 218.933 mg/100 g, respectively. (Singh *et al*., 2019). This study was aimed to preserve the nutritional quality of cashew apples by developing different products and exploring their commercial use. Typically considered as waste by cashew nut industries, the cashew apple can be transformed into valuable products, contributing to both waste reduction and enhanced economic utilization.

Objectives

Procurement and processing of raw materials for preparation of cashew apple jam.

Formulation and Standardization of cashew apple jam.

Evaluation of acceptability and nutritive value of cashew apple jam.

Methodology

1. Procurement and processing of raw materials for preparation of cashew apple jam

Cashew apple in the fresh form was obtained from Thirupuvanam, Ramnad District. Crisp, firm, tight, medium to large size and red colour developed apples selected for processing. Other ingredients such as sugar, jaggery and palm jaggery were purchased from the local market.

2. Formulation and Standardization of cashew apple jam

The jam was formulated using nutrient-dense ingredients in various proportions and the best product was chosen for various studies. The product was standardized by trials in clean and sterile instrumentation within the food process laboratory. The cashew apple jam was prepared in three different variations along with the standard. The ingredients were mixed in varied proportions to achieve three variations apart from the standard preparation. Sugar was used as the standard product whereas jaggery and palm jaggery were used in the variations in different percentages. Different standardisation methods using the types of sugar namely sugar,

jaggery and palm jaggery were carried out on trial basis and the best method of preparation was identified and is mentioned here.

i) Standardization of Jam using sugar - Sugar solution was prepared by adding 50 g of sugar in 40 ml of water over a medium of flame to dissolve the sugar completely. Then 50 ml of ground cashew apple pulp was added to the sugar solution, the mixture was heated at 100℃ for 14 minutes. Then 1 ml of lemon juice was added.

ii) Standardization of jam using jaggery - In 15 ml of water ,25 g of jaggery was dissolved over a medium flame and filtered the sugar syrup. Adding 75ml of ground cashew apple pulp and thoroughly combining it with the sugar syrup and heated at 83℃ for 15 minutes, after mixing in 1ml of lemon juice, the mixture was taken off from the heat turned off.

iii) Standardization of jam using palm jaggery - Sugar solution was prepared by adding 30g of palm jaggery in 15 ml of water over a medium of flame to dissolve the sugar completely than 70 ml of ground cashew apple pulp was added to sugar solution, the mixture was heated at 80℃ for 15 minutes.

The above methods were identified to be the best method as resulted in a cashew apple jam with the desired consistency and texture.

Table I-Development and Standardization of Jam

Ingredients	Variation I CAPJ1	Variation II CAPJ2	Variation III CAPJ3
Cashew apple fruit pulp (g)	50	75	70
Sugar (g)	50	-	-
Jaggery (g)	-	25	-
Palm Jaggery (g)	-	-	30
Water (ml)	40	15	15
Lemon juice (ml)	1.0	1.0	1.0

Three variations of jam were formulated as variation I coded as CAPJ1, variation II as CAPJ2 and variation III as CAPJ3. The pulp and sugar ratio were varied in the three variations. In variation I (CAPJ1), 50g of pulp and 50 g of granulated sugar were taken. In variation II (CAPJ2), 75g of fruit pulp and 25g of jaggery were taken. And in variation III (CAPJ3), 70g of fruit pulp and 30 g of the palm sugar were taken. All the three variations were standardized to 100g. Table 1 represents the preparation of jam using method three.

Results and Discussion

1. Sensory evaluation of cashew apple jam

Table II, depicts the sensory scores of cashew apple jam.

Table II- Sensory scores of cashew apple jam

Characteristics	Standard	Variation 1 CAJ1	Variation 2 CAJ2	Variation 3 CAJ3	ANOVA	
					F Value	P Value
Appearance	8.70 ± 0.4	8.23 ± 0.5	8.87 ± 1.0	7.57 ± 1.2	9.390	<0.00*
Color	8.70 ± 0.4	8.13 ± 0.5	8.13 ± 1.1	7.27 ± 1.1	17.62	<0.00*
Flavor	8.63 ± 0.5	8.10 ± 0.7	8.10 ± 0.2	7.43 ± 1.3	10.54	<0.00*
Taste	8.60 ± 0.7	8.17 ± 0.8	8.57 ± 0.8	7.37 ± 0.9	11.81	<0.00*
Texture	8.60 ± 0.5	7.93 ± 0.5	7.67 ± 0.9	7.50 ± 0.8	10.56	<0.00*
Overall Acceptability	8.70 ± 0.5	8.07 ± 0.8	8.00 ± 0.6	7.43 ± 1.2	10.68	<0.00*
t Test - Standard vs Variation		7.94^{NS}	7.62^{NS}	14.61*		

^{NS} – Non Significant *Significant at 1% level

From Table II, sensory evaluation of the cashew apple jam revealed that the mean values for appearance for standard was 8.70, followed by CAJ1 with 8.23; CAJ2 8.87 and CAJ3 7.57. The mean values for colour were 8.70 for standard, 8.13 for CAJ1and CAJ2, and 7.27 for CAJ3. The mean values obtained for flavour for standard with the mean value of 8.63, followed by CAJ1 and CAJ2 with 8.10, and CAJ3 with 7.43. The taste of the standard scored maximum mean value of 8.60 followed by 8.17, 8.57 and 7.37 for CAJ1, CAJ2 and CAJ3 respectively. With regard to texture, standard showed a mean value of 8.60 followed by CAJ1 with 7.93, CAJ2 with 7.67 and CAJ3 with 7.50.

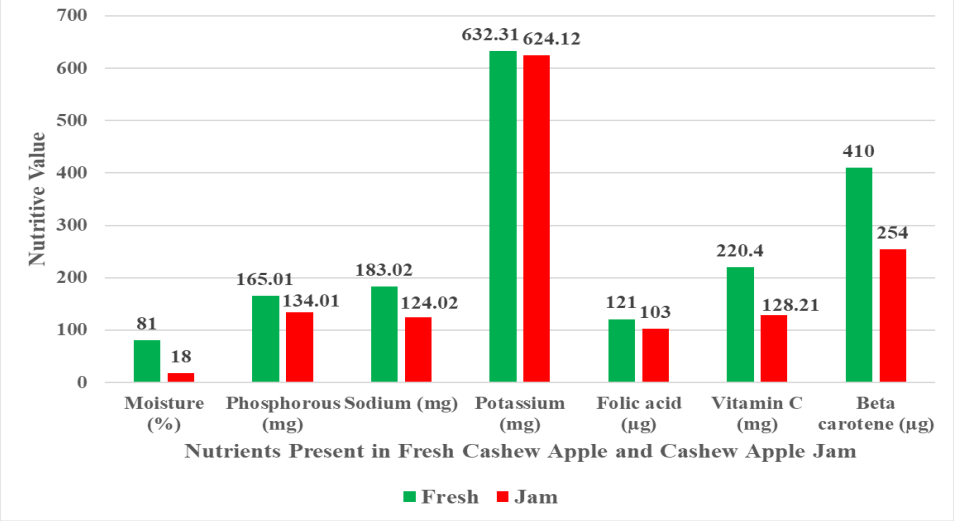
When considering the overall acceptability of the cashew apple jam, CAJ1 achieved a maximum mean score of 8.07, closely followed by CAJ2 with a score of 8.00, which was comparable to the standard's score of 8.70. Subsequently, CAJ3 received a mean score of 7.43.A statistical analysis using a 't' test was conducted to compare the overall acceptability of the standard with CAJ1, CAJ2, and CAJ3. The calculated 't' values for CAJ1, CAJ2, and CAJ3 were 7.94, 7.62, and 14.61 respectively. The outcomes indicated that the differences between CAJ1 and CAJ2 were not statistically significant, while the disparity in CAJ3 was statistically significant at a 1% significance level. Considering the mean values and nutritional aspects, panel members favored CAJ2 as the most acceptable product among the options of CAJ1, CAJ2, and CAJ3.

2. Nutritional Quality of fresh cashew apple and cashew apple jam

Table III, represents the proximate principles namely, moisture, carbohydrate, protein, fat, crude fibre, total fibre, iron, calcium, phosphorus, sodium, potassium, folic acid, zinc, vitamin C and beta carotene was analysed for the best accepted cashew apple jam i.e. variation 2 with jaggery.

Table III-Nutritional quality of fresh cashew apple and cashew apple jam

NUTRIENTS	Fresh Fruit	Jam CAJ2
Moisture (%)	81.00	18.00
Carbohydrate (g)	42.51	55.14
Protein (g)	14.90	13.90
Fat (g)	01.02	01.02
Crude fibre (g)	03.14	02.23
Total fibre (g)	09.20	07.31
Iron (mg)	06.02	06.73
Calcium (mg)	39.24	71.42
Phosphorous (mg)	165.01	134.01
Sodium (mg)	183.02	124.02
Potassium (mg)	632.31	624.12
Folic acid (µg)	121.00	103.00
Zinc (µg)	03.70	02.017
Vitamin C (mg)	220.40	128.21
Beta carotene (µg)	410.00	254.00



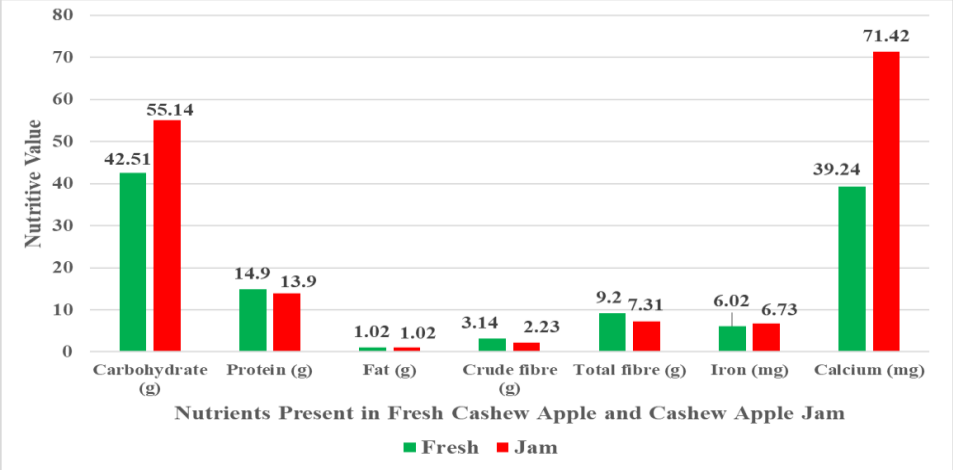


Table III highlights that fresh cashew apples exhibit the highest moisture content at 81.00%, followed by jam at 18.00%. When considering carbohydrate levels, fresh cashew apples contain 42.5g, while jam contains 55.14g per 100g. Protein content varies as well, with fresh cashew apples containing 14.90g and jam holding 13.90g. In terms of fat content, fresh cashew apples exhibit 1.02g, while jam has 01.02g. Crude fiber content per 100g at 03.14g in fresh cashew apples and 02.23g in jam. Total fiber, fresh cashew apples contain 9.20g and jam contains 07.31g per 100g.

The iron content varies, with fresh cashew apples having 06.02mg and jam containing 6.73mg per 100g. Calcium content per 100g is outlined as follows, fresh cashew apples with 39.24mg and jam containing 71.42mg.The phosphorus content of fresh cashew apples contains 165.01mga and jam contains 134.01mg per 100g. Sodium content varies with fresh cashew apples at 183.02mg and jam at 124.02mg per 100g. Potassium content per 100g stands at 632.31mg in fresh cashew apples and 624.12mg in jam. Zinc content per 100g varies, fresh cashew apples contain 0.370µg and jam has 0.2017µg. Folic acid content per 100g is as follows as fresh cashew apples contain 121.00µg and jam contains 103.00µg. Vitamin C content in per 100g shown, fresh cashew apples have 220.40mg and jam contains 128.21mg. Finally, beta carotene content per 100g is observed as fresh cashew apples has 410.00µg and jam has 254.00µg.

When examining the proximate principles of cashew apple jam, it becomes evident that jaggery used jam possesses a higher nutrient content compared to the other sugars used cashew apple jam. This superiority in nutrients can be attributed to the minimal heat applied during the jam production process. Consequently, jam stands out as the option with superior nutritional value due to its retention of essential nutrients resulting from the minimal heat exposure.

Results and Discussion

The research focused on development of cashew apple products with the aim of retaining the sensory attributes and nutritional value of highly perishable fruit cashew apples. Cashew apple jam was developed using different methods to standardize the products. Each utilizing different temperature, duration, and energy sources. The results demonstrated success in retaining the nutritional quality of cashew apple jam.

Sensory attributes were evaluated using a 9 point hedonic scale, recording the mean value and standard deviation. The statistical analyses, including ANOVA and t-tests, underscored the significant differences between the standard and cashew apple jam consistently obtained the highest mean scores indicating superior sensory qualities of cashew apples jam. Overall acceptability, based on a composite evaluation, also ranked jaggery used cashew apple jam was the most acceptable than the other sugar and palm sugar used cashew apples products. These findings suggest that jaggery used cashew apple jam has high nutrients and retains superior sensory qualities making it a nutritional optimal choice for consumers with pleasing sensory experience.

The proximate principles of fresh and cashew apples products were analyzed for various nutrients. The cashew apple products exhibited lower moisture content and higher concentrations of carbohydrates. Proteins, fats, and fiber did not vary when compared to the fresh cashew apple. Additionally, mineral content such as iron, calcium, phosphorus, sodium, and potassium, as well as the presence of folic acid, zinc, vitamin C, and beta-carotene values are higher in cashew apple jam than in the fresh cashew apple when examined.

Conclusion

The cashew apple, a tropical fruit and a significant byproduct of the cashew nut processing industry, is rich in vitamins, polyphenols, sugars, minerals, amino acids, and dietary fiber, making it a valuable candidate for practical food applications. Development of cashew apple products are employed to retain the nutritional value and sensory attributes of this highly perishable fruit. The research focused on retaining the sensory attributes and nutritional value of cashew apples through the development of cashew apple jam using different sugars. The cashew apple jam consistently exhibited superior sensory qualities, ranking highest in appearance, color, flavor, taste, and texture, as well as overall acceptability. Proximate analysis revealed that jaggery used cashew apple jam secured higher nutritional content than the other sugars used in cashew apple products.

The economic viability of developed cashew apple was emphasized, suggesting its potential to offer value-added products for both urban and rural settings, thereby mitigating

post-harvest losses and unlocking economic opportunities. The study aimed to develop cashew apple jam with high acceptability, recognizing the nutritional and bioactive significance of cashew apple to consumers' health, farmers' income, and the country's economy, ultimately contributing to a reduction in current post-harvest losses.

References

1. Emmanuelle, D., Joseph, D., Victor, A., & Mohamed, M. S. (2016). A review of cashew (Anacardiumoccidentale L.) apple: Effects of processing techniques, properties and quality of juice. *African Journal of Biotechnology*, 15(47), 2637–2648.
2. Gul, K., Singh, A. K., & Jabeen, R. (2016), Nutraceuticals and functional foods: the foods for the future world. Critical reviews in food science and nutrition, 56(16), 2617-2627.
3. Kumar, S. M., Ponnuswami, V., & Padmadevi, K. (2015). Cashew industry in India. Acta Horticulturae, 1080, 97–101.
4. Oliveira, N. N., Mothé, C. G., Mothé, M. G., & de Oliveira, L. G. (2020). Cashew nut and cashew apple: a scientific and technological monitoring worldwide review. *Journal of Food Science and Technology*, 57(1), 12–21.
5. Preethi, P., Rajkumar, A. D., Shamsudheen, M., & Nayak, M. G. (2019). Prospects of cashew apple-A compilation report. Technical Bulletin, 2, 28.
6. Ruffino, B., & Zanetti, M. (2017). Present and future solutions of waste management in a candied fruit–jam factory: Optimized anaerobic digestion for on site energy production. *Journal of Cleaner Production*, 159, 26-37.
7. Singh, S. S., Abdullah, S., Pradhan, R. C., & Mishra, S. (2019). Physical, chemical, textural, and thermal properties of cashew apple fruit. *Journal of Food Process Engineering*, 42(5), 1–10.
8. Talasila, U., & Shaik, K. B. (2015). Quality, spoilage and preservation of cashew apple juice: A review. Journal of Food Science and Technology, 52(1), 54–62.
9. Theses, M. (2020). Development of quality dried cashew apple products.

புறநானூற்றில் வரகுப்பயிர் பயன்பாடு

க.உமாராணி,

உதவிப்பேராசிரியர், தமிழ்த்துறை, சீதாலக்ஷ்மி ராமஸ்வாமி கல்லூரி,

திருச்சிராப்பள்ளி.

umaranisrc2016@gmail.com

ஆய்வுச்சுருக்கம்

"உண்டி முதற்றே உணவின் பிண்டம்" என்கிறது புறநானூறு. பழந்தமிழகத்திலேயே வரகு உணவாக உட்கொள்ளப்பட்ட ஒரு வகை தானியமாக இருந்தள்ளது. வரகு ஐந்து மாதங்களில் அறுவடை செய்யக்கூடிய சிறுதானியமாகும். அனைத்து மண் வகைகளிலும் சிறப்பாக வளரக்கூடியது. மழைபெய்து முடிந்த பிறகு மண்ணில் அதிக ஈரப்பதம் இல்லாமல் புட்டுப்பதத்தில் இருக்கும் போது விதைத்தால் நல்ல மகசூலைத் தரக்கூடியது. ஓட்ஸ் என்பதும் வரகுப்பயிரின் ஒரு ரகமாகும். சர்க்கரை நோய் உள்ளவர்களுக்கு இரத்தத்தில் உள்ள சர்க்கரையின் அளவைக் கட்டுக்குள் வைத்திடும் சிறந்த உணவாக உள்ளது. மூட்டு வலி, மூட்டு வீக்கம், எலும்புகள் வீக்கம் உள்ளவர்களுக்கு சிறந்த மருந்துணவாகச் செயல்படுகின்றது. உடல் சூட்டைத் தணித்து உடலைக் குளிர்ச்சியாக வைத்துக் கொள்ள உதவுகிறது. கண்புரை நோய்கள், கண் வீக்கம் போன்ற பிரச்சினைகளுக்குத் தீர்வாகவும் செயல்படுகிறது. நரம்பு சம்மந்தப்பட்ட பிரச்சினைகள், கல்லீரல் அலற்சி, நிணநீர் சுரப்பிகளைச் சீராக்கவும் செய்கிறது. சிறுநீரகங்களில் கற்கள் ஏற்படுவதைத் தடுத்து, சிறுநீரகங்களின் செயல்பாடுகளை மேம்படுத்துகின்றது. இரத்தத்தைத் தூய்மைப்படுத்தி இரத்தத்தைச் சுத்தம் செய்கிறது. கோவில் மூலவர் சன்னிதிக்கு மேல் அமைக்கும் கோபுர விமானங்களில் வரகு தானியத்தைக் கொட்டி நிரப்புவது வழக்கம். இது மின்னல் தாக்கும் போது கருவறை விக்ரகம் சேதமடையாமல் பாதுகாக்கும். வரகினை ஆண்டு கணக்கில் இருப்பில் வைத்து விற்பனை செய்ய முடியும். இத்தகு சிறப்புகளை, மருத்துவப் பயன்களைத் தரக்கூடிய வரகுப்பயிரினைத் தமிழகத்தில் மக்கள் தங்கள் அன்றாட உணவில் பயன்படுத்தி வந்தனர் என்பதற்கு அகச்சான்றுகளாக இலக்கியச் சான்றுகள் திகழ்கின்றன. தமிழிலக்கிய வரலாற்றில் பொற்காலம் என்று சொல்லப்படுகின்ற சங்க காலத்தில் எழுந்த எட்டுத்தொகை, பத்துப்பாட்டு என்ற சங்க இலக்கியங்களில் வரகு என்ற சொல்லாட்சி இருபத்தொன்பது இடங்களில் வந்துள்ளது. தமிழக மன்னர்களின் போர், வீரம், கொடை போன்ற பண்புநலன்களைப் புலவர் பெருமக்கள் நானூறு பாடல்களில் வடித்துக்

கொடுத்துள்ளனர். இத்தகைய புறநானூற்றில் 34-9, 120-9, 197-12, 215-1, 321-6, 322-3, 327-2, 327-7, 328-3, 333-9, 335-4, 384-4 ஆகிய பன்னிரண்டு இடங்களில் வரகுப்பயிர் பயன்பாடு இடம்பெற்றுள்ளது. சங்க காலத்தில் நெல்லுக்கு நிகராக வைத்து வரகு மதிக்கப்பட்டது. வரகில் அரிசி, கோதுமையைக் காட்டிலும் நார்ச்சத்து அதிகமாகவும், மாவுச்சத்து குறைந்தும் காணப்படுகின்றது. வரகில் புரதம், கால்சியம், வைட்டமின் பி, தாதுப்பொருட்கள் ஆகியன நிரம்பவுள்ளன. கோடை காலத்தில் நல்ல குளிர்ச்சியாக இருக்க வேண்டும் என்பதால் அக்காலத்தில் வீடுகளில் கூரை வேய்வதற்கு வரகுத்தாளைப் பயன்படுத்தியுள்ளனர். புறநானூற்றுப்பாடல்களில் வரகுப்பயிர் பயன்பாட்டையும், பண்டைய தமிழகத்தில் சிறுதானிய வகையினைச் சார்ந்த வரகின் முக்கியத்துவத்தையும் இக்கட்டுரை எடுத்துரைக்கின்றது.

திறவுச்சொற்கள் – சங்க இலக்கியங்கள், புறநானூறு, வரகுப்பயிர், உணவு, சிறுதானியம்

புறநானூற்றில் வரகுப்பயிர் பயன்பாடு

உலகில் மானுட இனம் வாழத்தொடங்கிய காலந்தொட்டு உணவும், உடையும், உறையுளும் மனிதர்களின் செம்மையான வாழ்விற்கு ஆதாரமாகின்றன. **"சுழன்றும் ஏர் பின்னது உலகம் அதனால் உழந்தும் உழவே தலை"** என்ற வள்ளுவரின் வாய்மொழிக்கிணங்க உழவுத்தொழிலும் உணவு உற்பத்தியும் மனித சமூகத்தின் அன்றாட வாழ்க்கைக்கும், செயல்பாடுகளுக்கும் ஆற்றலைத் தருகின்றன. இவ்வுலகில் மனித உயிர்களின் இயக்கமானது உணவை மையமாகக் கொண்டே சுழன்று வருகின்றது. இந்நிலப்பரப்பானது ஐவகை நிலங்களாகப் பாகுபாடு செய்யப்பட்டிருந்தது. ஒவ்வொரு நிலத்தைச் சேர்ந்தவர்களும் தங்கள் நிலங்களின் மண் வளத்திற்கேற்பவும், தட்ப வெட்பச் சூழலுக்கேற்பவும் உணவு உற்பத்தியினை மேற்கொண்டு வந்தனர். அவ்வவ் நிலங்களில் விளைந்த பொருட்களைக் கொண்டு தங்கள் உணவுகளைச் சமைத்து உண்டு வந்தனர். இயற்கை வளங்களால் சிறப்புற்றிருந்த பழந்தமிழகத்தில் நெற்பயிர்களும், சிறுதானியப்பயிர்களும் செழித்து வளர்ந்து மக்களின் சோர்வு நீக்கி உடலுக்கும், உள்ளத்திற்கும் ஆரோக்கியத்தையும், பலத்தையும் தந்தன. அவ்வகையில் சிறுதானியப் பயிர்களில் ஒன்றான வரகுப்பயிரின் பயன்பாடு தமிழிலக்கிய வரலாற்றின் பொற்காலம் என்று அழைக்கப்படுகின்ற சங்க இலக்கியங்களில் இருபத்தொன்பது இடங்களில் பயின்று வந்துள்ளது. இதில் தமிழரின் அறப்பண்புகளையும், மறப்பண்புகளையும் போற்றியுரைக்கின்ற இலக்கியமான புறநானூற்றில்

பன்னிரண்டு இடங்களில் இடம்பெற்றுள்ளது. புறநானூற்றின் வழியாக அறியப்படும் வரகுப்பயிரின் பயன்பாட்டினை இக்கட்டுரை ஆராய்கின்றது.

மூவகைப்பொருள் பாகுபாடு

தமிழர்தம் வாழ்வில் மூவகைப் பொருள் பாகுபாடு காணப்பட்டது. முதற்பொருள், கருப்பொருள். உரிப்பொருள் என்ற மூன்றாக அமைந்திருந்தது.

"முதல் கரு உரிப்பொருள் என்ற மூன்றே
நுவலும் காலை முறை சிறந்தனவே
பாடலுட் பயின்றவை நாடுங் காலை" -**(தொல்.அகம்.** 3)[1]

இவ்வாறாக சொல்லப்பட்டவற்றுள் முதற்பொருள் எனப்படுவது,

"முதல் எனப்படுவது நிலம், பொழுது இரண்டின்
இயல்பென மொழிப இயல்புணர்ந்தோரே" –(தொல்.அகம்.4)[2]

என்று நிலத்தையும், பொழுதையும் முதற்பொருளாகத் தொல்காப்பியம் வரையறுக்கின்றது. உலகின் செயல்பாடுகளுக்கு நேரம் மற்றும் இடம் முக்கியத்துவம் வாய்ந்ததாக இருக்கின்றது என்ற கருத்தின் அடிப்படையிலேயே இதனை முதற்பொருள் என்கிறோம். இதில் நிலம் என்பது குறிஞ்சி, முல்லை, மருதம், நெய்தல், பாலை என்ற ஐவகை நிலப்பாகுபாட்டுகளாக அமைந்திருந்தன. பொழுதில் சிறுபொழுது ஒரு நாளின் ஆறு பிரிவுகளையும், பெரும்பொழுது என்பது ஓர் ஆண்டின் ஆறு பருவங்களையும் குறிப்பதாக இருந்தது.

கருப்பொருள்

கருப்பொருள் என்பதனை ஐவகை நிலங்களுக்கும் தனித்தனியே வகைப்பாடு செய்யப்பட்டிருந்தது. எட்டு வகையாக கருப்பொருள் வரையறுக்கப்பட்டது.

"தெய்வம் உணாவே மா மரம் புள் பறை
செய்தி யாழின் பகுதியொடு தொகைஇ
அவ்வகை பிறவும் கருவென மொழிப" -**(தொல். அகம்.**20)[3]

ஒவ்வொரு நிலத்திற்குமான வழிபடு தெய்வம், உண்ணும் உணவு, விலங்கு, பறவை, பறை, செய்தி, யாழின் பகுதி என்று தொல்காப்பியம் கூற பின்னாளில் வந்த மரபிலக்கணங்கள் யாவும் கருப்பொருளினை ஆரணங்கு, உயர்ந்தோர், அல்லோர். பறவை, விலங்கு, ஊர், நீர், பூ, மரம், உணவு, பறை. யாழ், பண், தொழில் என்றவாறு பதினான்காக மிகுதிப்படுத்தி உரைத்தன.

உரிப்பொருள்

ஐந்திணை மக்களுக்குமான வாழ்வியல் ஒழுக்கங்களே உரிப்பொருள் எனப்பட்டன. புணர்தல், பிரிதல், இருத்தல், ஊடல், இரங்கல் என்ற ஒழுக்கங்கள் முறையே குறிஞ்சி, பாலை, முல்லை, மருதம், நெய்தல் என்ற ஐவகை நிலங்களுக்குரியவையாக அமைந்திருந்தன.

ஐவகை நிலங்களுக்குமான உணவுகள்

குறிஞ்சி முதலான ஐவகை நிலங்களுக்குண்டான உணவுகளைப் பின்வருமாறு வரிசைப்படுத்தலாம்.

குறிஞ்சி – மலைநெல், திணை

முல்லை – வரகு, சாமை, பால், நெய்

பாலை – சூறையாடலால் வரும் பொருள்

மருதம் – நெல், தேறல், மீன், கரும்பு

நெய்தல் – மீன், உப்புக்குப் பெற்ற பொருள்

என்றவாறாக ஐவகை நிலங்களில் வாழ்ந்த மக்களின் உணவுப்பொருட்கள் அமைந்திருந்தன.

சிறுதானியங்கள்

சிறுதானியம் (*Millet*) என்பது வரகு, சாமை, தினை, குதிரைவாலி, கம்பு, கேழ்வரகு, சோளம் ஆகிய வடிவில் சிறியதாக உள்ள தானிய வகைகளைக் குறிக்கும். சிறுதானியங்களைப் பழந்தமிழர் தங்கள் உணவில் பெரும்பாலும் சேர்த்துக் கொண்டனர் என்பதைச் சங்க இலக்கியங்கள் வாயிலாக அறியமுடிகிறது. மேலும் திருக்குறளிலும் பல்வேறு பாக்களில் பனை என்பதற்கு எதிர்பதமாய் தினை என்ற சொல் பயன்படுத்தப்பட்டுள்ளது. மேலும் வள்ளியை முருகன் தினைக்களத்தில் சந்தித்தல், குறவர் இனமக்கள் தினைப்புனத்தைக் காவல் காத்தல், தேனொடு தினையினைக் கலந்து உண்ணுதல் ஆகியவற்றின் வாயிலாக சிறுதானியம் என்பது பாரம்பரிய உணவு என உணர முடிகின்றது.

பாரம்பரிய உணவு வகைகளில் உடலுக்குத் தேவையான ஊட்டச்சத்தினை சிறுதானியங்கள் அளிக்கின்றன என்று உணவியல் நிபுணர்கள் கூறுகின்றனர். மேலும் இன்றைய காலச்சுழலான குறைவான மழைப் பொழிவு, குன்றிய மண்வளம், தேவைக்கதிகமான உரப்பயன் பாடு அது ஏற்படுத்தும் சூழல் கேடுகள், வேளாண் இடுபொருள் விலை ஏற்றம் போன்றவை சிறுதானியமே வருங்கால உணவு என கருத வழிவகுக்கிறது.

வரகுப்பயிர் (kodo millet)

பண்டை தமிழ் நாட்டில் மிகவும் பொதுவாக உட்கொள்ளப்பட்ட ஓர் உணவு தானியமாகும். வரகை அரிசிக்குப் பதிலாக இட்லி மற்றும் தோசைகளில் பயன்படுத்தலாம். அரிசி, கோதுமையைக் காட்டிலும் வரகில் நார்ச்சத்து மிகவும் அதிகமாக உள்ளது. இதில் மாவுச்சத்து குறைந்து இருப்பதால், ஆரோக்கியத்துக்கு நல்லது. வரகில் புரதம், கால்சியம், வைட்டமின் பி ஆகிய ஊட்டச்சத்துக்கள் காணப்படுகின்றன. தாதுப்பொருட்களும் நிரம்பவுள்ளன. மேலும், வரகுப்பயிர் விரைவில் செரிமானம் அடைவதுடன் உடலுக்குத் தேவையான சக்தியையும் கொடுக்கிறது. வரகுப்பயிரின் உயிரியல் வகைப்பாட்டினைப் பின்வருமாறு அறியலாம்.

திணை: **தாவரம்**
வரிசை: **Poales**
குடும்பம்: **Poaceae**
துணைக்குடும்பம்: **Panicoideae**
பேரினம்: **Paspalum**
இனம்: **P. scrobiculatum**

என்பதாகும்.

சங்க இலக்கியங்களில் வரகுப்பயிர்

தமிழ்ச்சமூகத்தின் அடையாளமாக, பண்பாட்டின் பெருமையாகத் திகழ்பவை சங்க இலக்கியங்களே ஆகும். எட்டுத்தொகை மற்றும் பத்துப்பாட்டு ஆகிய பதினெண்மேற்கணக்கு நூல்களில் பெரும்பாணாற்றுப்படை(193), முல்லைப்பாட்டு(98), மதுரைக்காஞ்சி(272), மலைப்படுகடாஅம்(24,113), நற்றிணை(121-2), குறுந்தொகை(220-1, 282-1), ஐங்குறுநூறு(496-1), பதிற்றுப்பத்து(30-22), அகநானூறு(194-9, 284-3, 359-13, 367-6, 384-6, 393-5, 394-3) என்றவாறாக சங்க்கால மக்களின் வாழ்வியலில் வரகுப்பயிரின் பயன்பாடு இருந்துள்ளமையை இலக்கியங்களின் வாயிலாக அறியமுடிகின்றது.

புறநானூற்றில் வரகுப்பயிர்

பண்டைய கால தமிழக மக்களின் வாழ்வில் அகமும், புறமும் இருகண்களாகப் போற்றப்பட்டன. அகப்பொருளும், புறப்பொருளும் மனித வாழ்க்கையினைச் செம்மைப்படுத்தின. அரசனின் போர், வீரம், கொடை, பேராண்மை போன்ற பண்புநலன்களை எடுத்துரைக்கின்ற இலக்கியமாக புறநானூறு திகழ்ந்தது. புலவர் பெருமக்களால் புகழ்ந்து பாடப்பட்ட வேந்தர்களின் ஆட்சித்திறம், போர்த்திறம், ஈகை, கொடையறம் போன்றவை

எக்காலத்திற்கும் தமிழக மன்னர்களின் புகழுக்கு அகச்சான்றுகளாய் திகழ்கின்றன. புறநானூற்றில் எடுத்தாளப்பட்டுள்ள வரகுப்பயிர் பயன்பாட்டினைப் பின்வருமாறு வரிசைப்படுத்தலாம்.

புன்புல வரகு

1. புறம்.34-9 ஆலத்தூர் கிழார் சோழன் குளமுற்றத்துத் துஞ்சிய கிள்ளி வளவனைப் பாடியது. பாடாண்திணையில் இயன்மொழித்துறையில் அமைந்த பாடல்.

"புறவுக் கருவன்ன **புன்புல வரகின்**"

இதில் பால் ஊற்றிப் பொங்கிய வரகரிசிப் பொங்கலைத் தேனில் தொட்டுக்கொண்டு முயல் கறியோடு உண்ணுமாறு பாணர்களுக்கு வழங்குபவன் என சோழனைப் புலவர் புகழ்கின்றார்.

2. புறம்.197-12 கோனாட்டு எறிச்சலூர் மாடலன் மதுரைக் குமரனார் சோழன் குராப்பள்ளித் துஞ்சிய பெருந்திருமாவளவனைப் பாடியது. பாடாண்திணையில் பரிசில் கடாநிலை துறையில் அமைந்த பாடல்.

"**புன்புல வரகின்** சொன்றியோடு பெறூஉம்"

இப்பாடலில் முள்வேலிக்குள் இருக்கும் முன்னைக்கீரையில் ஆடு தின்றது போக எஞ்சியிருப்பதைப் பறித்து வரகு சோற்றோடு சமைத்துத் தரும் சிறிய ஊரில் வசிக்கும் சிற்றரசர் ஆயினும் புலவரை மதித்தால் புலவரும் அவ்வரசரை மதிப்பர் என்ற பொருள் படும்படியான பாடலின் வரகுச் சோறின் பயன்பாடு தெரியவருகிறது.

புது வரகு

1. புறம். 120-9 கபிலர் பாரியைப் போற்றிப் பாடிய பாடல். பொதுவியல் திணையில், கையறுநிலை துறையில் அமைந்த பாடல்.

"வாலிதின் விளைந்த **புதுவரகு** அரியத்
தினைகொய்யக் கவ்வை கறுப்ப அவரைக்
-------"

இப்பாடல் பாரியின் நாட்டு வளத்தைக் கூறுவதாக அமைந்துள்ளது. அதாவது பாரி இருந்தபோது அவன் நாட்டில் நன்றாக விளைந்த வரகு, தினை, எள், அவரை இவற்றை அறுவடை செய்து உணவாக்கி தந்தனர் என்று கூறுவதன் வாயிலாக வரகரிசிச் சோற்றினை உண்டு மகிழ்ந்தது அறிய வருகிறது.

2. புறம்.322-3 ஆவூர் கிழார் வீரன் ஒருவனைப் புகழ்ந்து பாடியது. வாகைத்திணையில் வல்லான்முல்லை துறையில் அமைந்துள்ளது.

"**புதுவரகு** அரிகால் கருப்பை பார்க்கும்"

என்ற பாடல் அரசர்களுக்கு அச்சத்தை ஏற்படுத்தும் வேல் வீரனின் ஊரானது வரகை அரிந்த தாளில் எலிகள் மேய வரும்போது சிறுவர்கள் அதனைப் பிடிக்க வில்லெடுத்து வருவர் என்ற செய்தியைக் கூறுகிறது.

கவைக்கதிர் வரகு

1. புறம். 215-1 கோப்பெருஞ்சோழன் தன் நண்பன் பிசிராந்தையாருக்காகப் பாடிய பாடல். பாடாண்திணையில் இயன்மொழித்துறையில் அமைந்துள்ளது.

"கவைக்கதிர் வரகின் அவைப்புறு வாக்கல்"

என்ற பாடலில் வடிக்கப்பட்ட வரகுச்சோற்றையும் தெருவோரத்தல் வளர்ந்திருக்கும் வேளைச்செடியின் பூவைத் தயிரில் கலந்து இடைச்சி சமைத்த புளிங்கூழையும் அவரைக்காய் கொய்பவர் நிறைய உண்டனர். இத்தகு மக்கள் வாழ்கின்ற நாடே பிசிராந்தையார் வாழும் பாண்டிநாடு என்று கோப்பெருஞ்சோழன் தன் நண்பனின் நாட்டுச்சிறப்பையும், பிசிராந்தையாரின் வருகையைப் பற்றியும் கூறுகின்றார்.

கலிஆர் வரகு

1. புறம்.321-6 உறையூர் மருத்துவன் தாமோதரனார் சென்னி என்னும் அரசனைப் பாடியது. வாகைத்திணையில் வல்லாண்முல்லை எனும் துறையில் அமைந்துள்ளது.

"**கலிஆர் வரகின்** பிறங்குபீள் ஒளிக்கும்"

இப்பாடலில் சென்னி எனும் அரசனின் நாட்டில் புன்செய் வளம் மிக்கது. இங்கு வரகு நல்ல விளைச்சலைத் தரக்கூடியதாய் இருக்கும்.

சில்விளை வரகு

1. புறம்.327-2 பாடியவர் பெயர் தெரியவில்லை. வாகைத்திணையில் வல்லாண்முல்லை துறையில் அமைந்த பாடல்.

"**சில்விளை வரகின்** புல்லான குப்பை

வரகுகடன் இரக்கும் நெடுந்தகை"

என்ற பாடலில் எருதுகளைக் கட்டி கடா விடுதல் செய்யாததால் குறைவாக விளைந்த வரகை இளைஞர்களே காலால் மிதித்துப் பிரித்தெடுத்தனர். அவ்வரகில் கடன்காரர்களுக்குக் கொடுத்தது போக எஞ்சியதைப் பாணர் உண்டு வெளியேறினர் என்று கூறுவதன் வாயிலாக வரகுப்பயிரின் பயன்பாடு பற்றி தெரியவருகின்றது.

வரகும் தினையும்

1. புறம்.328-3 இப்பாடலையும் பாடியவர் யாரென தெரியவில்லை. வாகைத்திணையில் மூதின்முல்லை துறையில் அமைந்த பாடல்.

"**வரகும் தினையும்** உள்ளவை யெல்லாம்"

என்ற பாடலானது, வள்ளல் ஒருவனின் புகழினை எடுத்துக்கூறி அவனிடம் செல்லுங்கள் என்று புலவர் ஒருவர் பாடிய பாடல் இது. இதில் புன்செய்க் கொல்லைகள் நிறைந்த அவ்வூர்களில் நெல்விளையாது என்றும் வரகும், தினையுமே விளையுமென்று கூறுவதன் மூலம் வரகுப்பயிரினை அறுவடை செய்திருந்த நிலையைக் காணமுடிகின்றது.

2. புறம்.333-9 பாடிய புலவர் யாரென தெரியவில்லை. வாகைத்திணையில் மூதின்முல்லை துறையில் அமைந்த பாடல்.

"**வரகும் தினையும்** உள்ளவை யெல்லாம்"

என்ற பாடலில் தலைவி ஒருத்தி தம் வீட்டை நோக்கி பசியோடு வருகின்ற புலவர்களுக்கு வரகும் தினையும் இல்லாமல் போனாலும் கூட விதைக்காக வைத்திருக்கின்ற தினையைக் குற்றி உணவிடுவாள் என்ற செய்தி இப்புறநானூற்றுப்பாடலின் வழி புலனாகின்றது.

கருங்கால் வரகு

1. புறம் 335-4 மாங்குடி கிழார் என்னும் புலவர் போரில் வீரமரணம் அடைந்த வீரர்களுக்கு வைக்கப்பட்ட நடுகல்லையே வழிபடுவர் என்று புகழ்ந்து பாடும் பாடல்.

"**கருங்கால் வரகே** இருங்கதிர்த் தினையே"

என்ற பாடலில் வரகு, தினை, கொள், அவரை ஆகியவையே முக்கிய உணவுப்பொருள்கள் என்ற மாங்குடிகிழாரின் கூற்று வரகின் முக்கியத்துவத்தை எடுத்துரைக்கின்றது.

2. புறம்.384-4 புறத்திணை நன்னாகனார் கரும்பனூர் கிழான் என்னும் அரசனைப் பாடியது.

"வன்பாலான் **கருங்கால் வரகின்**"

என்ற பாடல் கரும்பனூர் கிழான் என்னும் அரசனின் வள்ளல் தன்மையைப் போற்றிப்பாடுகின்றது. இதில் முல்லை நிலத்தில் விளைந்த வரகு அரிந்த தாளில் வாழும் எலியைக் குறும்பூழ் பறவை பிடிக்கச்செய்யும் தன்மையைச் சுட்டிக்காட்டுவதன் மூலம் வரகுப்பயிர் சாகுபடி பற்றி ய செய்தியை அறிய முடிகின்றது.

இவ்வாறாக புறநானூற்றில் புன்புல வரகு. புது வரகு, கவைக்கதிர் வரகு, கலிஆர் வரகு, சில்விளை வரகு, கருங்கால் வரகு. வரகும் தினையும் என்றவாறாக வரகுப்பயிரின் பயன்பாடும், வருகையிடங்களும் அமைந்திருக்கின்றன. முல்லைநிலத்தில் விளையக்கூடிய வரகுப்பயிரானது நெல்லோடு ஒப்ப மதித்துக் கொள்ளப்பெற்றதும், பழந்தமிழரின் முக்கியமான உணவுப்பொருள்களில் ஒன்றாக விளங்குவதும் வரகின் தனிச்சிறப்பாகும். மிகுந்த மருத்துவப் பயன்களைத் தரவல்லதாக வரகு காணப்படுகின்றது.

சங்க காலம் தொட்டு தற்காலம் வரையிலும் சிறுதானியங்களில் சிறப்பிற்குரியதாக வரகு மதிக்கப்படுவதற்கும், பயன்படுத்தப்படுவதற்கும் அதன் மருத்துவக் குணங்களே காரணமாகும். இத்தகு சிறப்புவாய்ந்த வரகினை முன்னோர் போற்றிய திறன் கொண்டு முன்னோர் மொழிபொருளைப் பொன்னேபோல் போற்றும் திறம் படைத்தவர்களாகத் திகழ்வோம். நல்வாழ்வு பெறுவோம்.

அடிக்குறிப்புகள்

1. தொல்காப்பியம் பக். 7இளம்பூரணர் உரை, கழக வெளியீடு.
2. மேலது. பக்.8
3. மேலது, பக்.17

1. சங்க இலக்கியச் சொல்லடைவு, பெ.மாதையன், தமிழ்ப்பல்கலைக்கழக வெளியீடு. தஞ்சாவூர்-20. முதற்பதிப்பு திசம்பர் 2007.
2. தொல்காப்பியம் பொருளதிகாரம் பக். இளம்பூரணர் உரை, திருநெல்வேலி தென்னிந்திய சைவ சித்தாந்த நூற்பதிப்புக்கழகம் லிமிடெட், 154, டி.டி.கே. சாலை, சென்னை-600018. முதற்பதிப்பு சூன் 1953.
3. புறநானூறு மூலமும் உரையும், அ.ப.பாலையன், சாரதா பதிப்பகம், சென்னை. முதற்பதிப்பு சூலை 2008.

ASSESSMENT OF NUTRITIONAL STATUS AND LIFESTYLE PATTERN AMONG SELECTED POST-MENOPAUSAL WOMEN IN RAMANATHAPURAM DISTRICT – PILOT STUDY

Adithiyalakshmi.S[1] and Sridevi SivakamiP.L[2]

[1]Research scholar and [2]Associate Professor

Department of Food Service Management and Dietetics, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu, India

Abstract

The menopause is defined as the critical age-related natural or induced phenomenon involves permanent stoppage of menstruation cycle. Women's health at the age of menopause are highly influenced by unhealthy lifestyle practises, in-turn increases the risk of lifestyle diseases. The study investigates the impact of lifestyle habits and dietary practices on the nutritional status and health, specifically focusing on diabetes mellitus and hypertension, among postmenopausal women in the Ramanathapuram district, Tamil Nadu. In a sample of 50 respondents aged 50–60 years, convenient sampling was employed to gather background information, anthropometric assessments, blood pressure measurements, and dietary data through a well-structured interview schedule. Most post-menopausal women exhibited overweight (N= 37) and were categorized as grade 1 obese (N = 6). Waist Hip Ratio, a significant indicator, showed that 20 women were at higher risk of developing diseases due to central obesity. Statistical analysis revealed a noteworthy association between Waist Hip Ratio and diabetes mellitus, with a 35% positive correlation (P value = 0.025, Pearson correlation value= 0.354). Diabetes mellitus and hypertension were highly prevalent (30 and 29 cases, respectively). Mean dietary consumption ranging from 1500 to 1550 Kcal, 55 to 60g of protein, 20g of fat, and 11 to 15g of fibre, millet consumption showed a strong association with constipation (P=0.037) and a negative correlation (Pearson correlation value= 0.330). Additionally, the study identified significant associations between the amount and type of oil used and heart attack risk (P<0.05, 35% correlation). Unhealthy lifestyle practices, such as high Waist Hip Ratio and afternoon napping, correlated with increased risks of diabetes and hypertension among postmenopausal women (P=0.044, 31.8% correlation). The findings underscore the importance of addressing lifestyle factors in post-menopausal health interventions.

Keywords: *Post-menopausal age, lifestyle habits, dietary practices, disease prevalence.*

Introduction

The World Health Organization defines menopause as “The permanent cessation of menstruation as a result of the loss of ovarian activity. The menopause is defined as the critical age-related natural or induced phenomenon involves permanent stoppage of menstruation cycle.

The typical age range for menopause in Indian women is 48 to 55 years. Early menopause may occur between 45 to 50 years, while some experience 'premature menopause' naturally before the age of 40. This variability underscores the diverse timelines at which women may transition through this significant hormonal stage in their lives (Ghosh et al., 2019).

As per the World Health Organization (WHO), projections indicate that by 2030, around 1.2 million women will be either premenopausal or postmenopausal, with an annual increase of 4.7 million. These estimations highlight the anticipated growth in the number of women experiencing the different stages of menopause, emphasizing the need for health considerations and support (Surendran et al., 2019)

Metabolic syndrome (MetS) comprises cardiovascular risk factors such as hypertension, hyperlipidaemia, high blood sugar, and abdominal obesity. This cluster increases the risk of cardiovascular disease and diabetes (Ebtekar et al, 2018). The incidence of obesity, android fat distribution increases after menopause, it fosters the occurrence of number of metabolic disorders.

Women’s health at the age of menopause are highly influenced by unhealthy lifestyle practises, in-turn increases the risk of lifestyle diseases. The hormonal changes in post-menopausal age create various structural and functional changes with symptoms of changes in anthropometric adiposity indices, cardiovascular disease risk indicators, muscle strength and physical performances having potential in accelerating to diseases in accompanying with unhealthy lifestyle practices involving improper dietary practices, lack of physical activity and stress. (Rathnayake et al 2019).

The health and nutritional well-being of menopausal women are significantly influenced by diet. It is advisable for women in this phase to consume a diet abundant in phytoestrogens, fiber, and low in fat, particularly saturated fat. This dietary approach aims to support hormonal balance and overall health during the menopausal period.

The present study aims to asses and study the nutritional status, lifestyle pattern among the selected post-menopausal women, as it forms the base in understanding the health status.

Methodology

Study area

The study was conducted in Mandapam coastal area of Ramanathapuram District of Tamil Nadu. The researcher reaches individual houses to collect the required data from the post-menopausal women.

Study sample and sampling technique

A descriptive research design was adopted as the study aims to describe the nutritional profile, life style diseases and millet consumption pattern of post- menopausal women. The study was mainly focussed on the post-menopausal women above the age group of 40 years with cessation of menstrual cycle.

The convenience sampling technique was used to select the study sample, a total of 50 post-menopausal women above the age group of 40 were included in the study. The women who still menstruate, above the age of 60 years were excluded. The intentional cessation of menstruation (ie., uterus removal) were also included in the study.

Study tool

A well formulated interview schedule was used to collect the required information such as their basic information – demographic profile, nutritional profile, lifestyle and medical history and their millet consumption pattern.

The demographic profile such as age, marital status, number of family member, occupational status, monthly family income, monthly expenditure, educational status and the age of menarche and menopausal are interviewed. The nutritional profile of post-menopausal women was studied by anthropometric assessment such as their height, weight, hip circumference, waist circumference and blood pressure was measured using digital sphygmomanometer. Their food habits, skipping of meals, water, oil, beverages, vegetables and fruits consumption were interviewed. The three - day recall was carried out find their mean nutritional intake. The basic knowledge and awareness on other cereals and millets, consumption of millets in daily diets, form of consuming millets, purchasing millet products and the amount of money spent for millets per month were collected. Life style and medical history of post - menopausal women were collected for dietary assessment through a face to face interview with the post - menopausal women.

Statistical analysis

The data collected from the post-menopausal women through the interview schedule was recorded, coded and statistically analysed for descriptive statistic, association and correlation at 95% confidence interval through SPSS version 27.

Results and Discussion

Demographic Profile

The post – menopausal women (N=50) were interviewed through interview schedule. The Table -I shows their basic demographic profile, Major Post menopausal women are in the age group of 50 – 60 years of age (N = 35) and had their menopause at correct age (45 -55 years of age). Thirty nine of them belongs to nuclear family with two to four family members. Majority of the selected post-menopausal women had their school and college education where two of them were working and eight were retired from their work. Twenty three of them had their monthly family income between 26,000 to 52,000 rupees

Table I-Demographic profile

Variables		**Number of Respondents**
Age	40 – 50 years	15
	50 – 60 years	35
Age of menarche	Early menarche (<12 years)	5
	Normal (12 – 14 years)	28
	Late menarche (>14 years)	17
Age of menopausal	Early menopause	16
	Normal menopause	34
Type of Family	Nuclear	39
	Joint	5
	Extended	6
Marital Status	Single	3
	Married	35
	Divorced	1
	Widowed	11
No. of family members	Single	6
	Two members	12
	Three members	10
	Four members	15
	Five members	5
	Six members and above	2
Educational status	Illiterate	1
	<8th standard	7
	8th standard	8
	SSLC	18
	HSC	11
	Diploma	3
	Post-graduation	2
Occupational status	Working	2

	Retired	8
	House wife	40
Family income	<2,000 Rs	3
	2,000 – 7,000 Rs	5
	7,000 – 13,000 Rs	9
	13,000 – 20,000 Rs	8
	20,000 – 26,000 Rs	2
	26,000 - 52,000 Rs	23

Nutritional Status

The nutritional status of the post-menopausal women was assessed by series of assessments of anthropometric measurements, blood pressure and through recording their food habits. The anthropometric measurements such as height, weight, waist circumference, hip circumference gives a clear cut data on their nutritional status.

Table II-Nutritional Status of post-menopausal women based on BMI (N=50)

Indicators	BMI	Number of Respondents
Underweight	<18.5	-
Normal	18.5 – 24.9	7
Overweight	25.0 – 30.0	37
Grade 1 obese	30.0 – 35.0	6

Table III- Nutritional status of post-menopausal women based on WHR (N=50)

Nutritional Status	WHR	Number of Respondents
Normal	<0.85	30
Centrally obese	>0.85	20

Body Mass Index is inexpensive screening tool, calculated by dividing person's weight in kilogram by height in metre square. Though BMI doesn't measure body fat directly, it strongly associate with various metabolic diseases and its outcome. The waist hip ratio is the direct measure of body fat distribution. The nutritional status of the post-menopausal women on the scale of body mass index and waist hip ratio were given in table II and table III. It shows that majority of the selected post-menopausal women are overweight (N = 37) and six of them were categorized as grade 1 obese with BMI 30 to 35. Also, twenty of the post-menopausal women were centrally obese having waist hip ration above 0.85 which may increases the risk of various metabolic disorders.

Blood Pressure

The screening blood pressure can give the actual prevalence of hypertension among the selected post-menopausal women. The blood pressure of the individual post-menopausal women was measured by digital sphygmomanometer. Based on their systolic and diastolic blood pressure, the blood pressure is categorized as normal, elevated or prehypertension, stage 1 hypertension and stage 2 hypertension.

Table IV-Prevalence of Hypertension among Post Menopausal Women 3

Category	Blood Pressure	Number of Respondents
Normal	<120/80	13
Elevated or Prehypertension	120-139/ 80-89	23
Stage1 hypertension	140 – 159 / 90 - 99	12
Stage 2 hypertension	>160 / >100	2

From table IV, most of the post-menopausal women have elevated blood pressure (N = 23) of 120 – 139 / 80 – 89 mmHg and twelve of them were in the stage one hypertension having 140 – 159 / 90 – 99 mmHg.

Dietary Assessment

The dietary assessment of food habits, skipping of meals, water, oil, beverages, vegetables and fruits consumption and dietary recall were recorded. Its findings are 1.Majority of the selected post-menopausal women are vegetarian (N=33) and consume at least three meals per day. 2. About of the total selected post-menopausal women have the habit of skipping meals (N = 24) and breakfast was the meal mostly skipped by the selected post-menopausal women. 3. Majority of them have fresh fruits and vegetables everyday (N =36, N=44 respectively). 4. Mean water consumption was found to be five to six glasses of water per day. 5. The selected post-menopausal women have the habit of consuming hot beverages such as milk, coffee, tea and chukka coffee at least thrice a day. 6. Almost everyone (N = 46) have the habit of adding sweetener in their beverages especially table sugar. 7. Sunflower oil is highly preferred by them (N = 21) followed by organic groundnut and sesame oil. 8. The amount oil used per month by the post-menopausal women and their families was found, it shows majority use three litres a month (N=20). 9. Dried foods such vathal, vadagam are consumed by maximum number of post-menopausal women. 10. Among them, 33 selected post-menopausal women have the habit of consuming cereals other than rice and wheat and 30 of them had

millets in their daily menu. 11. Millet health mix and millet dosa mix were major ready to cook millet products purchased by post-menopausal women (N= 9, N = 6 respectively). 12. Requires more time for cooking (N=6) was the major reason for not consuming millets in daily diet. 13. on monthly basis, Less than spent ₹500 on a monthly basis for millets.

Table V-Mean Dietary Consumption and Recommended Dietary Allowances

Nutrients	Mean Dietary Consumption	Recommended Dietary Allowances (Sedentary women)	Difference
Energy (KCAL)	1691±240	1650 (30 kcal/ 55kg)	+40.89
Carbohydrate (g)	310±50	-	-
Protein (g)	63±8	45.65	+17.61
Fat (g)	21±4	20	+1
Fibre (g)	13±1	25	-11.97

(Source: Revised Short Summary Report -2023, ICMR-NIN Expert Group On Nutrient Requirement for Indian, RDA & EAR - 2020)

Through the dietary recall, the mean dietary consumption was found. Its comparison with RDA is given the table V. The selected post-menopausal women were sedentary and hence their RDA for sedentary was taken. It is found that the total energy and protein consumption exceeds the recommended dietary allowances and the consumption of fat coincides with the RDA. Mean fibre consumption of the selected post-menopausal women were low and there is about 11.97g of fibre is to be needed to meet out daily average requirement. Almost 73% of the energy is obtained from the carbohydrate sources. The focus on enriching the foods with fibre content is essential. Many studies shows same nutritional inadequacy in this type of population.

Lifestyle Pattern and Medical History

The lifestyle pattern such as daily activity, engagement in physical activity, exercise, yoga, sleep hygiene, screen time were interviewed and its findings were 1.Thirty-five of the selected post-menopausal women answered ‘Yes’ for the question ‘Do you engage in physical activity?’ 2. ‘Walking’ was the major physical activity recorded (N=40). 3. Thirty-seven post-menopausal have the habit of using mobile phones and twenty eight of the total respondents use mobile about three to five hours a day. 4. Almost everyone have the habit of sleeping in the afternoon and spend about half an hour to one hour to afternoon sleep. 5. The average sleeping hours of selected post-menopausal women was found to three to hours a night. 6. Almost twelve and twenty one of them have difficulty and disrupted sleep respectively.

Table VI-Distribution of Non-Communicable diseases among post-menopausal women

Non-Communication Diseases	Frequency (N=50)
Diabetes Mellitus	30
Hypertension	29
Hypercholesteremia	14
Anaemia	5
Hypothyroidism	3
Arthritis	23
Heart attack	3
Constipation	22

The medical history of the post-menopausal women was recorded, the distribution of major diseases among the selected post-menopausal women was given in the table VI. The diabetes mellitus and hypertension was the highly prevalent followed by arthritis, constipation and hypercholestremia (N = 23, N = 22 and N = 14 respectively).

Association and Correlation of Variables

Table VII-Association of selected variables with non-communicable diseases

Variables	*Chisquare value, P value*	*Correlation of coefficient*
Waist Hip Ratio, Diabetes mellitus	*5.017, 0.025*	*0.354*
Type of oil used, Heart attack	*40.000, <0.001*	*0.349*
Millet consumption, Constipation	*4.365, 0.037*	*-0.330*
Diabetes mellitus, physical activity	*6.906, 0.009*	*0.410*
Sleeping in the afternoon, WHR	*4.038, 0.044*	*0.318*

(P value <0.05 denotes the statistically significant relationship)

The statistical test such as chisquare and correlation was applied to find the relationship between the variables such as their nutritional status, physical activity, dietary consumption and diseases. The statistically significant relationships between the variables are given in the table VII. The statistically significant association was found between waist hip ratio and diabetes mellitus where, p value = 0.025 and 35% degree of positive relationship between them.

Where waist hip ratio may be a risk factor in increasing the incidence of diabetes mellitus. The type of oil used and heart attack has high statistically significant association and a positive correlation of 34.9%. Where, the negative correlation of 33% degree between millet consumption and constipation was found. Through this we can understand millet consumption plays a vital role in preventing the incidence of constipation, as they are rich source of fibre, forms a bulk and helps in gastrointestinal movement. The physical activity is the well known factor associated with metabolic diseases, also in the present study, the diabetes and physical activity have a positive correlation (41% and P value <0.05). Sleeping in the afternoon also may be a factor in increasing the waist hip ratio thus contributing to other diseases.

Conclusion

The present study involved in assessing the nutritional status and lifestyle pattern of selected post-menopausal women of Ramanthapuram district. Major findings such that majority of post-menopausal women were overweight with central obesity, having elevated blood pressure or prehypertensive. Mean dietary consumption shows low fibre consumption among them. Low physical activity, sleeping in the afternoon also a factor for low quality night sleep. The association and correlation of different variables was also studied to understand the risk factors and to intervene them. Thus, the study underscore the importance of addressing lifestyle factors in post-menopausal health interventions.

References

1. Ghosh, Debosree & Singha, Partha & Parida, Pratap. (2017). Post Menopausal Health of Indian Women: A Review. Current Women's Health Reviews. 13. 10.2174/1573404813666171201150725.
2. Surendar R, Durgapriya G, Arthi M, Srikanth S. (2019), Quality of life among post - menopausal women in rural Puducherry. Public Health Rev Int *J Public Health Res*.; 6(3):112-118
3. Mansi Tiwari, Mridula Saikia Barooah, Ruma Bhattacharyya, Premila L. Bordoloi and Moloya Gogoi. (2020), Assessment of Nutritional Status among Postmenopausal Women of Jorhat, Assam, India. *Int.J.Curr.Microbiol.App.Sci.* 9(03): 1187-1195.
4. Fariba Ebtekar, Sahar Dalvand, Reza Ghanei Gheshlagh, (2018), The prevalence of metabolic syndrome in postmenopausal women: A systematic review and meta-analysis

in Iran, Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 12 (6), P955-960, ISSN 1871-4021.

5. Rathnayake, N., Lenora, J., Alwis, G., & Lekamwasam, S. (2019). Prevalence and Severity of Menopausal Symptoms and the Quality of Life in Middle-aged Women: A Study from Sri Lanka. *Nursing research and practice*, *2019*, 2081507.

IMPACT OF NUTRITION EDUCATION ON KNOWLEDGE LEVEL OF VITAMIN-A AMONG ADOLESCENTS

Sri Rahavi.V[1], Kavyajyothi. H[2]

[1]PG Student, PG Department of Food and Nutrition, Bishop Heber College, Tiruchirappalli, Tamil Nadu.

[2]Assistant Professor, Department of Food Science, Dr.N.G.P. Arts and Science College, Coimbatore, Tamil Nadu.

Abstract

The aim of the study was to compare preference, knowledge and perception of vitamin A among adolescents of age category from 18 - 22 years before and after education session. Respondents (n=60) selected were bespectacled adolescents and were selected through purposive sampling method. Typed form questionnaires was disseminated to the respondents. Initially questionnaire was distributed and instructed to answer according to their own knowledge and perception. Responses are verified and education session was conducted to improve the knowledge of respondents on vitamin A role and consumption. Second set of questionnaire were disseminated to analyse the impact of education among respondents. Data were analyzed using the paired t test. The results of survey revealed that the knowledge level on the sources of beta carotene and sources of vitamin A has also been improved (p=0.01)(p=0.02)(p=0.05) after the session which explains the importance of peanuts, ghee and daily requirements of vitamin A. The perception on sources of vitamin A is also changed (p=0.01) after the session. The study concluded that education session conducted for respondents has a great impact on knowledge on vitamin A, functions and daily requirements.

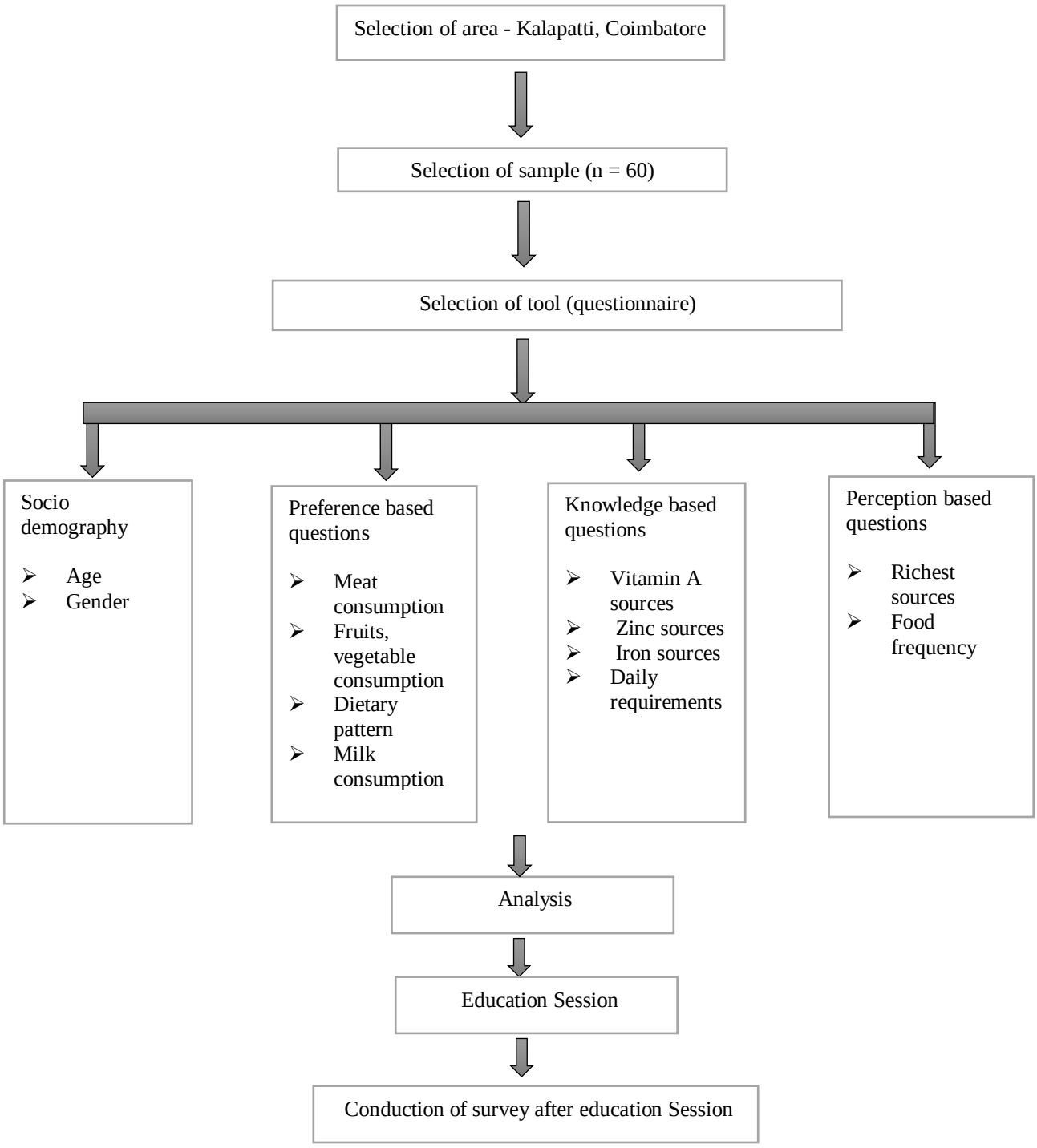
Key words *- Bespectacled, knowledge, impact, perception, Vitamin A, nutrition education*

Introduction

Vitamin-A is fat- soluble vitamin, contains group of organic compounds that includes retinol, retinal, retinoic acid and several provitamin-A, carotenoids[1,2].Vitamin-A is essential for embryo development, maintenance of immune system, and for vision[3]. Though Vitamin-A is important, its deficiency is

common and pooled analysis of population-based-surveys from 138 low-income and middle-income countries people found that 29% of children had vitamin A deficiency in year 2013[4]. Thus study entitled,"Impact of nutrition education on knowledge level of vitamin-A among adolescents" concentrates on educating bespectacled adolescents and adults on importance of vitamin-A in human body.

Materials and Method: Study Design



1.1 Selection of area and samples

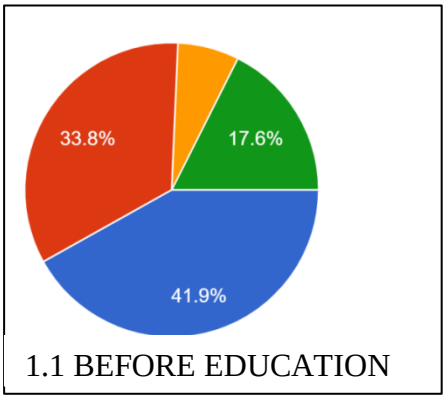
Coimbatore, Kalapatti was selected for study based on convenience of investigator and samples selected was 60 bespectacled adults between the age of 18 - 20 years comprising college students (n=60).

1.2 Selection of tools

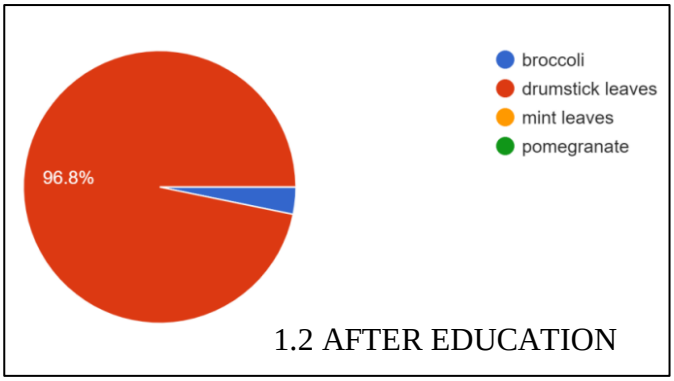
Computerized questionnaire were generated by investigator under the guidance of professor, helps to collect data on socio-demographic profile, consumer preference, knowledge and perception. Google forms were used in survey with close ended questions. Free availability of the tool and automatic recording of user response in the spreadsheet have made data collection and analysis simple. In a country like India, where internet user base is increasing day by day web-based survey tools may become obvious choice for survey research which reach out large population. Subject's socio-demographic characteristics covered information on personal details such as age and gender. A set of questions were formed on subject's preference, perception and knowledge on consumption of vitamin A. These questionnaire covered information on subject's preference on consumption of fruits, vegetables, milk and meat; knowledge based questionnaire covered information on subjects' common knowledge about sources, requirements and functions of vitamin A; perception based questionnaire covered information on subjects' perception towards richest sources, food frequency and myths regarding vitamin A. SPSS version 20.0 were for statistical analysis to analyze the collected data.

Results and Discussion

Figure1: Perception on "richest source of vitamin A among students".



1.1 BEFORE EDUCATION



1.2 AFTER EDUCATION

Figure 1.1 indicates, around 41.9% people believe that broccoli is the richest source of vitamin A then drumstick leaves, mint and pomegranate. After education, perception of the people changes and understood the fact that drumstick leaves are the richest source of vitamin A which is interpretative in figure 1.2.

Figure 2: Preference on "foods rich in beta carotene among students" .

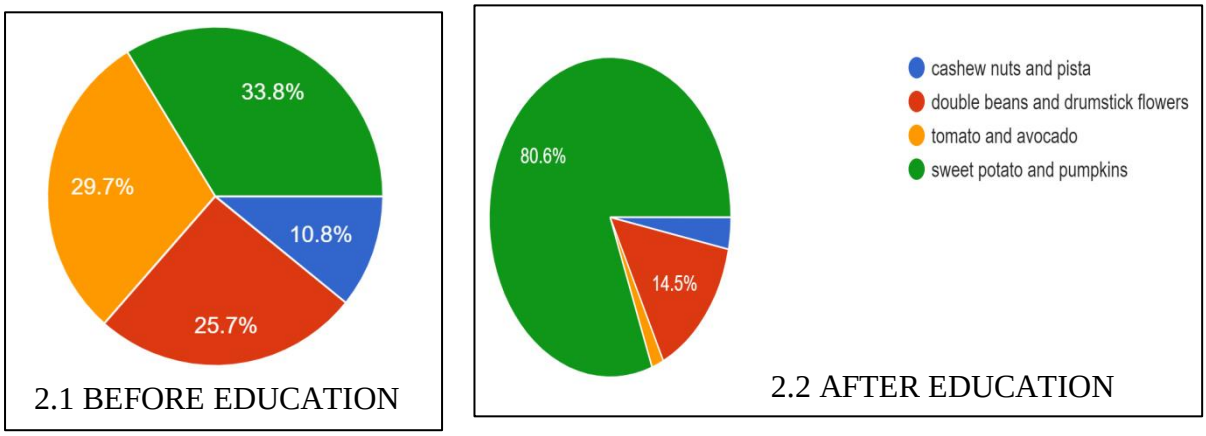
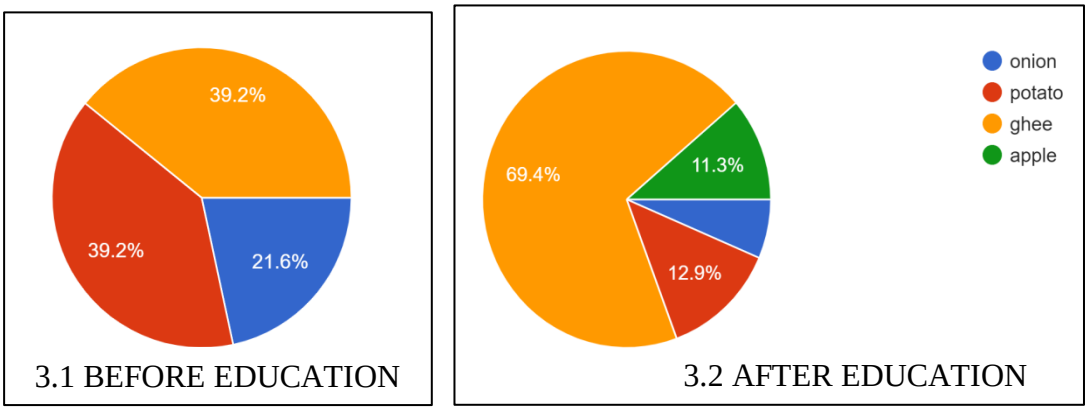


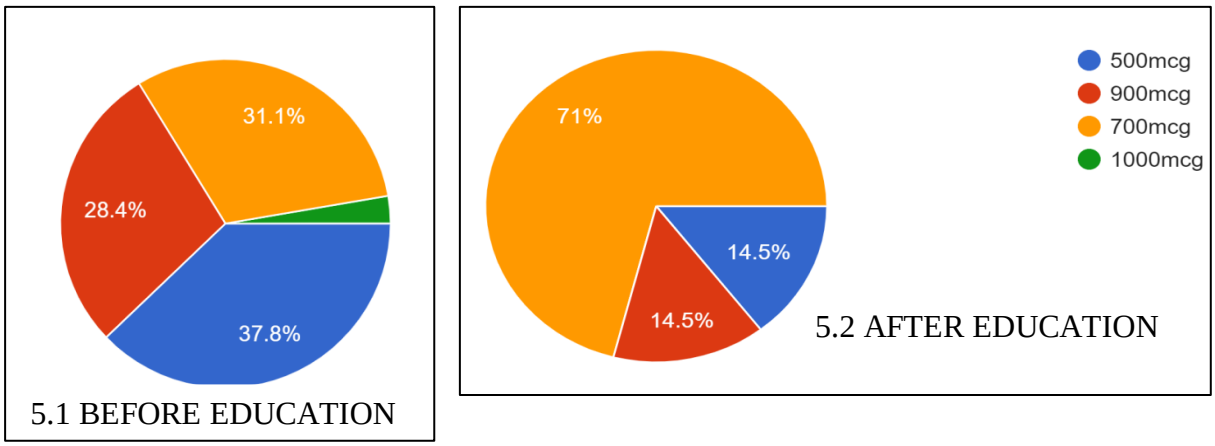
Figure 2.1 indicates ,10.8% people consider that cashew nuts and pista are foods rich in beta carotene , while 25.7% people consider double beans and drumstick flowers as richest sources. Remaining 29.7% and 33.8 % people consider tomato, avocado, sweet potato, pumpkins are foods rich in beta carotene. After education session, 80.6% people understands that sweet potato and pumpkins are richest source of beta carotene.

Figure 3: Knowledge on statement that "intake of food roughly contains 8% of daily needs of vitamin A" .



From the above figure 3.1, we understand that 39.2% people believes apple as one of important sources of vitamin A then ghee. After education session perception changes as 69.4% people concluded that ghee intake roughly satisfies the 8% of daily needs of vitamin A.

Figure 4: Knowledge on daily requirement of vitamin A.



From figure 4.1, 37.8% people consider 500mcg as daily requirement of vitamin A whereas after session, 71% of people understand that 700mcg is requirement of vitamin A per day.

Statistical Analysis:

SPSS version 20.0 were for statistical analysis to analyze the collected data and the results are provided in Table1, 2 and 3.

Table 1: <u>Preferance based question</u>

Questionnaire	Paired t test	P value
Foods rich in beta carotene.	0.79	*0.02
*SIGNIFICANCE VALUE : 0.005		

From Table 1, it was observed that education session has improved knowledge of respondents which has been proven by P value 0.02, indicating the significance value 0.005.

Table 2 Knowlegde based question

Questionnaire	Paired t test	P value
Peanuts boost your eye health and protect eye cells from free radicles which break down eye's tissues. Above statement____	0.0007	*0.01
_____ intake roughly contains 8% of daily needs of vitamin A	0.29	*0.02
Requirement of vitamin A	0.0003	*0.05
*SIGNIFICANCE VALUE : 0.005		

From Table 2, it was observed the education session has improved the knowledge of respondents regarding richest sources of vitamin A which has been proven by the P values 0.01, 0.02 and 0.05 indicating the significance value 0.005 is verified.

Table 3 Perception based question

Questionnaire	Paired t test	P value
Richest source of vitamin A	0.46	*0.01
*SIGNIFICANCE VALUE : 0.005		

From Table 3, the changes in perception of respondents is identified and proven by P value 0.01.

Conclusion

Recommended Daily Amount (RDA) for vitamin-A for a 25-year-old male is 900micrograms/day, or 3000IU. Infants, children, and pregnant and lactating persons need extra vitamin A for fetal growth and tissue maintenance and metabolism [5,6]. Hence the study is mainly conducted to educate bespectacled adolescents and adults

on importance of vitamin-A to create awareness in prevention of vitamin-A deficiency in current and upcoming generation.

References

1. Blaner WS. Vitamin -A and Provitamin A Caroteniods. In Marriott BP, Birt DF, Stallings VA, Yates AA, eds. Present Knowledge in Nutrition. 11th edition. Cambridge, Massachusetts: Wiley-Blackwell;2020:73-91.
2. Ross A.Vitamin A. In: Ross AC, Caballero B, Cousins RJ, Tucker KL, Ziegler TR, eds. Modern Nutrition in Health and Disease. 11th edition. Baltimore, MD: Lippincott Williams & Wilkins; 2014:260-77.
3. Wolf G (June 2001) "The discovery of the visual function of vitamin A" The journal of Nutrition. 13 (6): 1647-50.
4. Stevens GA, Bennett JE, Hennocq Q, Lu Y, De-Regil LM, Rogers L, et al. Trends and mortality effects of vitamin A deficiency in children in 138 low-income and middle-income countries between 1991 and 2013: a pooled analysis of population-based surveys. Lancet Glob Health 2015 Sep;3(9):e528-36. doi: 10.1016/S2214- 109X(15)00039-X [PubMed abstract]
5. McCauley ME, van den Broek N, Dou L, Othman M. Vitamin A supplementation during pregnancy for maternal and newborn outcomes. Cochrane Database Syst Rev 2015: Cd008666. doi:10.1002/14651858.CD008666.pub2 .Update in: Cochrane Database Syst Rev.2015;10:CD008666.PMID:21069707.
6. Ota E, da Silva Lopes K, Middleton P, Flenady V, Wariki WM, Rahman MO, et al. Antenatal interventions for preventing stillbirth, fetal loss and perinatal death: an overview of Cochrane systematic reviews. Cochrane Database Syst Rev 2020;12:Cd009599 .doi:10.1002/14651858.CD009599.pub2.PMID: 33336827;pmcid:pmc8078228.

KNOWLEDGE ABOUT GUT HEALTH IN ADULTS

Tamizh Thendral.S[1], Rajiny Ch[2]

[1]Ph.D Research Scholar, [2]Assistant Professor

PG ∧ Research Department of Home Science,

KMGIPSR, Puducherry, India.

kalkitamizh@gmail.com[1], rajbal2014@gmail.com[2]

Abstract

The gut microbiome is crucial for human health and influences the development of chronic diseases, such as metabolic diseases to gastrointestinal disorders and colorectal cancer. The human gut microbes contain tens of thousands of microorganisms such as bacteria, viruses, fungi and so on. These microbes have both good and bad qualities; good microbes play an important role in our health. It protect against pathogens and contribute to growth-modifying functions, it also helps in various important functions of the body like immunity. And it directly or indirectly affects the functions of our body through its basic functions. This paper indicates the basic knowledge of gut and the how gut bacteria related to our gut health. A pilot study was conducted in chunampet area households, fifty samples were selected and face-to-face interviews using a pre-tested questionnaire. Although their knowledge of the gut was good enough, but they lack an understanding of the gut microbiome and how important it was to our health.

Keywords: *gut health, knowledge, gut microbiome, probiotics.*

Introduction

In recent trends, the role of gut health is considered more important. In the past, the gut was viewed as only one part of the human body, but current technology has proven how important the microbes in the gut are to our overall health. Hence the present study was carried out on the knowledge of the gut and the impact of a healthy gut in Chengalpattu district, Chunampet.

Review of Literature

Gut microbiome in health and disease: Our gut microbiome undergoes changes due to age, environment, stress, diet, and health status, from in-utero variations to those that rapidly occur postpartum (Gail A. Cresci 2015). The role played by the human gut microbiome in

both health and disease has been extensively researched, which has established its involvement in human metabolism, nutrition, physiology, and immune function are all related to this (Matthew J. Bull and Nigel T. Plummer 2014).

Gut microbiome-implications for diet: Human health is heavily influenced by the gut microbiome, which is shaped by dietary patterns and environmental factors. The fermentation of dietary fiber produces short-chain fatty acids, which is how different populations of intestinal bacteria mediate their beneficial effects and endogenous signals with vital roles in lipid homeostasis and reducing inflammation (Ronald D. Hills, Jr et al., 2019).

Methodology

Study type and study setting: A pilot study was conducted at Chengalpattu district, Chunampet municipality, Tamilnadu.

Sample size, tool and study design: Fifty samples were selected and the questionnaire was designed and contacted during visits to the sites of the participants and answers were derived.

Study procedure: Information pertaining to knowledge about gut health, causes and function of gut bacteria.

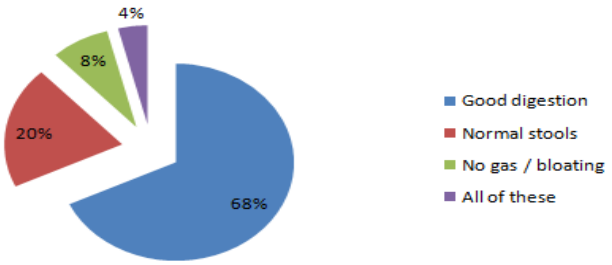
Results and Discussion

Table 1-Healthy gut

Healthy gut	Numbers(50)	Percentage (%)
Good digestion	34	68
Normal stools	10	20
No gas / bloating	4	8
All of these	2	4

A total of 68 percent of households it's known to have good digestion, and this is a sign of healthy gut, followed by 20 percent of households had normal stools, only a minimum of 4 percent of households had good digestion, normal stools, and no gas/bloating had it should relating to gut health.

Figure 1- Healthy gut



Causes of gut health:

Table 2-Causes of gut health

Causes of gut health	Numbers(50)	Percentage (%)
Eating habits	45	90
Lifestyle changes	4	8
Drinking / smoking	0	0
All of these	1	2

A majority of 90 percent of households state that eating habits surely affect gut health. Followed by 8 percent of selected samples responded lifestyle changes cause gut health. Only 2 percent mentioned eating habits, lifestyle changes, and drinking/smoking affect the healthy gut and none stated drinking/smoking cause gut health.

Essential microorganism for gut:

Table 3-Essential microorganism for gut

Essential microorganism for gut	Numbers(50)	Percentage (%)
Bacteria	7	14
Fungi/algae	0	0
Protozone	0	0
Don’t know	43	86

A majority of 86 percent of households were not aware of the microorganisms present in the gut and their importance to the gut, and 14 percent of the households mentioned gut bacteria are essential for gut health.

Function of gut bacteria

Table 4-Function of gut bacteria

Function of gut bacteria	**Numbers (50)**	**Percentage (%)**
Supply essential nutrients	3	6
Prevent pathogen microbes	0	0
both	0	0
Don’t know	47	94

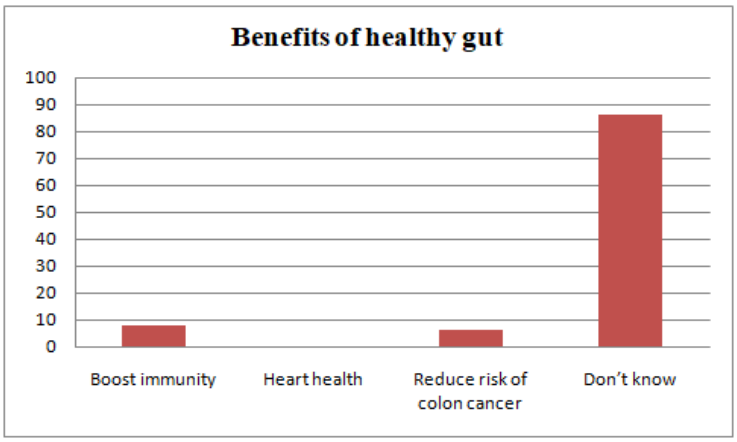
A majority of 94 percent of households were unaware of the functions of bacteria and their uses for our overall health. Only 6 percent of households stated gut bacteria supply essential nutrients to our bodies.

Benefits of healthy gut

Table 5-Benefits of healthy gut

Benefits of healthy gut	**Numbers (50)**	**Percentage (%)**
Boost immunity	4	8
Heart health	0	0
Reduce risk of colon cancer	3	6
Don’t know	43	86

Figure 2-Benefits of healthy gut



A majority of 86 percent of households were not aware of the benefits of a healthy gut and opined that if the gut was healthy, the digestive process was done correctly, followed by 8 percent of households stated that a healthy gut would boost immunity because good gut health leads to good physical health and only 6 percent households felt that it will reduce the risk of colon cancer.

Conclusion

The gut microbiome is essential to human health and influences the development of chronic diseases, such as metabolic diseases gastrointestinal disorders, and colon cancer. Many researchers found the vital role of the human gut microbiome in both health and disease. The result indicates the knowledge about the gut was good enough, but lack an understanding of the gut microbiome and how important it was to our health.

References

1. Gail A. Cresci (2015), Gut Microbiome, American Society for Parenteral and Enteral Nutrition, 30, 732-746
2. Matthew J. Bull and Nigel T. Plummer (2014), The Human Gut Microbiome in Health and Disease Integr Med (Encinitas); 13(6): 17–22.
3. Ronald D. Hills, Jr et al., (2019) Gut Microbiome: Profound Implications for Diet and Disease, Nutrients.; 11(7).

NANOPARTICLES ROLE IN FOOD PACKAGING AND PRESERVATION INDUSTRIES- REVIEW

Supreetha, Saketh, Kamala Golla
Department of Biochemistry & Nutrition
Bhavan's Vivekananda College of Science, Humanities and Commerce, Sainikpuri
Secundrabad, Telangana, India

Abstract

Nanoparticles are ultrafine particles that are not visible to the naked eye, and these nanoparticles have number of applications in various areas such as food packaging and preservation, pharmaceutical industries, optoelectronics, drug delivery, medical imaging, diagnostics and chemical industries. This review is focused in explaining the importance of nanoparticles in food packaging and preservation. In the food packaging industries, the shelf life of packed foods can be extended by killing microbes responsible for food spoilage through the generation of reactive oxygen species (ROS), which cause bacterial DNA damage, protein denaturation, and cell damage. Nanoparticles also inhibit quorum sensing and formation of biofilm thereby inhibiting microbial growth and extending shelf-life of packaged foods. However, there are concerns from consumers and regulatory agencies about directly introducing engineered nanoparticles into food, as it might cause toxicity. As this area needs more scientific approach, extensive research has to be performed.

Keywords: *Nanoparticles, food packaging, reactive oxygen species (ROS), quorum sensing, biofilm and shelf-life.*

Introduction

Nanoparticles are a class of compounds that have been explored due to their enhanced properties and find potential applications in various fields such as food processing and preservation, optoelectronics, drug delivery, and medical imaging. Inorganic metal oxides are extensively investigated in the field of antibacterials by controlling over their particle size, morphology and crystal defects through appropriate synthesis methods. Metal oxides such as AgO, CuO, TiO2, ZnO, Al2O3, SiO2, Fe2O3, and CeO2 are used in the preparation of nanoparticles that improve its antibacterial activity. [1] Nanoparticles can be synthesized in laboratories at small scale level by applying biogenic methods as they are much preferred.
Biogenic methods mainly employed includes the use of plant materials as they are biocompatible, and eco-friendly, hence reduces the risk of allergies and other consequences. For example ZnO nanoparticles can be obtained from *Nigella sativa* seed extract

To increase the shelf-life of packed foods, food preservatives are added to prevent spoilage by killing or inhibiting the growth of food borne pathogenic bacteria. Addition of the food preservatives to the food also results in nutritional and organoleptic changes. To avoid the usage of food preservatives a mechanism-based approach renders the development of highly efficient target-specific antimicrobial NPs [nanoparticles] or MONPs [Metal Oxides Nanoparticles]. MONPs-based food packaging is preferred because they have crystalline structure and have more edges and corners thus, show excellent antimicrobial activity [1]

MONPs can inhibit the growth of bacteria in multiple ways out of which the two most effective methods to inhibit the growth of bacteria are by producing Reactive Oxygen Species (ROS) and the other method is by their Anti- Quorum sensing ability. ROS produced by Zn are formed by the electron−hole pair which is generated from the semiconductor ZnO by excitation of electrons from the appropriate band levels through absorption of light (UV or visible), and these electron−holes produce ROS on interaction with water. [2] Quorum sensing is a cell-to-cell communication happening between bacteria that helps them to produce signalling molecules called as autoinducers. Bacterial cross talk with these signalling molecules can be intra or inter species specific. This could be one of an important factor in enhancing the food contamination. [6]

Antibacterial activity of MONPS by ROS

Most Gram-positive bacteria have teichoic acids with substantial phosphate groups that are negatively charged which allows cell wall to stretch to the surface which increases negative charge and enhances the binding of positively charged metal ions. Additionally, the reactive oxygen species (ROS) produced by the nanomaterials interfere with biological processes of the bacteria. All of the tested bacterial pathogen strains exhibited time-dependent rapid bactericidal action by nanomaterials and metal ions released by nanoparticles from the extracellular environment can penetrate cells and interfere with biological processes. When the metal ions are free to interact with biological components like proteins, membranes lipids, and DNA, cell functions are disrupted. Reactive oxygen species (ROS) can be produced inside the cell by nanoparticles. A variety of ROS can be formed by nanomaterials in cells like, ·O2−, OH-, and H2O2 which interfere in physiological and pathological cellular processes and kill the bacteria

The cells have a various repairing and antioxidant mechanisms for defence and among them, a natural tripeptide namely glutathione is an efficient antioxidant. Upon exposure to ROS, glutathione is oxidized and bacteria's antioxidant defence system against ROS is suppressed. Thus, the glutathione depletion may be a defining sign of the negative effects imposed on bacteria by nanomaterials' prooxidant actions in cells. Hence the overall antibacterial effect is caused by the metal nanomaterial which produces the ROS as shown in Fig. 1. [2, 3]

ROS-Production & Mechanism

ROS are produced by the surface defects present on metal upon reacting with the UV light or Visible light and some metals may also produce ROS in absence of light like Zn. Zn is studied extensively because it has good broad spectrum antibacterial activity, it can also produce ROS in darkness and also ZnO is regarded safe material by the U.S Food and Drug Administration thus, it is studied extensively. [3]

Mechanism of production of ROS in light and dark

Production of ROS in light

By excitation of electrons from the appropriate band levels through absorption of light (UV or visible) the electron−hole pair is generated from the semiconductor, and these electrons−holes produce ROS on interaction with water. Surface oxygen vacancy may trap the

photo excited electrons and preventing recombination inturn increasing the production of ROS ROS production can decrease if recombination takes place.

Production of ROS in dark

$$O_2 + e^- \rightarrow {}^{\bullet}O_2^-$$

$${}^{\bullet}O_2^- + H_2O \rightarrow {}^{\bullet}HO_2 + OH^-$$

$${}^{\bullet}HO_2 + {}^{\bullet}HO_2 \rightarrow H_2O_2$$

$$H_2O_2 + {}^{\bullet}O_2^- \rightarrow O_2 + {}^{\bullet}OH + OH^-$$

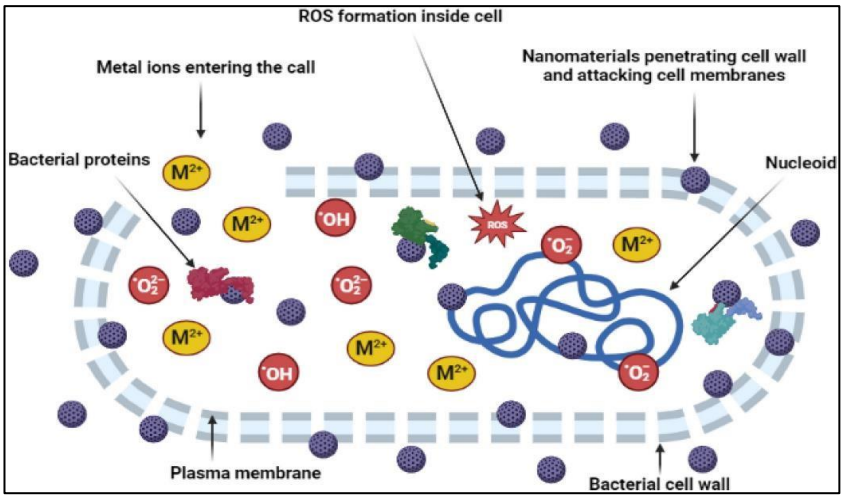
Step 1-Oxygen from the atmosphere can react with an electron from the ZnO surface to form a superoxide radical.

Step 2-Superoxide in water solvates to form Hydroperoxyl radical.

Step 3-Hydroperoxyl radicals can recombine to form H2O2.

Step 4-H2O2 may react with superoxide radical to form hydroxyl radical and hydroxyl ion.

Singlet oxygen formation is not possible in the dark as a hole is required for its formation which will not be produced in the dark. H2O2 is generated form aqueous suspensions of ZnO even in the dark that can cause oxidative stress resulting in antibacterial activity. Antibacterial



activity especially in the dark, has been investigated by NBT (Nitroblue tetrazolium) degradation study, spin trap ESR study using DMPO, and SOD scavenging study in order to elucidate its role in the antibacterial activity. [3]

Source: - [2] Jayanetti, M., Thambiliyagodage, C., Liyanaarachchi, H. *et al.* In vitro influence of PEG functionalized ZnO–CuO nanocomposites on bacterial growth. *Sci Rep* 14, 1293 (2024). https://doi.org/10.1038/s41598-024-52014-6

Antibacterial activity by anti – quorum sensing ability of MNOPS

Excessive food is lost due to quorum sensing regulated microbial spoilage or by contamination of food by pathogens. Quorum sensing (QS), a bacterial cell communication

system is often associated with the bacterial spoilage of food products. Several proteolytic, lipolytic, chitinolytic, and pectinolytic activities are regulated by Quorum sensing which is responsible for the deterioration of foods. Moreover, several types of signalling molecules have been detected in different spoiled food products. Safe QS inhibitors are required that can interfere with bacterial signalling system and prevent food spoilage and biofilm formation by food-related bacteria. therefore, food safety can be achived by inhibiting Quorum sensing and formation of biofilm.

Quorum sensing is communication between two bacterial calls and it can take place between both Gram-positive and Gram-negative bacteria also. Three major types of autoinducers have been recognized as acyl-homoserine lactones (AHLs), autoinducing peptides (AIPs) and autoinducer-2 (AI-2s) molecules. These signal molecules regulate the production of various molecules like pectinase, protease, siderophore-mediated iron chelation, a characteristic feature associated with food spoilage. The production of violacein pigment in , virulence in *Pseudomonas aeruginosa*, flagellar motility in *Listeria monocytogenes*, *Chromobacterium violaceum*, bioluminescence in *Vibrio harveyi* and *V. fischeri* are regulated by Quorum sensing. sporulation, cell differentiation and community organization leads to the development of the mature biofilms [4]

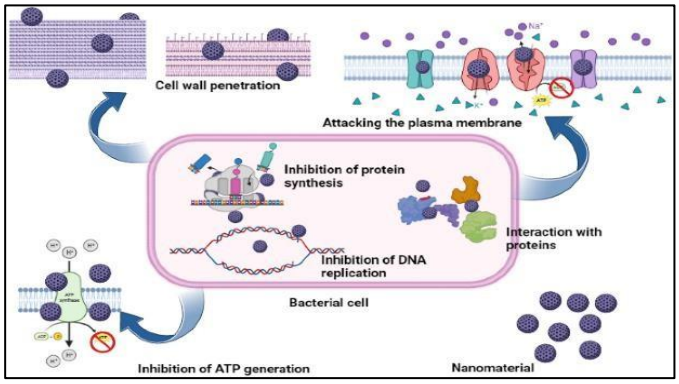
Anti quorum sensing by nanoparticles

QS directs the production of biofilm in bacteria from its initial stage to its maturation or until its fully formed. Food spoilage mainly occurs due to the formation of biofilm and these are the carriers of bacterial contamination which leads to food spoilage.

S. aureus accessory gene regulator (agr) quorum sensing is driven by an autoinducer peptide (called AIP) harbouring a thiolactone ring and an exocyclic tail at the N terminus. formation of biofilms and secretion of virulence factors in *P. aeruginosa* is carried out by quorum sensing (QS) . QS signalling relies on the concentration of signal molecules such as *N*-acyl homoserine lactones (AHLs), which bind to their respective transcriptional regulators such as LasR and RhlR. Intracellularly the AHLs are produced by LuxI and then transported to the extracellular space. At sufficient concentrations, AHLs bind to their respective receptors (LuxR) which in turn induces transcription of virulence genes, including biofilm formation, production of toxins, enzymes and other factors that promote pathogenesis.

Virulence factors namely namely LasA protease, LasB elastase, siderophores, rhamanolipid was inhibited by Microfabricated Ag Nanoparticles (mfAgNPs) in a concentration dependent manner. In *P. aeruginosa* the production of Alginate an exopolysaccharide is regulated by QS which forms the major portion of biofilm matrix. mfAgNPs reduced the production of alginate. significantly as the concentration of mfAgNPs increased. mfAgNPS also down regulated the genes responsible for production of biofilm (*lasA*, *lasB*, *phzA1* and *rhlA)* Additionally, mfAgNPs also disrupted the architecture of biofilm too[5]. EPS (exopolysaccharides)plays a key role in the maintenance of biofilm architecture and provides increased resistance to the cells to antibiotics as well as to osmotic and oxidative stresses. EPS was reduced significantly when bacterial pathogens were treated with sub-MICs of NS-ZnNPs(Zinc nanoparticles obtained from *Nigella sativa*) Biogenic nanoparticles (NS- ZnNPs)

and impaired the bi . *L. monocytogenes, P. aeruginosa* PAO1, and *E. coli* considerably. the synthesized Zinc nanostructures is a potential QS and biofilm inhibitor that can not only be exploited as an antipathogenic but nontoxic bioactive material that can be used as food packaging material and/or as food preservative [4,6]



Source: - Jayanetti, M., Thambiliyagodage, C., Liyanaarachchi, H. *et al.* In vitro influence of PEG functionalized ZnO–CuO nanocomposites on bacterial growth. *Sci Rep* 14, 1293 (2024). https://doi.org/10.1038/s41598-024-52014-6

Nanoparticles in food packaging

The nano particles used in packaging material can be selected or designed based on which organisms is most likely to be grown on that particular food for eg :- if the packaged food is more likely to get contaminated by *S.aureus* then zinc nano particles can be used for packaging as it is more sensitive to Zinc than other nano particle[4]. When Zinc is incorporated into food packaging material it can inhibit the growth of bacteria by production of ROS in presence or absence of UV light which interfere with its biological processes and also supresses its antioxidant defence system against ROS by interfering with physiological and pathological cellular processes or by inhibiting its ability of Quorum Sensing thereby restricting the production of enzymes like pectinase, protease and compounds like siderophores and inhibit bacterial growth resulting in extended shelf-life of the packaged food.

Food packaging applications

The emergence of nanotechnology assisted to present novel food packaging materials with antimicrobial properties and with nano-sensors to trace and monitor the food. For example, ZnO has been included into a number of food linings in packaging to avoid spoilage plus it maintains colours. ZnO-NPs provide antimicrobial activity during food packaging. Additional properties such as the barrier properties, constancy, and mechanical capability are also achieved. Silvestre *et al* introduced the use of polymer nanotechnology in packaging.

Active Packaging

Active packaging produce an effective antimicrobial action on food, and saves the inert products from the environmental factors. The release of NPs on to the food surface kills bacteria

present on it due to its antibacterial activity and prevents food from spoilage. Active packaging is also known as antimicrobial packaging, where NPs interact directly with the product which leads to the death of growing bacteria on food surfaces. Thereby reducing the possibility of pathogen contamination and thus a safe product with an extended shelf life was obtained.

Intelligent Packaging and Smart Packaging

It involves NPs for sensing, detecting, tracing, recording, and communicating. It utilizes a number of indicators for monitoring the food quality in terms of microbial growth as well as temperature and packing integrity. **Chitosan**, a biopolymer of crustacean waste can be used as a reducing agent for the synthesis of gold nanoparticles, which is a greener method. Variation in the concentration of chitosan results in varying the size of AuNPs This can be used to ensure the quality and safety of frozen stored, perishable food and pharma products during shipping and transportation to far away locations. The preparation method is very simple and eco-friendly and easily adoptable by the industry. [8]

Versatile ability of NPs to alter their antibacterial activity

We can alter the efficiency of NPs according to the food we want to preserve, for eg :- If food is Highly susceptible to the growth of MOs then the Bactericidal activity of the nanoparticle can be elevated by coating it with PEG or PVC or any other suitable substance. This method of application is also used in surgical instruments and usage of delicate devices.[7]

Dermatology

Metal and metal oxide NPs are usually used in cosmetology and dermatology, particularly for the treatment of bacterial and fungal skin infections, and sun protection and speedy skin cell repair by use of reduction creams.

Increased shelf-life of fresh fruits

Biodegradable films made up of nano cellulose controls water vapour transfer rate and maintains freshness and lowers microbial growth.

Respiration activity

O_2 concentration were maintained and CO_2 was increased gradually this results in bacteriostatic and fungistatic activity and decreased decay rate [8].

Conclusion

Metal-based nanomaterials, such as Al_2O_3, CrO_3, Fe_3O_4, SiO_2, TiO_2 and ZnO_2 as well as quantum dots and different metallic nanoparticles like Ag, Au, and Pt show antibacterial activity. Conditions in cell like oxidative stress, endothelial cell inflammation, apoptosis, and ecotoxicity are due to these metal oxides. CuO is a potent NP which has the ability to inhibit overall bacterial growth. Zn has broad spectrum anitimicrobial activity and also Zn produces ROS and also has impressive Anti QS activity which can also inhibit formation of biofilms which kill bacteria efficiently and prevent food spoilage. Similarly, Microfabricated silver nano

particles also exhibit good antimicrobial activity and also Anti QS activity which can even supress the genes responsible for production of biofilm and also can disrupt the mature biofilm eventually killing the bacteria.

Nanoparticles are excellent for food packaging as they are bio compatible and also efficient in killing broad spectrum of food borne bacteria and contribute to increased shelf life of the product and are highly biodegradable. Nanoparticle films can also be used in packing fresh fruits which alters the atmosphere around them and helps in storage for a longer time than usual.

Toxicity

Processing, and application of MONPs presents certain challenges because their nano-size which makes them easily to come in contact with cell membranes, enhancing their uptake and transport capacity. Recent investigations on Silver nanoparticles has shown that these may effect respiratory and cardiovascular systems, osteoblasts and osteoclasts, DNA, and embryo development malformations. Some studies show that nanoparticles toxicity is based on their particle and some studies show that nanoparticles damage DNA irrespective of their particle size. [9] Nanoparticles toxicity is not completely understood more research has to be carried out in this area [1]

References

1. Jeyakumar Saranya Packialakshmi, Jungu Kang, Aswathy Jayakumar, Siyeon Park, Yoonjee Chang, Jun Tae Kim, (2023), Insights into the antibacterial and antiviral mechanisms of metal oxide nanoparticles used in food packaging, *Food Packaging and Shelf Life*, 40, 101213.
2. Li, Y., Zhang, W., Niu, J., & Chen, Y. (2012), Mechanism of Photogenerated Reactive Oxygen Species and Correlation with the Antibacterial Properties of Engineered Metal-Oxide Nanoparticles. *ACS Nano*, 6(6), 5164–5173.
3. Jayanetti, M., Thambiliyagodage, C., Liyanaarachchi, H. *et al. (*(2024), In vitro influence of PEG functionalized ZnO–CuO nanocomposites on bacterial growth. *Sci Rep* 14, 1293.
4. Al-Shabib, N., Husain, F., Ahmed, F. *et al.*(2016), Biogenic synthesis of Zinc oxide nanostructures from *Nigella sativa* seed: Prospective role as food packaging material inhibiting broad-spectrum quorum sensing and biofilm. *Sci Rep* 6, 36761.
5. Singh, B., Singh, B., Singh, A. *et al.* (2015), Mycofabricated biosilver nanoparticles interrupt *Pseudomonas aeruginosa* quorum sensing systems. *Sci Rep* 5, 13719.
6. Jin-Hyung Lee, Yong-Guy Kim, Moo Hwan Cho, Jintae Lee, (2014), ZnO nanoparticles inhibit Pseudomonas aeruginosa biofilm formation and virulence factor production, *Microbiological Research*, Volume 169, Issue 12, 888-896.
7. Mohan, C.O., Gunasekaran, S. & Ravishankar, C.N. (2019), Chitosan-capped gold nanoparticles for indicating temperature abuse in frozen stored products. *npj Sci Food* 3, 2.
8. Efthymiou, MN., Tsouko, E., Papagiannopoulos, A. *et al.* (2022), Development of biodegradable films using sunflower protein isolates and bacterial nanocellulose as innovative food packaging materials for fresh fruit preservation. *Sci Rep* 12, 6935.
9. Vimbela GV , Ngo SM , Fraze C, Yang L , Stout DA (2017), *International Journal of Nanomedicine*, 12, 3941—3965,

FOOD AND LIFESTYLE OF THE INDUS VALLEY CIVILIZATION

Nithya.V

Assistant Professor, Department of History

Seethalakshmi Ramaswami College, Tiruchirappalli, Tamil Nadu, India

Abstract

One of the world's oldest urban cultures, the Indus Valley Civilization thrived in the fertile plains of the Indus River between 3300 and 1300 BCE. The sophisticated urban planning, agricultural practices, and culinary preferences of the people who lived in the Indus Valley Civilization are illuminated in this research paper, which delves into the dietary habits and lifestyle of these people. This study aims to provide a comprehensive understanding of the food and lifestyle that characterized this remarkable ancient civilization by utilizing archaeological findings, ancient texts, and modern research methods.

Keywords: *Indus Valley Civilization, food, lifestyle, urban cultures.*

Introduction

Advanced urban planning, intricate drainage systems, and a high level of social organization were characteristics of the Harappan Civilization, which was also known as the Indus Valley Civilization [1]. The goal of this paper is to learn more about the dietary habits and lifestyle choices that the people of the Indus Valley made, as well as how they got food, cooked, and lived their daily lives.

One of the world's earliest urban cultures' inventiveness and sophistication can be seen in the Indus Valley Civilization, also known as the Harappan Civilization [2]. This ancient civilization flourished in the fertile plains of the Indus River between 3300 and 1300 BCE. Its vast territory included present-day India and Pakistan. Even though the cities of Mohenjo-Daro and Harappa are known for their sophisticated drainage systems and well-thought-out urban planning, Harappan archaeology still reveals fascinating details about the people's daily lives and diets [3].

The purpose of this study is to shed light on the lifestyle and food choices that the people of the Indus Valley Civilization made, as well as their culinary practices and societal interactions. We hope to provide a comprehensive comprehension of the intricate connection between the Harappans and their environment, agriculture, and social organization by utilizing contemporary research methods, ancient texts, and archaeological finds [4].

The well-planned cities, impressive infrastructure, and high degree of social organization of the Indus Valley Civilization set it apart [5]. In addition to being a matter of convenience, urban planning was a sign of a complex society with clearly defined roles and a sophisticated comprehension of city life. In addition to the culinary aspects, we look at the larger context of daily life, such as communal interactions, rituals, and the health effects of their diet choices.

By looking at the food and way of life of the Indus Valley Civilization, we set out on a journey to retell a story that goes beyond the buildings of old cities [6]. By shedding light on how a civilization that thrived in the cradle of the Indus River was able to sustain itself through innovative agricultural practices, communal living, and a rich culinary heritage, this research contributes to our comprehension of the human experience in the ancient world.

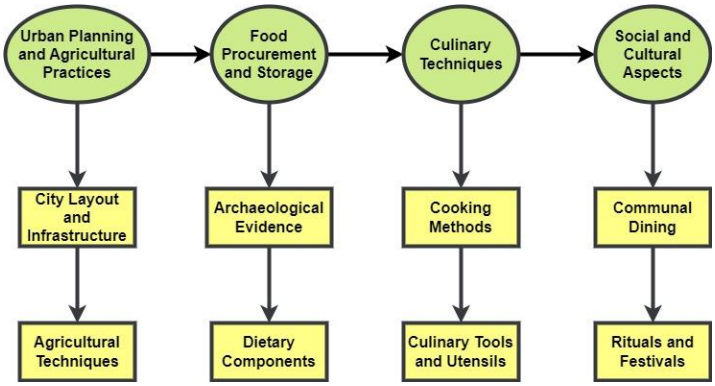


Fig 1-Overall representation of food and lifestyle of the Indus Valley Civilization

Urban Planning and Agricultural Practices

Some of the earliest examples of meticulously planned urban centers belonged to the Indus Valley Civilization. Cities like Mohenjo-Daro and Harappa showed an understanding of urban planning that was ahead of its time with a well-thought-out layout [7]. The houses were arranged in a grid pattern along the north-south and east-west axes of the streets. There was a clear distinction between public, commercial, and residential spaces in the organization of the city.

The cities had sophisticated infrastructure, including an elaborate drainage system, in addition to clearly defined streets. Covered drains made of fired bricks were built by the Harappans to effectively divert wastewater away from houses and streets [8]. Not only did the elaborate drainage system improve hygiene, but it also showed a level of civic planning that was unmatched in the ancient world.

The Indus Valley Civilization's advanced agricultural practices were closely related to its success [9]. The Indus River's nourishment of the region's fertile plains made it ideal for cultivation. The Harappans used the river's waters for irrigation in systematic agriculture.
There is evidence from archaeology that wells and canals were used for irrigation. The Harappans were able to grow a wide range of crops because they had a thorough understanding of how to manage water. Their agrarian economy was built on the production of staple crops like rice, wheat, and barley [10]. Evidence also suggests that cattle, sheep, and goats were domesticated, further contributing to their agricultural sustenance.

Fig 2

Fig 3

Town Planning and Irrigation

It wasn't just cities' meticulous planning and advanced drainage systems that were implemented; they were closely associated with the Indus Valley people's agricultural practices [11]. The surplus that was produced through effective farming probably played a crucial role in maintaining the urban centers, sustaining a population that was growing, and making it easier to trade with areas that were nearby.

An understanding of the Indus Valley Civilization's agricultural and urban planning practices reveals this ancient society's resourcefulness and foresight. The Harappan cities' longevity and prosperity were made possible by the combination of innovative agricultural technology and efficient infrastructure. As a result, they left an indelible mark on the ancient world's history of urbanization and agricultural development.

Fig 4-Agricultural practices–gleaned from the findings excavated at Indus Valley Civilization

Food Procurement and Storage

The methods that the people of the Indus Valley Civilization used to acquire and store food have been discovered through archaeological excavations [12]. The Harappan people's eating habits and food preferences can be seen through the study of artifacts like pottery, storage containers, and tools.

The prevalence of well-designed storage jars and containers made of materials like clay and terracotta is an important discovery. The size variation of these vessels suggests a planned method for storing various kinds of food. Seals on some containers point to a marking system and possibly an early form of trade or distribution.

Pottery, in particular, was essential for the preparation and storage of food. Cooking pots, bowls, and serving dishes with intricate designs have been found, demonstrating the significance of culinary practices. Researchers are able to identify the kinds of food that were cooked and stored in these vessels thanks to the presence of residue traces that are revealed by analysis of pottery.

Fig 5-Small Granary – for storing grains

Fig 6-Kitchen Utensil potteries found at Indus Valley Civilization

The Indus Valley Civilization's diet can be learned a lot from the examination of plant and animal remains at Harappan sites. Staple grains like wheat, grain, and rice were principal to their eating regimen [13]. Additionally, the presence of pulses, millets, and a wide range of fruits and vegetables lends credence to the notion of a comprehensive and varied culinary repertoire.

The presence of bones from cattle, sheep, goats, fish, and other animals indicates a mixed economy that relies on agriculture and animal husbandry. The Harappans followed a well-balanced diet that supplemented their predominantly plant-based diet with protein from animals.

Another fascinating aspect of the Harappan culinary tradition is the use of herbs and spices. Archaeological evidence points to a sophisticated understanding of flavor enhancement in their cuisine, as evidenced by the presence of various spices like cumin, coriander, and mustard seeds.

We can reconstruct the Harappan people's daily lives by comprehending the archaeological evidence of food procurement and storage. The diverse dietary components and effective methods of storage indicate a well-organized society that effectively managed resources, which contributed to the sustainability of their urban centers and the civilization's overall resilience.

Fig 7-Multigrain Laddoos excavated in 2017 at Binjor (Rajasthan)

Culinary Techniques

The Indus Valley Civilization's innovative approach to food preparation was exemplified by a wide range of cooking techniques in their culinary practices [14]. Archaeological evidence suggests that the Harappans used a variety of cooking methods to make a wide range of delicious dishes.

Roasting was a common method, and hearths and ovens can be found in both private homes and public buildings. The roasting of grains, vegetables, and meats in controlled ovens and open fires contributed to a wide range of culinary options.

Another common cooking method was boiling. Pottery vessels with traces of boiling have been found during excavations, pointing to the preparation of soups, stews, and other boiled dishes. The Harappans' mastery of pottery and its application in culinary practices are highlighted by the use of clay pots and containers for boiling [15].

Clay ovens indicate that baking was also a part of the culinary repertoire. The sophistication of Harappan baking methods is demonstrated by the fact that these ovens were probably used to bake a variety of breads. The Indus Valley people's culinary prowess was demonstrated by their capacity to control heat for a variety of cooking methods.

When it came to making culinary utensils and tools, the Indus Valley Civilization displayed a high level of craftsmanship. With a variety of vessels designed for cooking, serving, and storing food, pottery was important in the kitchen. The significance of cooking pots, bowls, and pans in everyday life was reflected in their meticulous construction.

Grains and spices, among other foods, are typically prepared with the help of mortars and grinding stones. Grinding implements were necessary for enhancing the flavors of Harappan cuisine and processing raw ingredients.

Even though metal tools were less common than pottery, they were still used in the Indus Valley people's cooking. The discovery of utensils made of copper and bronze, like knives and ladles, demonstrates that the Harappans were able to use metals for practical purposes.

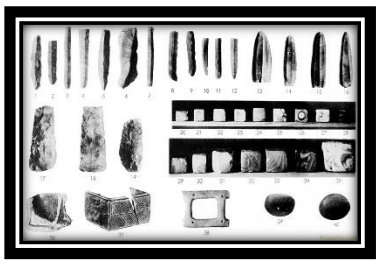


Fig 8-Utensils - like knifes and flint implements –
findings of Marshall (1922-27) Mohenjo Daro

In the culinary context, the Harappan people's diverse skill set is reflected in the combination of pottery, stone, and metal tools. These tools not only made meal preparation easier, but they also made their culinary practices more sophisticated and effective as a whole. The Indus Valley Civilization's culinary practices provide valuable insights into the daily lives of its inhabitants. This ancient civilization's ingenuity and resourcefulness in the area of food preparation is exemplified by the use of a variety of cooking methods and the handiwork that went into the making of culinary tools and utensils.

Social and Cultural Aspects

Food practices, communal dining, and daily life rituals are intricately linked to the social and cultural aspects of the Indus Valley Civilization [16]. A comprehensive comprehension of how food served as a nexus for social interactions and cultural expressions can be gained by examining these dimensions.

Archaeological evidence suggests that Harappan society relied heavily on communal dining. Common areas, like communal kitchens or dining areas, may have been used for communal purposes in the layout of residential buildings. The concept of communal gathering spaces is further supported by the presence of substantial public buildings with numerous rooms.

A communal approach to food preparation and consumption is indicated by communal dining areas with fireplaces and cooking facilities. The communal nature of Harappan life and the strengthening of community ties could have been fostered by sharing meals.

The well-defined streets and public spaces of the cities in the Indus Valley may have made it easier for people to interact with one another and do things together, like eat together. It's possible that Harappan society's cooperative spirit was reflected in communal dining.

The Indus Valley Civilization's religious and cultural ceremonies relied heavily on food. The presence of ritualistic objects like seals and terracotta figurines suggests a connection between spiritual practices and food offerings [17]. The sacred nature of food in Harappan culture is brought to light by the fact that ritual vessels found in some structures may have been used for particular ceremonies.

The fact that food-related artifacts were found in close proximity to figurines of animals and deities suggests a symbolic connection between spirituality and food. It's possible that special culinary preparations were made for festivals and celebrations, and some foods were only eaten on certain days. These celebrations probably strengthened social ties and cultural identity through their communal aspect.

The cultural significance of culinary practices in the Indus Valley Civilization is demonstrated by the inclusion of food in religious ceremonies and celebrations. It suggests that the Harappans saw food as a way to express their spiritual beliefs and communal values in addition to providing them with food.

Our comprehension of the Indus Valley Civilization's daily lives is enhanced by our comprehension of the social and cultural aspects of food. This ancient society's social fabric is revealed through communal dining and ritualistic practices, which emphasize the significance of food in forming individual and collective identities.

Health and Nutrition

Skeletal remains, dental health, and the overall health of the Indus Valley Civilization's inhabitants are all examined when examining the diet and health of this civilization [18]. These investigations shed light on the health conditions, dietary habits, and lifestyle factors that contributed to the Harappan people's physical stature.

The study of skeletal remains from Harappan sites provides important information regarding the population's overall health and living conditions. Life expectancy, the incidence of diseases, and nutritional status are all examined through anthropological methods.

Stress, malnutrition, or the presence of diseases can all be detected by examining the skeletal morphology and pathologies. Osteological research has revealed that, despite the fact that some members of the Indus Valley Civilization had dental problems and arthritis, the population's overall health indicators indicate that they were relatively well-nourished.

A population that participated in activities that supported musculoskeletal health and was physically active, as evidenced by the population's generally robust skeletal structure, has been observed by researchers. The fact that there isn't a lot of evidence of severe malnutrition

or debilitating diseases suggests that the Harappan people were able to stay in good health and get enough food.

The Harappan people's overall nutritional profile was influenced by the wide variety of foods they ate. As staples, cereals like wheat, barley, and rice provided essential carbohydrates. The diet was enriched with proteins, vitamins, and minerals by including legumes, fruits, vegetables, and animal products like meat and fish.

The discovery of grinding tools and processing equipment suggests that the Harappans had a sophisticated food preparation method that probably helped grains and other food items release their nutrients. Spices and herbs not only gave meals flavour, but they could also have increased their nutritional value.

The possibility of meeting nutritional requirements within the confines of the Indus Valley Civilization is highlighted by the combination of agricultural practices and a varied diet [19]. The archaeological evidence of the Harappans' diverse diets suggests that they were aware of the significance of eating a well-balanced diet for overall health.

A nuanced perspective on the lifestyle and well-being of its inhabitants can be gained by gaining an understanding of the health and nutritional aspects of the Indus Valley Civilization. The Harappans successfully adapted to their environment, maintaining a level of health that contributed to the sustainability of their civilization, despite challenges such as dental issues and nutritional diversity.

Fig 9-Wheat on Clay dish found at Mohenjo Daro, Indus Valley Civilization

Fig 10-Rectangular Granary built on raised platform to avoid flood found at Harappa

Fig 11-Burnt Grains of Wheat and Barley grains found at Rehman Dheri site

Conclusion

One of the most advanced societies of ancient times was characterized by a rich tapestry of innovation, organization, and cultural richness that can be seen in the food and lifestyle of the Indus Valley Civilization. We now have a comprehensive understanding of the intricate tapestry that was the Harappan way of life through the lens of urban planning, agricultural practices, food procurement, culinary techniques, and social aspects. With their grid-like layouts and sophisticated drainage systems, the well-planned cities of Mohenjo-Daro and Harappa demonstrated a society that recognized the significance of effective urban planning. This laid the groundwork for a well-organized, long-lasting civilization that thrived in the fertile Indus River plains.

The Harappan way of life was vitally influenced by agricultural practices. A surplus of food that could feed the growing population in urban centres was made possible by cultivating staple crops and using advanced irrigation methods. Their diet was further enriched and the culinary landscape became more diverse as animal husbandry was incorporated. The Harappans' inventiveness in resource management was highlighted by the archaeological evidence of food procurement and storage. A society that not only met its basic needs but also celebrated the art of culinary expression was emphasized by the presence of diverse dietary components, well-designed storage containers, and culinary tools.

Roasting, boiling, and baking were just a few of the culinary techniques that demonstrated a sophisticated approach to food preparation. The Harappans' skilful handiwork and adaptability to a variety of cooking methods were exemplified by the wide range of culinary tools, which included everything from pottery to metal utensils. Dining in groups became a popular social activity among Harappans. A society that valued collective experiences and strengthened social bonds through shared meals was suggested by the layout of cities and the presence of communal spaces. The Harappan people's daily lives were enriched spiritually and culturally by festivals and rituals that were connected to food practices.

Based on skeletal remains, an overall healthy population was depicted in the health and nutrition analysis. The diversity of the diet and overall skeletal health reflected a population that successfully adapted to its environment, despite challenges like dental issues. In conclusion, the food and way of life of the Indus Valley Civilization were characterized by the harmonious integration of urban planning, agriculture, culinary practices, and living in groups. The Harappans left behind not only the physical structures of their cities, but also the richness of their everyday lives, as shown by the food they prepared, shared, and revered. We gain a

profound appreciation for the resilience and creativity of humanity in the pursuit of sustenance, culture, and community as we delve deeper into the nuances of this ancient civilization.

Future Directions

Archaeological finds and interdisciplinary research have improved our understanding of the diet and way of life of the Indus Valley Civilization, but there are still a lot of areas for further investigation. Interdisciplinary collaboration between archaeologists, anthropologists, geneticists, and nutritionists could benefit future research. Traditional archaeological methods could be combined with cutting-edge technologies like DNA analysis, isotopic studies, and biomolecular techniques to gain a deeper understanding of genetic traits, health indicators, and the particulars of Harappan cuisine.

It's important to know how the agricultural practices of the Indus Valley Civilization affected the environment. To gain a more complete comprehension of the sustainability of their agricultural practices and the ecological footprint of the civilization, it would be helpful to investigate the soil composition, patterns of land use, and the long-term effects of irrigation systems on the environment. The spread of culinary practices, ingredients, and cultural influences could be better understood by looking into the trade networks and cultural exchanges with neighbouring regions. A deeper comprehension of the interconnectedness of ancient societies would be gained by examining trade routes, artifacts, and material culture from regions that were in contact with the Harappans. The Harappan script remains an ongoing challenge to decipher. The administrative, economic, and possibly culinary practices of the Harappans could all be revealed if this ancient writing system is better understood. Their cultural heritage may be revealed in new ways if linguistic and script studies are pursued in the future.

Pollen analysis and other paleoenvironmental studies could shed light on the flora and fauna of the Indus Valley Civilization. The Harappan people's adolescent acclimatization to their surroundings, as well as their agricultural and culinary preferences, may be better understood if we have a better understanding of the natural resources at their disposal and how they have changed over time. Future studies may investigate regional variations in food practices due to the Indus Valley Civilization's vastness. A more nuanced comprehension of the diversity that existed within this ancient society would result from examining the variations in diet, cooking methods, and cultural practices that were observed at various sites within the civilization. In conclusion, the study of the diet and way of life of the Indus Valley Civilization is a dynamic field with numerous avenues for further research. We will be able to get a

completer and more accurate picture of the complexities that defined this remarkable ancient civilization thanks to ongoing research and cross-disciplinary collaboration.

References

1. Kenoyer, J. M. (1997). Ancient Cities of the Indus Valley Civilization. Oxford University Press.
2. Possehl, G. L. (2002). The Indus Civilization: A Contemporary Perspective. AltaMira Press.
3. Wright, R. P. (2010). The Ancient Indus: Urbanism, Economy, and Society. Cambridge University Press.
4. Meadow, R. H. (1991). The origins and spread of agriculture and pastoralism in northwestern South Asia. In Harris, D. R., the Origins and Spread of Agriculture and Pastoralism in Eurasia, 390-412.
5. Shinde, V., & Willis, R. (2017). Excavations at Farmana: District Rohtak, Haryana. Archaeological Survey of India.
6. Madella, M., & Fuller, D. Q. (2006). Palaeoecology and the Harappan Civilisation of South Asia: A reconsideration. Quaternary Science Reviews, 25(11-12), 1283-1301.
7. Almond, Gabriel and Sidney Verba (2003). The Civic Culture. Princeton, NJ: Princeton University Press.
8. Cunningham, A. (2002). The Ancient Geography of India. New Delhi, Munshiram Manoharlal Pub. Pvt. Ltd.,
9. Farmer, S., R. Sproat and M. W. Witsel ((2004). The Collapse of the Indus- Script Thesis: The Myth of a Literate Harappan Civilization. Electronic Journal of Vedic Studies 11(2): 19-57.
10. Bisht, R. S. (2015). The excavations at Dholavira (1989–90 to 2004–2005). New Delhi: Archaeological Survey of India.
11. Danino, M. (2016). Aryans and the Indus civilization: Archaeological, skeletal, and molecular evidence. In G. Robbins Schug & S. R. Walimbe (Eds.), A companion to South Asia in the past, 205–224. Boston: Wiley Blackwell.
12. Dibyopama, A., Kim, Y. J., Oh, C. S., Shin, D. H., & Shinde, V. (2015). Human skeletal remains from ancient burial sites in India: with special reference to Harappan civilization. Korean Journal of Physical Anthropology, 28(1), 1–9.
13. Kenoyer, J. M., & Meadow, R. H. (2016). Excavations at Harappa, 1986–2010: New insights on the Indus Civilization and Harappan burial traditions. In G. Robbins Schug

& S. R. Walimbe (Eds.), A companion to South Asia in the past 145–168. Boston: Wiley Blackwell.

14. Kenoyer, J. M., Price, T. D., & Burton, J. H. (2013). A new approach to tracking connections between the Indus Valley and Mesopotamia: Initial results of strontium isotope analyses from Harappa and Ur. *Journal of Archaeological Science*, 40(5), 2286–2297.
15. Lee, H., Waghmare, P., Kim, Y., Hong, J. H., Yadav, Y., Jadhav, N., et al. (2019). Traumatic injury in a cranium found at Rakhigarhi cemetery of Harappan civilization as anthropological evidence of interpersonal violence. *Journal of Archaeological Science*: Reports, 23, 362–367.
16. Singh, V. (2017), Origin of the Hindu Religion and Sanskrit in Central Asia: A Recent Claim and its Rebuttal. Indian Historical Review, 44(1), 1–20.
17. Tandon, M. (2019), History of science in India: Focus on pre-Vedic and Vedic times. In Science education in India: Philosophical, historical, and contemporary conversations 3–26. Singapore: Springer Singapore.
18. Ceccarelli, A., and Petrie, C. (2020), Cultural evolutionary paradigms and technological transformations from the Neolithic to the Indus Urban Period in South Asia. IN Religions, Society, Trade and Kingship: Archaeology and Art in South Asia and Along the Silk Road 3500BC – 5th Century CE, South Asia Archaeology and Art 2016, Greaves, L.R., and Hardy, A. (Eds), Dev Publishing, New Delhi.
19. Khan, S., Yilmaz, N., Valipour, M., and Angelakis, A. (2021), Hydo-Technologies of Mehrgarh, Baluchistan and Indus Valley Civilisations, Punjab, Pakistan (ca. 7000–1500 BC), Water 13, no. 20: 2813.

A STUDY OF FOOD HABITS IN SANGAM PERIOD AS EVIDENCE IN TAMIL LITERARY WORKS

Saranya. V

Assistant Professor, Department of History,

Seethalakshmi Ramaswami College, Tiruchirappalli, Tamil Nadu, India

Abstract

This study examines the food practices of the Sangam Period, a significant period in Tamil history that lasted from 300 BCE to 300 CE. The study's subject is the Sangam literature, a collection of ancient Tamil poems and writings that depicts a diverse array of culinary practices and dietary preferences. By conducting a comprehensive analysis of these literary works, the purpose of this paper is to shed light on the ingredients, cooking techniques, social significance, and symbolic meanings associated with food during this period.

Keywords: *Tamil literature, Sangam period, culinary practices, food habits, social significance, symbolism, and metaphors.*

Introduction

A unique window into the social and cultural fabric of ancient Tamil society can be gained through the literary and artistic flourishing of the Sangam Period. During this time, people's way of life and sense of identity were significantly impacted by food, which is an essential component of human existence [1]. By looking at how food is depicted in Sangam literature, the purpose of this paper is to learn more about the culinary heritage of the Sangam period.

The Sangam Period, which lasted from 300 BCE to 300 CE, is regarded as a golden age in the rich tapestry of Tamil history [2]. It was characterized by remarkable literary and cultural accomplishments. One of a civilization's most important aspects is its food culture, and the Sangam Period is no exception. The ancient Tamil society is vividly depicted in Sangam literature as having a profound connection between the time's social fabric and culinary practices. This research paper aims to decipher the specifics of food habits during the Sangam Period by drawing on insights from the verses and narratives of the Sangam literary works.

We have a unique perspective on the gastronomic legacy of this period thanks to the Sangam literature, which includes poetry in Akam and Puram [3]. These timeless compositions provide glimpses into the people's daily lives, celebrations, and rituals by shedding light on the ingredients, cooking techniques, social dynamics, and symbolic meanings of food. By delving

into the poetic expressions of the time, this study aims to reconstruct the culinary landscape of the Sangam Period and provide a nuanced understanding of how food was intertwined with the Tamil people's cultural identity [4].

Verses that explain the essence of agricultural practices, the variety of ingredients, the art of cooking, and the significance of communal meals serve as our starting point for this investigation. To gain a deeper comprehension of the Sangam bards' poetic expressions, we also investigate the metaphors and symbolic representations of food [5]. We hope to expand our knowledge of the Sangam Period and the social, cultural, and symbolic significance of food in ancient Tamil society by carrying out this multidisciplinary study.

Methodology

Using a literary analysis approach, the study draws on the wealth of information in Sangam literature [6]. The study looks at different kinds of poetry, like Akam and Puram poetry, to see where food, feasts, cooking techniques, and the cultural contexts in which people ate are mentioned.

The Sangam scholarly works, which are important files of social and authentic information, are the subject of a top to bottom artistic investigation as a component of the examination strategy [7]. Using a methodical approach, the research aims to extract, interpret, and contextualize references to food, culinary practices, and associated rituals from these ancient Tamil texts. The compilation and classification of Sangam literary works, which include poetry written in both Akam (inner or subjective) and Puram (outer or objective) styles, is the first step. This extensive collection serves as the foundation for locating and obtaining references to meals, feasts, and culinary customs.

Using a close textual analysis of selected poems and prose passages, the study identifies explicit and implicit references to food items, cooking techniques, and communal dining practices [8]. The cultural and linguistic contexts in which food references are embedded are taken into account. A few examples of the food-related elements that are systematically categorized after being identified include ingredients, cooking techniques, culinary tools, and symbolic representations. This classification makes it easier to examine the various aspects of Sangam food culture in a systematic way.

To place the identified food references in their historical and cultural context, the study takes into account things like social structures, agricultural practices, and location. This contextualization is necessary for comprehending the socioeconomic and environmental factors that influenced food habits during the Sangam period. A comparative analysis with other external historical sources, archaeological findings, and ethnographic studies is used when

necessary in the research. This helps to validate and improve comprehension of the food habits derived from Sangam literature and paints a more complete picture of the culinary landscape.

The diversity of Sangam food culture is captured through an interdisciplinary approach. This means bringing together concepts from literature, history, archaeology, anthropology, linguistics, and linguistics to provide a complete and nuanced understanding of the subject. This study focuses on locating and comprehending food-related metaphors and symbolism in Sangam literary works [9]. This analysis goes beyond the literal descriptions to look into the deeper meanings and cultural connotations of food items. Using these methodological approaches, the purpose of this study is to enhance our comprehension of the cultural and historical aspects of ancient Tamil society by providing a comprehensive and nuanced portrayal of food habits during the Sangam period.

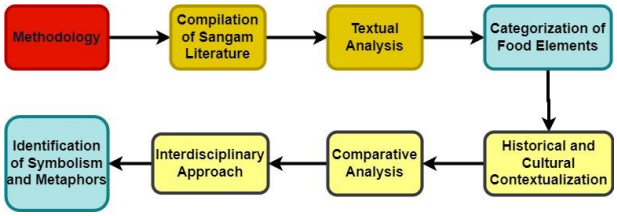


Fig 1-Methodology of food habits in Sangam period

Ingredients and culinary practices

This section examines the various Sangam cuisine ingredients. The availability and utilization of grains, meat, vegetables, fruits, spices, agricultural practices, and particular food items are the subject of the study [10]. Special emphasis is placed on the distinctive culinary practices and cooking methods of the Sangam Period. The culinary landscape of the Sangam Period, as depicted in Tamil literary works, vividly reflects the diverse array of ingredients and culinary practices that shaped the gastronomic heritage of ancient Tamil society. Through an in-depth examination of the verses and narratives, this section delves into the key components of Sangam cuisine, shedding light on the ingredients, cooking techniques, and dietary preferences that were prevalent during this historical epoch.

The staple grains that served as the foundation for Tamil cuisine are frequently mentioned in Sangam writing. There were a lot of rice, millets, and pulses, with rice playing a big part. By describing the cultivation of paddy fields and the significance of rice in everyday meals, the poems demonstrate the importance of rice to the diet of the time [11]. Sangam poetry's verses show how much fruits and vegetables are used in Tamil cooking. Descriptions of lush orchards, vegetable gardens, and forest produce highlight the variety of plant-based

foods consumed. Plantains, mangoes, and pumpkins are some of the fruits and vegetables that get mentioned the most, indicating their popularity.

Meat, particularly from domesticated animals and local wildlife, was a major component of Sangam cuisine. Hunting, roasted meat feasts, and various animal products are all depicted in the poems. In addition, references to seafood emphasize the significance of marine resources in the diets of coastal communities [12]. The extensive use of spices and condiments to enhance dish flavors is depicted in Sangam's literature. Common spices include coriander, mustard seeds, black pepper, and cumin. The careful application of these spices demonstrates a sophisticated understanding of the culinary arts as well as a keen appreciation for the sensory aspects of food.

The poems reveal a variety of cooking techniques used during the Sangam Period. Boiling, roasting, and steaming are frequently mentioned as cooking methods, demonstrating their adaptability. The use of hearths, grinding stones, and earthenware vessels emphasizes the significance of traditional cooking methods. The consumption of beverages, including a variety of fermented beverages, is demonstrated in Sangam literature. There is mention of palm wine, also known as "toddy," and beverages made from fermented rice, indicating a long history of brewing and fermentation. The kitchen's practices were more than just practical; they had intricate ties to rituals and the symbolic meanings they carried. Feasts and offerings to deities were part of celebrations, and the menu had cultural and religious significance [13]. By examining these various components, the purpose of this section is to provide a comprehensive understanding of the culinary practices and ingredients of the Sangam Period. In addition to providing insights into the dietary practices of the time, the culinary heritage depicted in Sangam literature reflects the cultural, social, and ecological contexts that shaped the gastronomic preferences of ancient Tamil society.

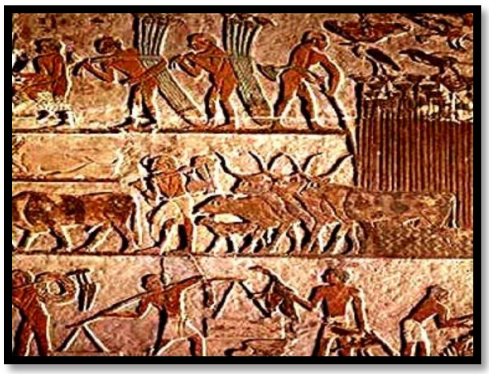


Fig 2-Civilization of Ancient

Social significance of food

Food wasn't just food during the Sangam period; it had a significant impact on society and culture [14]. This section examines the significance of food in social gatherings, religious ceremonies, and celebrations. In addition, it looks at food consumption hierarchies to show how choices in the kitchen reflected social status.

During the Sangam period, food transcended its role as merely a source of nourishment to acquire a significant social and cultural significance. In the extensive tapestry of Tamil literature from this era, the communal aspects of dining, the role of feasts in social gatherings, and the symbolic meanings associated with food are detailed. This section examines the social significance of food during the Sangam period, shedding light on how culinary practices were woven into daily life and social structures [15]. In Sangam poetry, dining together as a group is frequently depicted as an essential aspect of social life. More than just eating, sharing meals was a way of life; it was also a ritual that helped people stay socially together and strengthened family and community ties. By describing scenes from feasts where people gathered, shared meals, and conversed, the poems emphasize the social aspect of dining.

The literature suggests that social hierarchies are reflected in culinary choices. Different social classes or communities were linked to foods and dining habits. Highlighting the stratified nature of Sangam society, feasts hosted by kings and nobility differed in scale and opulence from those hosted by commoners. Feasts are celebrated as essential elements of ceremonies and celebrations in Sangam literature. Weddings, strict ceremonies, and other propitious events were set apart by intricate devouring. The poems' descriptions of feasts shed light on the cultural practices and customs associated with significant life events.

It was thought to be moral to extend hospitality and food to others. It was highly valued to offer free meals to guests and travellers. The poems frequently depict instances in which hosts took great pride in providing a plethora of food to demonstrate their wealth and hospitality [16]. In religious ceremonies and rituals, food was considered sacred. As a sign of a spiritual connection between the people and the divine, people frequently made offerings to deities and ancestral spirits. The selection of foods for these rituals had symbolic meanings that helped the community's spiritual and cultural identity.

Cultural identity was also influenced by culinary practices. Food traditions that were unique to each region reflected the local agricultural practices and environmental factors. The poems frequently emphasize regional specialties, fostering a sense of community and pride among the people. There are references to regional trade and exchange of culinary ingredients, indicating that food had a significant social and economic impact [17]. Spices, grains, and other

food items moved more easily through trade networks, fostering cultural exchanges and economic ties. Understanding the social significance of food during the Sangam Period sheds light on the connections between social structures, rituals, and cultural identity that culinary practices had. Due to the nuanced portrayal in Sangam literature, we are able to appreciate how food was a powerful medium for expressing social bonds, hierarchies, and the rich tapestry of everyday life in ancient Tamil society.

Fig 3-Significance of Food

Symbolism and Metaphor

The literature of Sangam is full of metaphors and symbolism related to food. By deciphering the symbolic meanings associated with particular foods, this section investigates the literary uses of food as literary devices to convey emotions, relationships, and societal values. The Sangam literary works are full of metaphors and symbolic representations, and food is a potent means of conveying deeper meanings and cultural nuances [18]. The various layers of meaning embedded in the descriptions of culinary components are examined in this section, which delves into the symbolism and metaphorical use of food in Sangam literature.

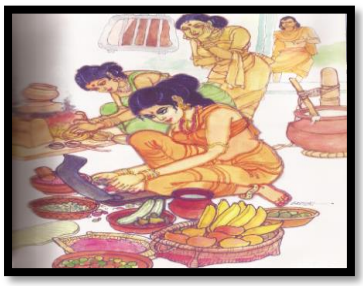
In Sangam poetry, food-related metaphors are frequently used to convey the intensity of emotions, especially in relation to love and passion. Expressions of romantic relationships gain a sense of richness from the metaphorical connections that are made between the emotions of lovers and descriptions of delicious treats, flavorful spices, and intoxicating beverages. Wealth and prosperity are represented by feasts that are overflowing with a variety of dishes and delicious flavors. The imagery of plentiful meals, which is frequently associated with royal gatherings, suggests not only the prosperity of the land but also the affluence and wealth of the rulers.

The dualities of life are metaphorically represented by the tastes of bitterness and sweetness. While sweetness is associated with happiness, success, and the fulfilment of one's desires, bitterness may represent difficulties, hardships, or unrequited love [19]. These

metaphors demonstrate the poet's ability to reflect on more general aspects of human existence by utilizing everyday experiences. In religious and ritualistic contexts, the offering of foods has symbolic significance. Dishes and ingredients become symbols for spiritual devotion, purity, and the connection to the divine. In these rituals, sharing food fosters a sense of community and common values.

Food's ability to spoil quickly serves as a metaphor for life's fleetingness. Reflection on the transience of worldly pleasures and the imminence of change is evoked by references to ripening fruits, harvesting grains, or feasts coming to an end. Metaphors are used to identify and distinguish various cultural and regional aspects through specific foods and culinary practices. The poems' inclusion of culinary traditions and regional specialties represent the distinct cultural identities of various communities within Tamil society.

The harmony that exists between human activities and the environment is metaphorically represented by references to agricultural practices, cultivation, and the utilization of natural resources in the production of food. The careful tending of fields and responsible farming practices represent the sustainable use of resources. As metaphors for social harmony and unity, shared meals and feasting are used [20]. The act of sharing a meal symbolizes cooperation, shared values, and the possibility of social cohesion. The poetic imagination of the time can be seen in Sangam literature's symbolic use of food, which elevates everyday objects to convey profound truths about human experience, emotions, and the interconnectedness of life.



Conclusion

The study of food practices during the Sangam Period, as depicted in Tamil literary works, reveals a fascinating tapestry of culinary practices, social dynamics, and symbolic meanings that shaped the lives of the ancient Tamil people. The Sangam literature, which includes Akam and Puram poetry, enables us to investigate the spheres of everyday life, societal structures, and cultural expressions of the time. Through the study of culinary methods and ingredients, a diverse and extensive culinary heritage has been discovered. The culinary

prowess of the people, regional distinctions, and the availability of resources were all reflected in Sangam cuisine. In addition to the standard grains and vegetables, it included meats, spices, and unique cooking methods. The poems' intricate details provide a sensory experience and transport us to the kitchens and dining tables of the Sangam period.

The unmistakable topic of the social meaning of food highlights the collective idea of eating, the function of banquets at festivals and other events, and the influence of social orders on culinary decisions. Sharing meals becomes a way to build relationships, show hospitality, and strengthen cultural identity. Through food, the Sangam poets vividly portray societal structures and the interconnectedness of their communities' members. Through the use of symbolism and metaphor, food becomes a metaphor for expressing one's feelings, considering the paradoxes of life, and conveying one's cultural identity. By utilizing everyday experiences like food taste, the poems demonstrate the poets' capacity to investigate profound truths about the human condition, relationships, and the fleeting nature of existence.

Beyond the scope of culinary history, the study of food habits during the Sangam period provides a comprehensive understanding of the sociocultural environment of ancient Tamil society. The Sangam literature serves as a mirror that reflects the ideals, aspirations, and philosophies of a bygone era. It is also a repository for culinary knowledge. As we savor the literary feast laid out in the verses of Sangam poetry, transcending time to connect with the culinary heritage of our ancestors, we gain a deeper appreciation for the intricate relationship between culture and food.

References

1. Srinivasan, K. R. (2004). The Sangam World: A Comprehensive Historical and Cultural Overview. Oxford University Press.
2. Subramanian, N. (1999). Sangam Polity: The Administrative and Military System of the South Indian Kingdoms. Ennes Publications.
3. Arokiasamy, A. (2010). Food and Society in Ancient Tamil Literature. *Journal of Historical and Cultural Studies,* 7(2), 123-145.
4. Venkatesan, V. (2015). Symbolism in Sangam Poetry. South Asian Studies, 31(2), 189-205.
5. Mahadevan, I. (1988). Early Tamil Epigraphy from the Earliest Times to the Sixth Century AD. Cre-A.
6. Nilakanta Sastri.K.A., (1964), Sangam Literatures – Pattupattu, Ettuthogai, Agananuru, Pura Nanooru, Mullai Pattu., etc., The Cultural History of the Tamils.

7. History of Tamilnadu Sangam Age (Social), (1983), Expert Committee for History of Tamilnadu, Director of Tamil Development, Kuralagam, Government of Tamilnadu, Madras.
8. Kandasami.A, (2013), Pazhanthamilarin Pazhakkavazhakkangal, International Institute of Tamil Studies, Tharamani, Chennai,
9. Sundarraj.V & S. Periyasamy, (2012), Unavum Udalnalamum, Ramayya Publication, Chennai.
10. Semmudhai Sadhasivam, A.Amalaarularasi, A.M. Sonal, (2016), Pazhan Thamizhar Vazhvum Varalarum (Inbam), Semmudhai Publication, Chennai.
11. Sadhasivam.S, S.Kausalyadevi, (2014), Kalanthorum Thamizhar Nagaregamum Panpadum, Semmudhai Publication, Chennai.
12. Herbert, Vaidehi. (2013), Pathuppattu. Digital Maxim LLC.
13. Chellaiah, J.V. (1975), Pattuppattu: Ten Idylls, Translated into English Verse, Colombo General Publishers, முத்தமிழ் மன்றம் - முகப்பு பக்கம்
14. Sutha, M. (2019), Sangakala Sadangugalum Pengalin Nilaipadum, Pathivugal Inaya Ithal, and ISSN: 1481-2991,
15. Sutha, M. (2020), Kappiya Manthar Padaipugalum Karuthuruvakkangalum, Vallamai Inaya Aivithal, and ISSN: 2348-5531,
16. Sutha, M., Priya, A., Ravikumar, R. (2021), Kalam Marium Mara Porgal Samooga Kattamaipai Tholurikum Penmozhi Kavithaigal. *International Research journal of Tamil*, E-ISSN: 2582-1113.
17. Subbaiah, Aranga. (2014), Ilakiya Thiranaivu Isangal Kolgaikal. Pavai Publications.

STREET FOOD PREFERENCES AND NUTRITIONAL AWARENESS AMONG SCHOOLGOING ADOLESCENTS (16-18 YEARS)

Nishanthi.S

Assistant Professor,

Department of Food Service Management and Dietetics

AIMAN College of Arts and Science for Women, Tiruchirappalli, Tamil Nadu, India

Abstract

Adolescence is a transition stage in the life cycle, linking childhood to adulthood. Adolescents are often labeled as difficult to manage and as having poor food habits for many adolescents these labels have not been earned and are not deserved. Encouraging teenage boys to consume a healthy diet will optimize their growth and development. According to the American Academy of Pediatrics on its Healthy Children, up to 30 percent of adolescent children don't eat breakfast, which can decrease concentration at school and inhibit a teen's athletic performance. Nutrition requirements for teenage males depend on age, activity level, and calorie needs. The nutrient needs and energy requirements are very high during adolescence. The basal metabolic rate (BMR) is the highest in any life stage except during pregnancy. More food is needed and girls need to increase their intake earlier than boys. Many health-related behaviors and attitudes, including those relating to diet, develop or change during adolescence. Current youth styles may impact on meal patterns and snacking habits, while flourishing youth industry marketing promotes the increased consumption of savory snacks, confectionery, and sweetened drinks, contributing to the high fat, high sugar nutrient intake documented in studies of adolescent diets. Eating disorders, including anorexia nervosa, bulimia nervosa, and binge eating disorder, are psychological disorders that involve extreme disturbances in eating behavior. A teen with anorexia refuses to stay at a normal body weight. Someone with bulimia has repeated episodes of binge eating followed by compulsive behaviors such as vomiting or the use of laxatives to rid the body of food. Binge eating is characterized by uncontrolled overeating. Street foods are defined as foods and beverages prepared and sold by vendors in streets and other public places for immediate consumption without further processing or preparation. Nutritionists, doctors, and other health advocates often work to educate people about junk food, encouraging them to eat well-balanced diets which contain a high proportion of healthy food. Eating junk food causes weight gain (Obesity), Diabetes, Heart disease, etc.,

Keywords: *Adolescence, healthy diet, eating disorders, street foods, junk foods.*

Introduction

Adolescence is a crucial time for the health and future of an individual and ultimately of entire societies. Key to ensuring the development of healthy societies is the availability of quality health service that reflect adolescents concerns and needs. In spite of this there is an alarming gap in health service provision to adolescents in both wealthy and poor nations. (Nelson. A 2004)

Eating habits of the adolescents are generally poor especially the eating habits of girls. The developmental aspects of adolescence urge them to separate from the family and establish their own identity. One way they assert themselves is to deviate from a normal food habits.

Street food consists of readymade food items that are sold by a vendor in markets or open places. They may include the solid food items, various drinks or juices. Street food has become a very important business nowadays. And people have always admired and loved street food and street food markets. (www.indicostreetkitchen.com)

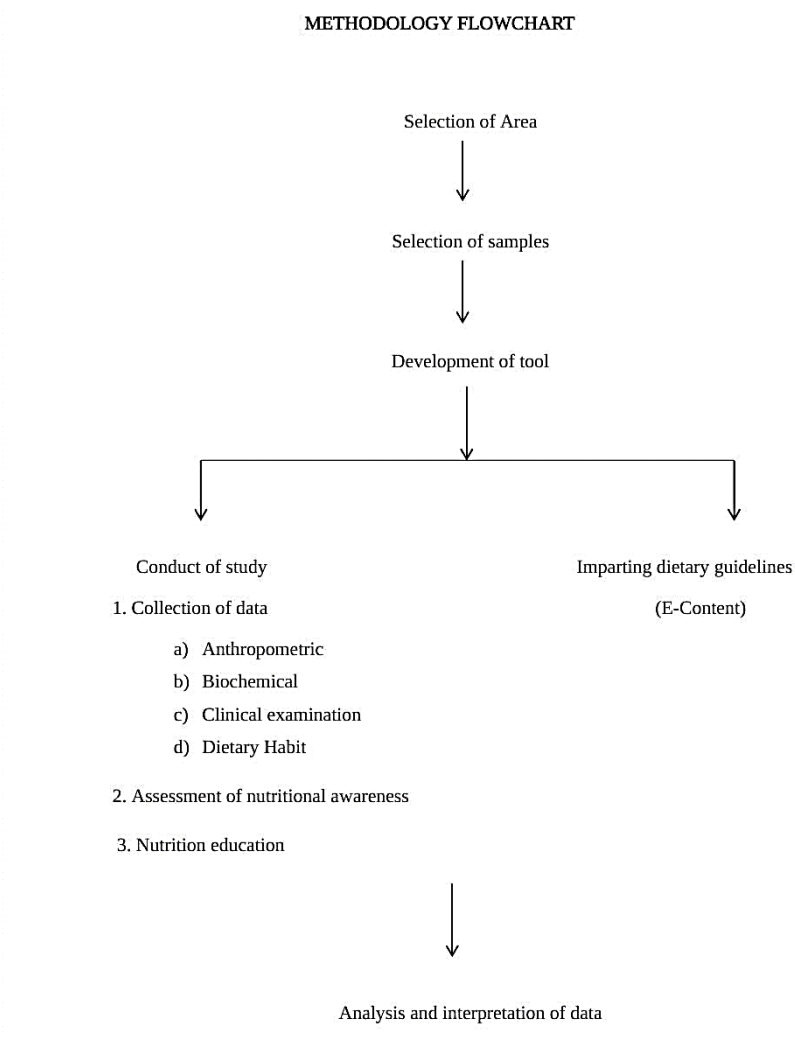
Street foods are defined as foods and beverages prepared and sold by vendors in streets and other public places for immediate consumption without further processing or preparation. (Van pined, 2014).

The term "street foods" describes a wide range of ready- to-eat foods or drink sold in a street or other public place, such as a market or fair, by a hawker or vendor, sometimes prepared in public places, notably streets. While some street foods are regional, many are not, having spread beyond their region of origin. (Nutshell, 2014).

Objectives

The objective of the present study is to

- select 100 school going adolescents in the age group of 16-18 years.
- study about the socio economic condition of the selected adolescents.
- study about street food consumption among selected adolescents.
- create awareness about the effect of street foods on adolescent’s health



Results

The results pertaining to the study entitled "Street Food Preferences and Nutrition awareness among School Going Adolescents (16-18 Years)" is discussed under the following heading:

General information

- 39 percentage of the samples were boys and 61 percentage of the samples were girls.
- 37 percentage of the samples were at the age group of 16 years and 37 percentage of the samples were at the age group of 17 years and 26 percentage of the samples were at the age group of 18 years respectively.

Anthropometry assessment

- 47 percentage of the samples where normal, 24 percentage of the people were overweight, 19 percentage of the samples were underweight and 10 percentage of the sample were obese.
- 23 percentage of the samples were found to be obese, 19 percentage of the samples were in underweight and 50 percentage of the people were normal.

Clinical examination

- 93 percentage of the samples have normal skin and seven percentage of the samples had pigmented skin.
- 86 percentage of the samples have clean and bright teeth and 14 percentage of the samples had discoloration of the teeth.
- 78 percentage of the samples have clear vision and 12 percentage of the samples have defected vision.

Food habits

- 54 percentage of the samples do not skip their meals and 46 percentage of the samples often skip their meals and 72 percentage of the samples skip their breakfast, 21 percentage of the samples skip their lunch and 8 percentage of the samples skip their dinner.
- 66 percentage of the samples have snacking habit and 34 percentage of the samples do not have snacking habit.
- 81 percentage of the samples consume street food and 19 percentage of the samples do not consume street foods.
- 78 percentage of the samples street food 1-2 times on weekly basis and 5 percentage of the sample consume street food 3-4 times on weekly basis and 5-6 times percentage of the samples street food 5-6 times on weekly basis.
- 58 percentage of the samples consume the street foods that are prepared from vendors home and 42 percentage of the samples consume street foods that are preparing in the vending vehicle.
- The majority of the samples tells that the street food that are preparing in the vending vehicle were rated moderate hygiene preparation.
- 73 percentage of the samples were not influenced by social media to

consume street food and 27 percentage of the samples were influenced by social media to consume street food.

- 73 percentage of the samples prefer to eat street food with their friends, 39 percentage of the samples prefer to street food with their family and 5 percentage of the samples prefer to street food with their relatives.
- Majority of the sample (87percentage) prefer street food for its taste, in psychological factors majority of the samples (64 percentage) prefer street food because of their mood swings and advertisement as a social factor was cited by 30 percentage.

Food frequency

The majority of the samples consume cereals, pulses, vegetables, milk and milk products, and nuts and oil seeds daily and some of the samples consume fruits, meat and meat products, and poultry every week.

Street food preference

The majority of the samples preferred samosa followed by pani poori, veg noodles, roadside kaalan, ice cream, vada, paratha, masala poori, chicken fried rice, shawarma, bajji, milkshakes, dosa, bhel poori, rasa poori, rose milk, pakkoda, chicken noodles, egg noodles, kulfi, chicken manchurian, gobi manchurian, pav bhaji, sundal, idly, waffers, puttu. 83 percentage of the samples know about healthy and nutritious street food and 17 percentage of the sample says that they do not know about healthy and nutritious street food.

Conclusion

The overall result shows that those who have 2 meals per day have more snacking habits and they prefer to take street foods in high amounts. Some were attracted by social media to go with street food. The responses posted by the samples show that they have adequate knowledge about healthy and non-healthy street foods during the awareness session. Finally, they gained knowledge on the impact of unhealthy street foods and the importance of healthy food.

References

1. Ackard D, Moe J, Perry C, et al (2000), Dietary patterns of obese high school girls: snack consumption and energy intake. Nutrition Research and Practice, 4(5):433-437.

2. Ahmed F, Zareen M, Khan MR, Banu CP, Haq MN, Jackson AA. (1998), Dietary pattern, nutrient intake and growth of adolescent school girls in urban Bangladesh. Public Health Nutr; 1:83-92.
3. Antia F.P and Abraham. P. (1997), Street Food, 4th edition, Oxford University Private Limited, 328 331.
4. Balabo. D., (1996), street food preferences, Williams and Wilkins Publishing Company, 48 - 49.
5. Bierdanier.C.D. and Zemplenis.J., (2009), Eating disorder of adolescence, CRC Press, P 21.
6. Edelstein.S., and Sherlin.J., (2008), Food habit of adolescence , Jones and Bartett Publishers, 109 – 114.
7. Kothari. C.R., (2010), Research Methodology, Second Editon, New Age International Publishers 5.
8. Sangita V Patel et.al, (2013), 31(4):490-6. Dietary pattern of school going adolescents in urban Baroda, India
9. Williams.R.S.,(1992), Nutrition throughout the lifecycle, Second Edition, Morby year book Publishing, 284 – 295.

SOCIAL MEDIA INFLUENCE ON FOOD CHOICES AMONG ADOLESCENTS – A PILOT STUDY

Aishwarya G

Assistant Professor, PG Department of Food Service Management &Dietetics,

AIMAN College of Arts and Science for Women, Trichy

Abstract

Adolescence is the most crucial phase of the human life cycle. It is a period in life that is characterized by tremendous physical and psychological challenges as their bodies and minds grow, evolve and mature at a rapid pace. This is not an easy task and every adolescent will require the help, support, and encouragement of their parents, teachers, peers, and the society to succeed. They need the knowledge of what is happening, what they should do and what they should not. The growing environment should help them not only in steering clear of the dangerous habits but also embrace a healthy lifestyle. The main target group of social media influencer marketing is young consumers including adolescents. Media food marketing increases the consumption of fried foods, sweets, and other foods that are high in energy and low in nutrients. Social media food marketing has achieved increased sales and preference of advertised products. Adolescents are at a unique life stage that makes them highly sensitive to social influences. Increased consumption of non-core food is associated with a range of chronic disorders and diseases (such as obesity, cardiovascular disease, cancer, etc.), and individual- and country-level economic losses. Social media facilitates the creative display of information, while simultaneously influencing, motivating, and engaging individuals on important health issues. More recent studies have found that approximately 87% of teens use social media to access health information, particularly content related to stress, depression, fitness, and anxiety. They use social media for health related to dieting, fitness, and body image. The modern age has brought upon many wonders that have our society grow and prosper. Technology has made everything accessible and convenient for a lot of people. One of the benefits of technology is the rise of social media and how it can help with advertising of many products, in this case, food-related one.

Keywords- *Food Choice, Adolescents, Influence, Social Media, Dietary Pattern.*

Introduction

Adolescence is the most crucial phase of the human life cycle. It is a period in life that is characterized by tremendous physical and psychological challenges as their bodies and minds

grow, evolve and mature at a rapid pace. This is not an easy task and every adolescent will require the help, support, and encouragement of their parents, teachers, peers, and the society to succeed. They need the knowledge of what is happening, what they should do and what they should not. The growing environment should help them not only in steering clear of the dangerous habits but also embrace a healthy lifestyle. (Sharma, 2003)

Adolescents' dietary patterns are generally characterized by frequent snacking, fast-food consumption, and meal skipping (Vaitkeviciute et al., 2015). Social media food marketing has achieved increased sales and preference of advertisedproducts. Adolescents are at a unique life stage that makes them highly sensitive to social mediainfluences. (World Health Organization, 2016). Increased consumption of noncore food is associated with a range of chronic disorders and diseases (such as obesity, cardiovascular disease, cancer, etc.), and individual- and country-level economic losses (Federal Trade Commission, 2012).

Social media's role in advertisement, digital word of mouth, customer relationship management, and the brands and success of companies. Food advertising and food and beverage firms are increasingly advertising on youth- popular social media platforms. (Bragg, M.A., 2020).

Objectives:

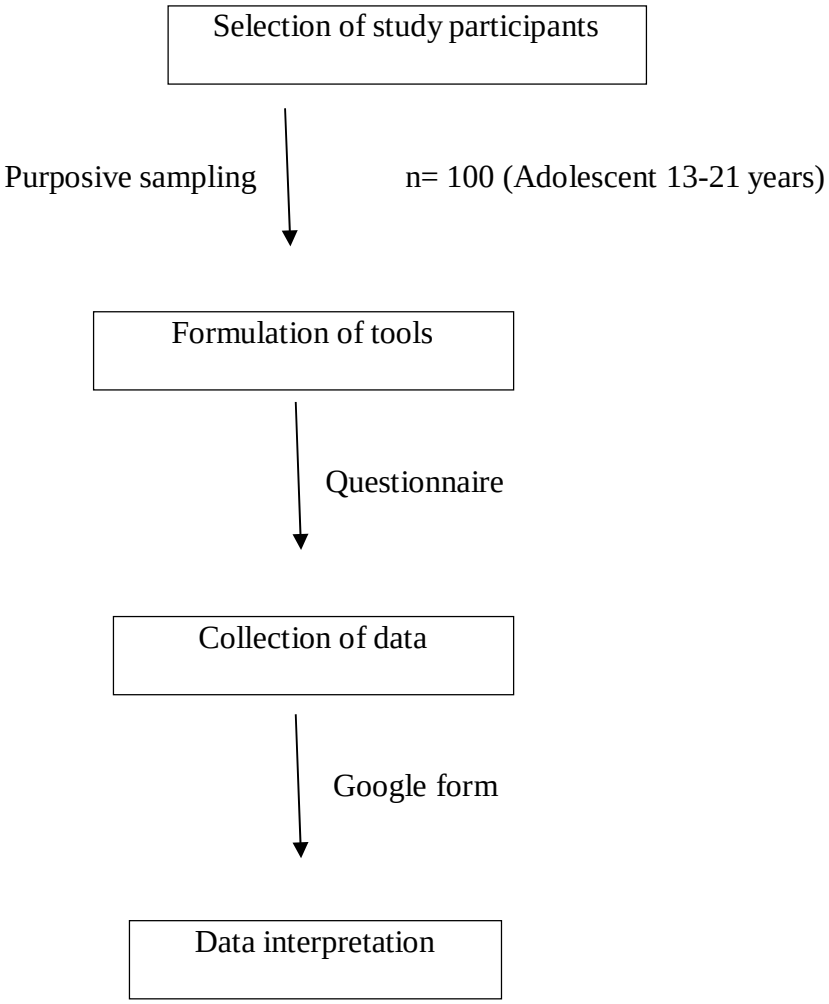
To analyze the food choices among adolescents.

To identify how social media influences adolescents.

To inculcate healthy food choices among adolescents.

Methodology

FLOW CHART



RESULT AND DISCUSSION

Gender distribution of the sample

S. No	Gender	Percentage
1	Female	90
2	Male	10
	Total	**100**

From the above table, the gender distribution of the sample among adolescent females is more than male. 90% of female adolescents and 10% of male. Most of the adolescent's female category are mostly use of social media than male

Both the genders increase their social media use but girls continue to use social media more than boys, with 59% of girls and 46% of boys interacting on social media for one or more hours per day**.**

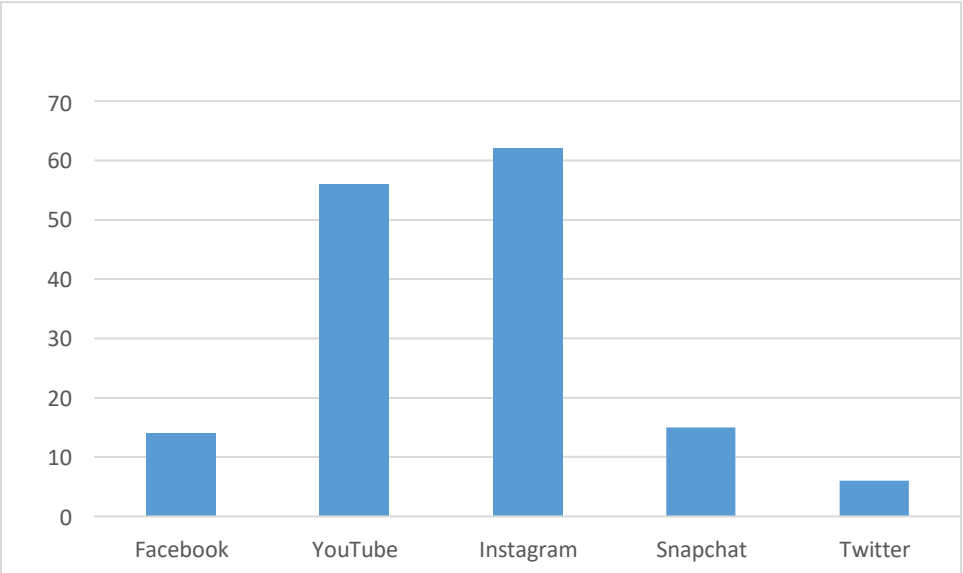
Ever attempted to follow a diet to lose weight

S. No	Opinion	Percentage
1.	Yes	42
2.	No	58
	TOTAL	**100**

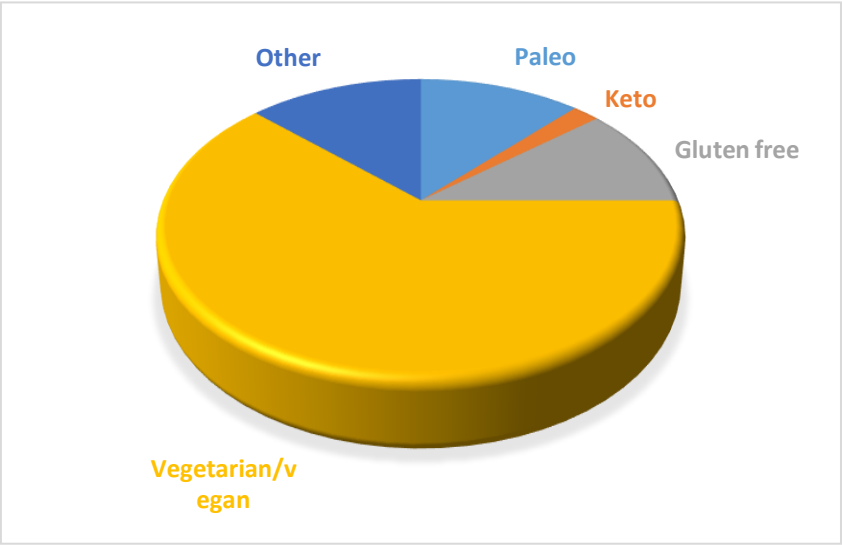
From the above table, shows that the maximum number of samples never attempted to follow a diet to lose weight.

Teenagers are being exposed to the unrealistically thin beauty ideal that is portrayed in the media. Through media exposure, teenagers are also exposed to a number of ways to lose weight and achieve this thin ideal. Attempts to lose weight can be associated with different behavioral changes such as alterations in eating habits and or exercise frequency**.**

Social media platform the respondents were most active in



Type of diets follow by the sample



Bought food product promoted by brand influencer to increase the marketing and sale

S. No	Opinion	Percentage
1.	Yes	19
2.	May be	23
3.	No	58

From the above table-XVI, most of the respondents did not buy food products promoted by brand influencers. Twenty three percent have a chance to buy food products promoted by influencers. Nineteen percent have bought the food product promoted by brand influencers.

Food marketing can take on many forms, such as branding, celebrity endorsements, social media post on Instagram, facebook, twitter, snapchat, contests and sale promotion.

Conclusion

Adolescents are at a unique stage that make them highly sensitive to social media influences. Among them, girls continue to use social media more than boys. Most of them are most active on social media platforms like Instagram, youtube, Facebook, snapchat, twitter. The social media influencer posts food related content on this platform. In this study, it was identified that most of the respondents follow a vegan/vegetarian diet (healthy diet). These are healthful and nutritionally adequate to all age groups.

References

1. Srilakshmi B, (2019), Dietetics, Eighth Edition, New Age International Ltd, Pp 137-140.
2. Santrock.J.W., (2007), “Adolescence”, Eleventh Edition, Tata Mcgraw – Hill publish Company Ltd, Pp 602-605.
3. Maartje Boer, M.Stevens, et.al., (2020), “Adolescents' intense and problematic social media use and their wellbeing in 29 countries”, Journal of adolescent health, pg. no 89-99
4. Kim Rousefell APD, et.al., (2019), “Social media, body image and food choices in healthy young adults”, Nutrition & Dietetics Journal of the dietitians association of Australia, Wiley Publishers, Volume 77, Issue 4, pg-19-22.

ANTI-GOUT POTENTIAL OF THE SELECTED MEDICINAL PLANTS AND THEIR UTILIZATION AS FUNCTIONAL FOODS

Tinu.D[1] and Radha. R[2]

[1]Ph.D. Scholar and [2]Assistant Professor (SG)

Department of Food Service Management and Dietetics

Avinashilingam Institute for Home Science and Higher Education for Women,

Coimbatore, Tamil Nadu, India

Abstract

Gout or gouty arthritis is a metabolic disorder characterized by a painful inflammation in the joints. The elevated uric acid profile is a causative factor for gout. Xanthine oxidase is an enzyme responsible for uric acid production. Hence the present investigation aimed to determine sustainable and economic sources that inhibit the production of xanthine oxidase and to utilize them for management of gout. For this, three types of plant materials were selected and their uric acid reducing potential was studied in vitro. The selected materials include rhizome of Curcuma Longa (Turmeric) and Zingeber Officinale (Ginger) and root of Phyllanthus Amarus (Keezanelli). The in vitro xanthine oxidase inhibition activity of the selected material was analyzed in both fresh and dried forms. The inhibition rates were analyzed at different concentrations (i.e. 10µg, 25 µg, 50 µg, 100 µg and 150 µg) and the IC_{50}values were calculated. All the dried samples had better inhibition rates compared to the fresh samples. The dried Curcuma Longa had the highest IC_{50} (98.32µg). In the next phase, functional recipes were prepared and sensory evaluated on a nine-point hedonic rating scale. All the ingredients used were ensured to be economic and locally available and aid in the effective management of gout at domestic level.

Key words: *Gout, xanthine oxidase, inhibition, functional recipes, domestic level.*

Introduction

Gout, or gouty arthritis, is a common metabolic disorder that is characterized by a painful, inflammatory response to deposits of sodium urate crystals in the synovial fluid of the joints and surrounding tissue (Akram *et al*, 2009). Pathologically, the increased blood uric acid levels are the

causative factor of gout, which leads to the crystal deposition in joints, tendons, and other tissues and uric acid renal stones (Gaffo et *al*, 2008).

One of the major causes of hyper uricemia and gout development is the abnormalities in the metabolism of serum uric acid and the decreased excretion of uric acid by the kidneys (Liu *et al*, 2015, Terkeltaub, 2003). A prevalence of up to 15-20% has been reported depending on the cut off value, for hyperuricemia in a population-based studies. Among the subjects 4% of the cases were with urate deposition (Zhu *et al*, 2011, Mikuls *et al*, 2005, Terkeltaub, 2003,). This factor makes urate deposition the major and most common type of arthritis in people especially men in their fifth decade or older (Mikuls *et al*, 2005, Terkeltaub, 2003).

Xanthine Oxidase (XO) is an enzyme which converts purine from protein-rich foods, such as organ meats and fish, to its metabolic by-product, uric acid (Gharbieh *et al*, 2018). The gout treatment involves the utilization of therapeutic agents such as the xanthine oxidase inhibitors (Unno *et al*, 2004, Kong *et al*, 2001). Xanthine oxidase inhibitors process by hampering the biosynthesis of the uric acid from purines in human body (Unno *et al*, 2004). And by increasing the excretion or reducing the uric acid production the risk can be reduced. Hence the present investigation aimed to determine sustainable and economic plant sources that inhibit the production of *x*anthine oxidase and utilization of them for gout management.

Methodology

The methodology adapted for the study on "Anti-Gout Potential of the Selected Medicinal Plants and their Utilization as Functional Foods" are as follows.

a. Collection of samples

Three locally available plant materials were selected for the conduct of the study. The collected samples were used in two forms: fresh and dried. For fresh samples the plant materials were collected, washed in cold water and air dried until the complete moisture got disappeared. For the dried samples, the fresh samples were collected, washed in cold water, air dried until disappearance of external moisture and then sun dried on a clean muslin cloth. The rhizomes of *Zingeber officinale* and *Curcuma longa* was dried for 3 weeks and *Phyllanthus amarus* root was dried for 5 days under sunlight.

Table I - The selected plant material

S.No	Binomial name	Common name	Regional Name	Family	Plant part used
1	*Zingeber officinale*	Ginger	Inji	Zingeberaceae	Rhizome
2	*Curcuma longa*	Turmeric	Manjal	Zingeberaceae	Rhizome
3	*Phyllanthus amarus*	Gale of the wind	Kizhanelli	Phyllanthaceae	Root

b. Ethanolic extraction of plant materials

The collected plant material underwent a conventional solvent extraction method by Redfern *et al*, 2014. A mortar and pestle were used to smash the fresh plant material in order to increase its surface area. A rotary evaporator was used to evaporate the ethanol when the procedure was complete, leaving a little yield of extracted plant material in the glass bottom.

c. In vitro xanthine oxidase enzyme inhibition assay

The in vitro xanthine oxidase enzyme inhibition assay was carried out according to the procedure by (Duong *et al*, 2017). For the assay, plant extracts were taken in five different concentrations i.e. 10µg, 25µg, 50µg, 100µg and 150µg per ml. Each range of concentration was tested to determine the xanthine oxidase inhibition activity and the IC_{50} values.

d. Formulation of functional recipes

Functional recipes were formulated in consideration with the principle of the diet for each condition. Each recipes consists a functional ingredient that is hypouricemic in nature. Recipes such as turmeric pineapple slushy, vegan golden milk, celery seed turmeric smoothie, amla ginger chutney, ginger pachidi, ginger veg stir fry, kizhanelli veg rice, kizhanelliver thuvaiyal and kizhanelli mint juice were prepared and sensory evaluated.

e. Sensory evaluation of the recipes

Sensory, subjective, or organoleptic evaluation is one that determines a food product's quality via the use of human senses. This aids in determining which product attributes should be enhanced and promoted. The sensory evaluation of the product was done with 9-point hedonic rating scale. The hedonic rating relates to pleasurable and unpleasurable experiences (Srilakshmi, 2015). Further the overall acceptability of the recipes were determined.

Results and Discussion

a. Analysis of xanthine oxidase inhibition at different concentration

The xanthine oxidation inhibition of plant materials at different concentration is presented in table-II

Table II – Xanthine oxidase inhibition of plant materials

Samples	Plant part used	10µg	25 µg	50 µg	100 µg	150 µg
Zingeber officinale (Fresh)	Rhizome	0.83%	7.1%	16.3%	33.5%	71.0%
Curcuma longa (Fresh)	Rhizome	1.20%	8.6%	22.8%	40.3%	75.2%
Phyllanthus amarus (Fresh)	Root	0.72%	5.8%	16.1%	31%	68.5%
Zingeber officinale (Dried)	Rhizome	1.10%	7.6%	17.4%	35.6%	73.8%
Curcuma longa (Dried)	Rhizome	1.53%	9.8%	24.7%	44.3%	82.7%
Phyllanthu samarus (Dried)	Root	0.81%	6.4%	18.7%	38%	74.5%

The highest rate of inhibition was observed more in dried samples than the fresh. In consideration with the concentration, more than fifty percent inhibition was observed at 150 µg. The least rate of inhibition was observed in fresh *Phyllanthus amarus* and the highest rate in dried *Curcuma longa*

b. Determination of IC_{50} values and superior inhibitor

A dose response logarithmic function curve was plotted based on the xanthine oxidase inhibition of plant materials and utilized to determine the 50% of inhibition and the values are highlighted in table –III

Table III - Determination of IC_{50} values of the plant materials

Samples	Plant part used	IC_{50} (µg)
Zingeber officinale (Fresh)	Rhizome	117.54
Curcuma longa (Fresh)	Rhizome	107.20
Phyllanthus amarus (Fresh)	Root	122.25
Zingeber officinale (Dried)	Rhizome	113.07
Curcuma longa (Dried)	Rhizome	98.32
Phyllanthus amarus (Dried)	Root	110.60

The dried rizhome of *Curcuma longa* was more potent (98.32 µg) than the other roots or rhizome such as the Zingeber *officinale* and *Phyllanthus amarus.* The fresh *curcuma longa* (107.20 µg) was effective among other fresh ones. The *Phyllanthus amarus* (122.25 µg) root was

the least potent among the fresh and *Zingeber officinale* (113.07 µg) was least inhibitor among the dried rhizome.

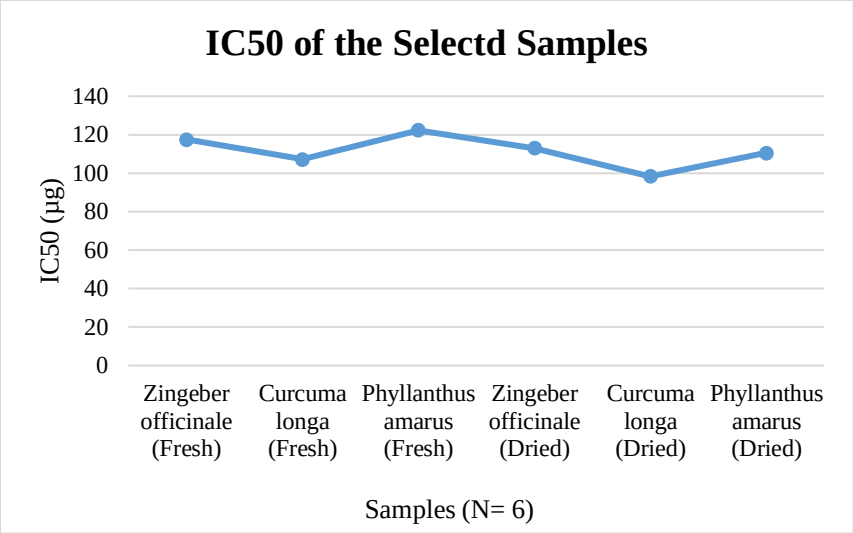


Figure-1 Potential xanthine oxidase inhibitors

The plant material with higher inhibition on a very low concentration is an effective inhibitor. As specified in Figure-1, the *Curcuma longa* is the potential inhibitor as it have reached the IC_{50} at a lower concentration which is lesser that 100 µg.

Recipe	Appearance	Colour	Flavor	Taste	Texture	Overall acceptability
Turmeric pineapple slushy	8.85±0.33	9.00±0	8.8±0.25	8.65±0.47	9.00±0	44.3±0.97
Vegan golden milk	9.00±0	9.00±0	8.9±0.21	9.00±0	9.00 ±0	44.8±0.42
Celery seed turmeric smoothie	8.65±0.47	8.65±0.47	8.8±0.25	9.00 ±0	8.8±0.25	43.6±1.62
Amla ginger chutney	8.9±0.31	8.9±0.31	8.6±0.51	8.5±0.52	8.9±0.21	43.8±1.53
Ginger pachidi	9.00±0	9.00±0	8.9±0.21	9.00±0	9.00±0	44.8 ±0.42
Ginger veg stir fry	9.00±0	9.00±0	8.7±0.42	8.7±0.42	8.65±0.7	44.05±1.23
Kizhanelli veg rice	8.5±0.52	8.8±0.42	8.55±0.49	8.5±0.52	8.4±0.39	42.75±1.28
Kizhanelli pumpkin thuvaiyal	9.00±0	9.00±0	8.8±0.42	8.9±0.21	9.00±0	44.7±0.6
Kizhanelli mint juice	8.00±0	7.95±0.15	8.25±0.35	8.25 ± 0.42	8.8±0.42	41.25±0.84

Table IV - Sensory scores of the developed functional recipes

c. Sensory evaluation of the developed functional recipes

The sensory evaluation of all the developed recipes in terms of appearance, colour, texture, flavor, taste and overall acceptability is reported in the Table-IV.

The Table IV highlights that all the developed recipes hold a very good sensory score. The recipes such as vegan golden milk, ginger pachidi, ginger veg stir fry and kizhanelli pumpkin thuvaiyal were highly acceptable in terms of appearance with a mean sensory score of 9.00±0. The turmeric pineapple slushy, vegan golden milk, ginger pachidi, ginger veg stir fry and kizhanelli pumpkin thuvaiyal scored highest (9.00±0) due to its vibrant colour. These Kizhanelli mint juice scored less both in colour and appearance. The Vegan golden milk (8.9±0.2) and Ginger pachidi (8.9±0.21) scored highest in flavor.

Recipes such as vegan golden milk, celery seed turmeric smoothie and ginger pachidi scored good in taste with a mean score of 9.00±0 and the Kizhanelli veg rice scored the least (8.4±0.39). The texture of turmeric pineapple slushy, vegan golden milk, ginger pachidi and kizhanelli pumpkin thuvaiyal was highly acceptable. Based on all the sensory scores, overall acceptability of each recipe was calculated in which the Vegan golden milk and Ginger pachidi scored high with a mean score of 44.8 ±0.42.

Conclusion

Gout is a one of the most prevalent inflammatory arthritis, which has been associated with persistent hyperuricemia and is brought on by the deposition of monosodium urate crystals in joints and other tissues. Generally, gout appears to be caused primarily by nutrition and genetic polymorphisms. It is impossible or extremely difficult to alter or manage through genetics but nutrition is a flexible and compatible tool to manage gout and hence the nutritious, antigout potential herbs and the formulated functional recipes could be more beneficial in gout management.

References

1. Abu-Gharbieh, E., Shehab, N. G., Almasri, I. M., & Bustanji, Y. (2018). Antihyperuricemic and xanthine oxidase inhibitory activities of Tribulus arabicus and its isolated compound, ursolic acid: in vitro and in vivo investigation and docking simulations. PloS one, 13(8), e0202572.

2. Akram, M., Asif, H. M., Usmanghani, K., Akhtar, N., Jabeen, Q., Madni, A & Shah, S. M. (2011). Obesity and the risk of hyperuricemia in Gadap Town, Karachi. Afr J Biotechnol, 10(6), 996-8.
3. Gaffo, A. L., & Saag, K. G. (2008). Management of hyperuricemia and gout in CKD. American Journal of Kidney Diseases, 52(5), 994-1009.
4. Kong, L. D., Abliz, Z., Zhou, C. X., Li, L. J., Cheng, C. H. K., & Tan, R. X. (2001). Glycosides and xanthine oxidase inhibitors from Conyza bonariensis. Phytochemistry, 58(4), 645-651.
5. Liu, R., Han, C., Wu, D., Xia, X., Gu, J., Guan, H., ... & Teng, W. (2015). Prevalence of hyperuricemia and gout in mainland China from 2000 to 2014: a systematic review and meta-analysis. *BioMed research international*.
6. Mikuls, T. R., Farrar, J. T., Bilker, W. B., Fernandes, S., Schumacher, H. R., & Saag, K. G. (2005). Gout epidemiology: results from the UK general practice research database, 1990–1999. Annals of the rheumatic diseases, 64(2), 267-272.
7. Terkeltaub, R. A. (2003). Gout. *New England Journal of Medicine*, 349(17), 1647-1655.
8. Unno, T., Sugimoto, A., & Kakuda, T. (2004). Xanthine oxidase inhibitors from the leaves of Lagerstroemia speciosa (L.) Pers. *Journal of Ethnopharmacology*, 93(2-3), 391-395.
9. Zhu, Y., Pandya, B. J., & Choi, H. K. (2011). Prevalence of gout and hyperuricemia in the US general population: the National Health and Nutrition Examination Survey 2007 - 2008. Arthritis & Rheumatism, 63(10), 3136-3141.

IODINE NUTRITION AND AUTISM SPECTRUM DISORDER- A REVIEW

Sneha Jayachandran[1], Anees Fathima Z[2], Veena BM[2] and Syeda Farha S[2*]

[1]MSc Student, [2]Assistant Professor, Department of Nutrition and Dietetics,

JSS Academy of Higher Education and Research, Mysore, Karnataka, India

syedafarhas@jssuni.edu.in

Abstract

ASD affects 1 in 68 children, indicating a relatively common neurodevelopmental disorder, and their prevalence has been increasing over the past 20 years. Prevalence estimates vary not only overall but also within and across gender and racial/ethnic groups. Individuals with ASD are reported to be more likely to have low iodine levels compared to healthy controls. The objective of this scoping review was to summarize the studies that assessed iodine status of children with autism and associate the severity of ASD. Although data to conduct a scoping review of iodine status and ASD in children was scarce, majority of the articles reviewed demonstrate emergent iodine deficiency among the population, indicating alarm for a public health concern needing immediate attention.

Keywords: *Iodine status, ASD, UIC, Nutrition*

Introduction

ASD affects 1 in 68 children, indicating a relatively common neurodevelopmental disorder, and their prevalence has been increasing over the past 20 years. Prevalence estimates vary not only overall but also within and across gender and racial/ethnic groups. This highlights the complex nature of ASD and the need for more nuanced understanding of how it manifests in different populations. These conditions may have their origins during fetal development, and both genetic and environmental factors are believed to play a role in the development of ASD. This underscores the multifactorial nature of the disorder, where a combination of genetic predispositions and environmental influences may contribute to its onset. According to recent studies, individuals with ASD are reported to be more likely to have low iodine levels compared to healthy controls. This suggests a potential association between iodine deficiency and the prevalence of ASD. ASD is characterized by difficulties in social interaction, communication challenges, and the presence of repetitive behaviors. It is a complex neurodevelopmental disorder with a multifactorial etiology,

involving both genetic and environmental factors. While genetic factors are known to contribute to the risk of ASD, researchers are also exploring various environmental factors that might play a role in its development. These factors can include prenatal and perinatal influences, exposure to certain substances, and nutritional factors. If low iodine levels are indeed associated with ASD, it raises questions about the potential impact of iodine deficiency on neurodevelopment, particularly during critical periods of fetal development. It's important to note that scientific understanding of the relationship between iodine levels and ASD is still evolving. Additional research is needed to establish a clear and causative link, understand the mechanisms involved, and explore potential interventions. If a link is confirmed, it may have implications for public health strategies, such as ensuring adequate iodine intake during pregnancy to support optimal fetal brain development and potentially reduce the risk of ASD. [1, 2]

Review of Literature

Iodine is a particularly important microelement in human physiology—it plays a crucial role as a component of thyroid hormones and deficiency at any stage of life can cause significant clinical manifestations. The most critical time for proper iodine status, however, is early in life—hypothyroidism due to iodine deficiency which can lead to impaired neurodevelopment. [3]

Table 1: Iodine Cut-off values for public health significance [4]

Indicator	**Concentration cut-off values for public health significance**		
Iodine deficiency measured by median Urinary iodine concentration (μg/L) in school-age children (≥6 years)	Concentration	Iodine intake	Iodine status
	<20 μg/L	Insufficient	Severe deficiency
	20-49 μg/L	Insufficient	Moderate deficiency
	50-99 μg/L	Insufficient	Mild deficiency
	100-199 μg/L	Adequate	Adequate iodine nutrition
	200-299 μg/L	Above requirements	May pose a slight risk of more than adequate iodine intake in these populations
	≥300 μg/L	Excessive	Risk of adverse health Consequences (e.g. iodine-induced hyperthyroidism or autoimmune thyroid disease)

Adequate levels of thyroid hormones are especially important for myelination, cell migration, differentiation and maturation of the fetal brain. IDD are caused primarily by insufficient dietary iodine intake and/or inadequate iodine utilization due to, for example, the

presence of goiterogens. In one study performed in Egypt, 54% of tested autistic children were found to be iodine deficient. Another study performed in USA found 45% lower iodine content in hair of children with autism when compared with healthy controls. Measurements of thyroid hormone levels and thyroid stimulating hormone levels are important in the assessment of thyroid function. The majority of dietary iodine, however, ends up in the urine, so although it is not a direct measurement of function, urinary iodine (UI) level is a great indicator of recent iodine intake and low values demonstrate a population is at risk for deficiency.

The research was conducted in a cohort of more than 4,000 Dutch mothers and their children, and it supports the view that autism can be caused by lack of maternal thyroid hormones T4, also called thyroxine, and T3, which is crucial to the migration of fetal brain cells during embryo development, early in pregnancy. The most common cause of thyroid hormone deficiency is a lack of dietary iodine, given that T4 contains four atoms of iodine. There are also environmental contaminants and dietary factors that affect thyroid function.

Prevalence of ASD

ASD has been the subject of discussion in recent years, partly because of claims from different countries that its frequency is rising. [5] Estimates of the prevalence of ASD have been recorded in studies, and they range from 0.07% to 1.8%. The studies also indicate a possible rise in ASD prevalence. This observed rise in prevalence appears to be partially explained by increased public awareness, broader diagnostic standards for ASD, younger diagnosis ages, and diagnostic replacement. [6]

Causes and risk factors

The exact causes of autism are not fully understood, but research suggests a complex interaction between genetic and environmental factors. Genetic predisposition plays a significant role, as certain gene mutations and chromosomal abnormalities have been associated with an increased risk of autism. Environmental factors, such as prenatal complications, maternal infections, and exposure to certain chemicals, may also contribute to the development of autism. [7]

Symptoms and diagnosis

The symptoms of autism typically become evident in early childhood, although they can sometimes be detected earlier. Common signs include difficulties in social interaction (such as

poor eye contact and impaired social communication), repetitive behaviors (like hand- flapping or fixated interests), sensory sensitivities, and challenges in verbal and nonverbal communication. Diagnosis is primarily based on a thorough assessment of the individual's behavior and development, often involving multidisciplinary evaluations by psychologists, pediatricians, and speech therapists. Autism affects children's perception of texture, which causes them to avoid numerous food groups. There was a clear desire for uniformity in a case study where a little boy ate the same meals at the same times every day for breakfast, lunch, and supper Pica, the daily practice of eating nonfood items like dirt and paper, is also prevalent in people with autism. [5]

Nutrition in ASD

Children get to try various meals, flavors, and sensations during their early life. Toddler and small child parents frequently use the following adjectives to describe their kids. "Picky eaters" who refuse to experiment with or consume a wide range of foods. Picky eating is common in young children who are developing normally, but it can be significantly more extreme and last longer in children with autism spectrum disorders.

Frequently, parents of children with autism spectrum disorders report that their children are extremely picky eaters who only take a small number of foods, sometimes as few as five. Children are typically referred for nutrition services for two main reasons: management of food selectivity and concerns about dietary adequacy. [8, 9]

1. Micronutrients: Some studies have suggested that individuals with ASD may have lower levels or altered metabolism of certain micronutrients such as vitamin D, vitamin B6, folate, and zinc. However, the findings have been inconsistent, and further research is needed to better understand the potential connections.

2. Gut Health and Microbiota: There is growing interest in the gut-brain connection and the role of gut health and gut microbiota in ASD. Some studies have found differences in the gut microbiota composition in individuals with ASD. Dietary interventions aimed at promoting healthy gut microbiota, such as probiotics and prebiotics, have been explored as potential therapeutic approaches. However, more research is needed to determine their effectiveness in individuals with ASD.

3. Food Sensitivities and Restricted Diets: Some individuals with ASD may have food sensitivities or intolerances. Certain dietary interventions, such as gluten-free and casein-free diets, have been

tried in some cases, but their effectiveness remains uncertain, and these diets should be implemented under the guidance of a healthcare professional.

It is important to note that nutritional needs can vary greatly among individuals with ASD, and it is advisable to consult with a healthcare professional or a registered dietitian who specializes in ASD to develop a personalized nutrition plan. [8]

Studies have inspected the relationship of autism spectrum disorder with iodine which showed a significant difference in UI iodine among ASD children compared to the control group.In the given study 19 out of 40 ASD children had iodine deficiency. Studies have shown that iodine deficiency of 54% and 58% in ASD children and their mothers existed compare to their counterparts. UI was lower among autistic patients and their mothers. Autism had a significant risk for association with each of low UI and intake of non-iodized salt. [9] A similar cross-sectional study performed on Turkish pregnant women and their offspring, exhibiting mild deficiency of iodine among the women and their offspring. [10]

Table 2: Nutrients important for brain development [4]

Nutrient	Requirement	Brain area
Iron	Myelin formation, Monoamine synthesis, Neuronal and glial energy metabolism	White matter, Striatal frontal, Hippocampal -frontal
Iodine	Myelination, neuronal proliferation	Cortex, striatum Hippocampus
Zinc	DNA synthesis	Autonomic nervous system
Copper	Neurotransmitter synthesis, energy metabolism	Cerebellum
Vitamin A	Neurogenesis	Hippocampus
Vitamin D	Neurogenesis	Hippocampus
LC-PUFA	Synaptogenesis, Myelin	Eye cortex

Maternal iodine status and Autism spectrum disorder

Thyroid hormone regulates neuronal proliferation, differentiation, migration, synapse formation, and myelination in the fetal brain and during early pregnancy the fetus acquires thyroid hormone solely from the mother. Epidemiological studies do not consistently show an association between maternal thyroid function and childhood ADHD. Maternal hypothyroidism and overt hyperthyroidism have been associated with a greater risk of diagnosed ASD, and allow maternal FT4 concentration measured in the first 18wk of pregnancy has been associated with a greater risk of autistic traits. A study, reported a suggestive association of both hypothyroxinemia,

characterized by low FT4 and normal TSH, and high FT4 with a greater risk of autistic traits within the clinical range. It is unclear whether iodine deficiency underpins the association between mild thyroid dysfunction and these neurodevelopmental disorders. Iodine deficiency in pregnant populations, which is defined by the WHO as a median urinary iodine concentration (UIC) <150μg/L, is common. Severe iodine deficiency during pregnancy has been associated with severe health outcomes including goiter, abortion, stillbirths, and intellectual disability in the offspring. Mild-to-moderate iodine deficiency— which has been defined in pregnant populations as a median UIC between 50 and 150μg/L — before conception and during pregnancy has been associated with neurodevelopmental outcomes, including lower child intelligence quotient (IQ) scores.

A study suggested that maternal iodine status may affect child outcomes in a dose-dependent manner, but the authors could not test whether the effects of iodine availability for the developing brain were related to impaired maternal thyroid function in pregnancy. Investigating such underlying mechanisms may elucidate which subgroups of pregnant women may be at a high risk of giving birth to children with neuro-behavioral problems. Given the important role of iodine for thyroid hormone production and fetal brain development, maternal iodine deficiency during a critical developmental window may potentially increase the risk of neurodevelopmental disorders in the offspring. Studies on the association between maternal iodine status during pregnancy and ADHD or ASD are rare. A small study performed in Italy showed that 68.7% of children (11 out of 16) born to mildly-to-moderately iodine deficient mothers—more than half of whom also suffered from hypothyroxinemia —were diagnosed with ADHD, whereas none of the children born to mothers originating from an iodine sufficient area were diagnosed with ADHD. In a larger Norwegian cohort, maternal iodine intake<200μg/d (which is lower than currently recommended in pregnancy) as reported at week 22 of gestation was also associated with higher ADHD symptoms but not with ADHD diagnosis. [1, 5, 10]

Conclusion

Maternal autoantibodies to thyroid peroxidase were associated with an increased risk of ASD, and a family history of thyroid autoimmune diseases is more prevalent in autistic children. European studies have also suggested that hypothyroidism during pregnancy increases the risk of ASD. However, no studies have assessed the relationship between maternal hypothyroidism and

the risk of ASD in children where there are wide racial/ethnic disparities. Therefore, similar kind of long term studies are warranted to study the association between iodine insufficiency and ASD.

References

1. Bernal, J. (2000), Thyroid Hormones in Brain Development and Function—Endotext. Edited by De Groot LJ, Chrousos G, Dungan K, Feingold KR, Grossman A, Hershman JM, Koch C, Korbonits M, McLachlan R, New M, Purnell J, Rebar R, Singer F, Vinik A. South Dartmouth (MA).
2. Raina, Sunil Kumar, Vishav Chander, Ashok K. Bhardwaj, Dinesh Kumar, Seema Sharma, Vipasha Kashyap, Mitasha Singh, and Amit Bhardwaj. (2017), Prevalence of autism spectrum disorder among rural, urban, and tribal children (1–10 years of age). *Journal of neurosciences in rural practice*, 8(3), 368-374.
3. Błażewicz, Anna, Agata Makarewicz, Izabela Korona-Glowniak, Wojciech Dolliver, and Ryszard Kocjan. (2016), Iodine in autism spectrum disorders. *Journal of Trace Elements in Medicine and Biology*, 34, 32-37.
4. Delange, Francois. (2000), The role of iodine in brain development. Proceedings of the nutrition society, 59(1), 75-79.
5. Vijay Sagar, K. J. (2011), Research on autism spectrum disorders in India. *AP J Psychol Med*, 12(1), 69-72
6. Raina, Sunil Kumar, Vishav Chander, Ashok K. Bhardwaj, Dinesh Kumar, Seema Sharma, Vipasha Kashyap, Mitasha Singh, and Amit Bhardwaj. (2017), Prevalence of autism spectrum disorder among rural, urban, and tribal children (1–10 years of age)." *Journal of neurosciences in rural practice*, 8(3), 368-374.
7. Herndon, Alison C., Carolyn DiGuiseppi, Susan L. Johnson, Jenn Leiferman, and Ann Reynolds.(2009), Does nutritional intake differ between children with autism spectrum disorders and children with typical development?. *Journal of autism and developmental disorders*, 39, 212-222.
8. Bowers, L. (2002,), An audit of referrals of children with autistic spectrum disorder to the dietetic service. *Journal of Human Nutrition and Dietetics*, 15(2), 141-144.

9. Hamza, Rasha T., Doaa H. Hewedi, and Mahmoud T. Sallam. (2013), Iodine deficiency in Egyptian autistic children and their mothers: relation to disease severity. *Archives of medical research*, 44(7, 555-561
10. Vural, Mehmet, Eosin Koc, Olcay Evliyaoglu, Hazal Cansu Acar, Abdurrahman Fatih Aydin, Canan Kucukgergin, Gozde Apaydin et al. (2021), Iodine status of Turkish pregnant women and their offspring: A national cross-sectional survey. *Journal of Trace Elements in Medicine and Biology*, 63, 126664.

IMPORTANCE OF BREASTFEEDING AND MANAGEMENT OF BREAST CONDITIONS IN POSTNATAL MOTHER

Agalya.E,[1] Gayathri, [2] Silambu Selvi [3]

[1] PhD Scholar, (Part time External), [2]Research Supervisor, Assistant Professor,

[3]Research Co Supervisor, Associate Professor, Department of Clinical Nutrition,

Faculty of Allied Health Sciences, Sri Ramachandra Institute of Higher Education and Research, (Deemed to be University), Porur, Chennai, Tamil Nadu, India

Abstract

Breastfeeding: "Nature's Gift for Growing". Breastfeeding has health benefits for both babies and mothers. Breast milk provides a baby with ideal nutrition and supports growth and development. Breastfeeding can also help protect baby and mother against certain illnesses and diseases. It supplies all the necessary nutrients in the proper proportions. It protects against allergies, sickness, and obesity. It safeguards against diseases, like diabetes and cancer. It prevents infections, like ear infections. It is easily digested – no constipation, diarrhea or upset stomach. Babies have healthier weights as they grow. Breastfed babies score higher on IQ tests. Postnatal mothers who breastfeed have a reduced risk of Type 2 Diabetes and certain cancers such as breast cancer, reduced weight, strengthen the bond with their children. Breast problems are sore or cracked nipples, not enough breast milk, breast engorgement, blocked milk duct and mastitis. The baby needs to be warm attachment, and to breastfeed frequently to remove the milk. The fullness decreases after a feed, and after a few days the breasts become more comfortable as milk production alter to the baby's needs. We review the importance of breastfeeding and breast conditions from previous articles. This review provides useful information on importance of breastfeeding, guidance for management of breast problems and to help avoid long-term morbidity.

Keywords: *Breastfeeding, nutrition, protection, warm attachment, breast conditions*

Introduction

Breastfeeding: "Nature's Gift for Growing". Breastfeeding has health benefits for both babies and mothers. Breast milk is the ideal food for infants. It is safe, clean and contains an antibody which helps to protect against many common childhood illnesses. It provides a baby with ideal nutrition and supports growth and development. (1) Breastfeeding can also help protect baby and mother against certain illnesses and diseases. It supplies all the necessary nutrients in the proper proportions. It protects opposed to allergies, sickness, and obesity. It

safeguards against diseases, like diabetes and cancer. It prevents infections, like ear infections, constipation, diarrhea or upset stomach. Babies have healthier weights as they grow. Breastfed babies score higher on IQ tests. (2) Mothers who breastfeed have a reduced risk of Type 2 Diabetes and certain cancers such as breast cancer, reduced weight, strengthen the bond with their children. Breast problems are sore or cracked nipples, not enough breast milk, breast engorgement, blocked milk duct and mastitis. The baby needs to be warm attachment, and to breastfeed frequently to remove the milk. The fullness decreases after a feed, and after a few days the breasts become more comfortable as milk production alter to the baby's needs. (2, 3)

Breast milk

Breast milk is the ideal food for infants. It is safe, clean and contains antibodies which help protect against many common childhood illnesses. Breast milk provides all the energy and nutrients that the infant needs for the first months of life, and it continues to provide up to half or more of a child's nutritional needs during the second half of the first year, and up to one third during the second year of life. (3, 4)

Importance of breastfeeding

Breastfeeding can also help protect baby and mother against certain illnesses and diseases. It supplies all the necessary nutrients in the proper proportions. It protects opposed to allergies, sickness, and obesity. It safeguards against diseases, like diabetes and cancer. It prevents infections, like ear infections, constipation, diarrhea or upset stomach. Breastfed babies score higher on IQ tests. Mothers who breastfeed have a reduced risk of Type 2 Diabetes and certain cancers such as breast cancer, reduced weight, strengthen the bond with their children.

Breast milk changes constantly to meet babies' needs

The milk changes in volume and composition according to the time of day, nursing frequency, and age of baby to promote healthy growth. Breast milk is the perfect food for the baby. (2, 3, 4).

Breast milk is always ready and good for the environment

Breast milk is available wherever and whenever to the baby. It is always at the right temperature, clean and free, no bottles to clean, Breastfeeding has no waste, so it is good for the environment.

Benefits to mothers who breastfeed

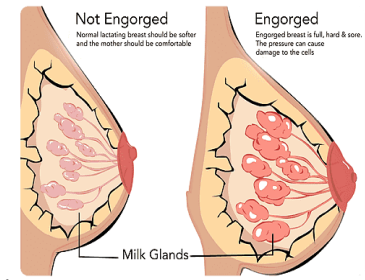
Postnatal mothers have a reduced risk of Type 2 Diabetes and certain cancers such as breast cancer, easier to return to what they weighed before they got pregnant, strengthen the bond with their children.

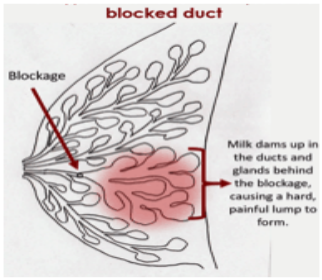
Some important hints

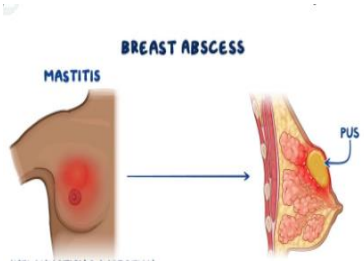
Breastfeed quickly after birth and breastfeed frequently 8 to 12 times in a 24 hour period, hold baby skin-to-skin contact, keep the baby with in the hospital, do not give a pacifier or bottle until breastfeeding is well established, give only breast milk.(5)

Management of Breast conditions

Breast Problems	**Symptoms**
Not enough breast milk	The mother may worry that her baby is not getting enough milk.
Breast engorgement	The mother has symptoms of swelling, tightness, hard, full, tense, warm and tender breasts with throbbing, aching pain and an increase in size of the breasts (4)
Blocked duct	Those who have blocked duct noticed with the symptoms such as tender, localized lump in one breast, with redness in the skin over the lump.
Breastfeeding and thrush	Thrush infections can sometimes happen when the nipples become cracked or damaged and the baby has a thrush infection.
Baby is not latching on properly	The mother has painful breastfeeding or the baby does not seem to be satisfied after the feeds (5)
Mastitis	Mastitis is an inflammation of breast tissue that sometimes involves an infection. There is a hard swelling in the breast, with redness of the over lying skin and severe pain. Usually only a part of one breast is affected, which is different from engorgement, when the whole of both breasts are affected the woman has fever and feels ill. Mastitis is commonest in the first 2–3 weeks after delivery but can occur at any time (6)
Breast abscess	The mother has painful swelling and collection of pus that forms in the breast, which feels full of fluid. The discoloration of the skin may be occurring at the point of the swelling. Breast abscesses commonly happen as a complication of mastitis. Mastitis is a condition that causes breast pain and swelling (inflammation) (6)
Sore or fissured nipple	The mother has severe nipple pain when the baby is suckling. There may be a visible fissure across the tip of the nipple or around the base. The nipple may look squashed from side-to-side at the end of a feed, with a white pressure line across the tip (7)







Causes

Failure to remove breast milk, the common reasons are delayed initiation of breastfeeding, infrequent feeds, poor attachment, ineffective suckling and tight clothing or trauma to the breast. (2, 7)

Management

The mother must remove the breast milk frequently from distressed breast. If the baby can attach well and suckle, then she should breastfeed as frequently as the baby is willing. If the baby is not able to attach and suckle effectively, should express the milk by hand or with a pump a few times until the breasts are softer, so that the baby can attach better, and then get him or her to breastfeed frequently. (8) Apply warm compresses to the breast or take a warm shower before expressing, which helps the milk to flow. Use cold compresses after feeding or expressing, which helps to reduce the oedema. If the mother has an abscess needs to be drained and treated with penicillinase-resistant antibiotics, when possible drainage should be either by catheter through a small incision, or by needle aspiration (which may need to be repeated). Placement of a catheter or needle should be guided by ultrasound. A large surgical incision may damage the areola and milk ducts and interfere with subsequent breastfeeding, and should be avoided. (9, 10)

Conclusion

Breast infection is common and if make do properly will usually settle with antibiotics alone. Breast abscesses require minimally invasive aspiration in combination with antibiotics to give the most favorable outcome. Stay away from these problems by management of frequently

removed milk from the breast. The right way is to decreases the fullness with frequent feeds, and after a few days the breasts become more comfortable as milk production alter to the baby's needs. We reviewed the importance of breastfeeding and breast conditions from previous articles. This review provides useful information on importance of breastfeeding, guidance for management of breast problems and help to avoid long-term morbidity.

References

1. WHO., (1998.), Evidence for the Ten Steps to successful breastfeeding. Geneva: World Health Organization.
2. WHO. (2000), Mastitis: causes and management. Geneva: World Health Organization; (WHO/FCH/CAH/00.13)
3. Mohrbacher N, Stock J. (2003), The breastfeeding answer book. 3rd revised ed. Schaumburg, Illinois, USA: La Leche League International.
4. Dennis CL. (2002), Breastfeeding initiation and duration: a 1990–2000 literature review. *J Obstet Gynecol Neonatal Nurs.* 31(1):12–32.
5. Meedya S, Fahy K, Kable A. (2010), Factors that positively influence breastfeeding duration to 6 months: a literature review. *Women and Birth.* 23 (4):135–45.
6. Li R, Darling N, Maurice E, et al. (2005), Breastfeeding rates in the United States by characteristics of the child, mother, or family: the 2002 National Immunization Survey. *Pediatrics.* 115(1):31–7.
7. Murray EK, Ricketts S, Dellaport J. (2007), Hospital practices that increase breastfeeding duration: results from a population-based study. *Birth.* 34(3):202–11.
8. Philipp BL, Merewood A. (2004), The Baby-Friendly way: the best breastfeeding start. *Pediatr Clin.N.Am.* 51(3):761–83.

DEVELOPMENT AND STANDARDIZATION OF FRUIT PEELS INCORPORATED FOOD PRODUCTS

Ameena Beebi.B[1] Vinnarasi Mary.J[2]

[1]Assistant Professor, [2]II M.Sc., student Department of Home Science,

V.V. Vanniaperumal College for Women, Virudhunagar, Tamil Nadu, India.

ameenabeebib@vvvcollege.org, 22702216@vvvcollege.org

Abstract

The fruit processing industry used to generate large amounts of wastes, including pomace, seeds, and peels, leading to negative environmental impacts and considerable treatment expenses. However, various studies had demonstrated that these by-products were rich in bioactive compounds, particularly dietary fibers and phenolic compounds, resulting in significant chemical, physical, and biological properties. These characteristics had made fruit peels incorporated products a valuable source for new supplements in food products, with a substantial impact on intestinal function. Fruit peels, rich in dietary fibers and bioactive compounds, contribute positively to gut health. The dietary fibers promote regular bowel movements and act as prebiotics, supporting the growth of beneficial gut bacteria. Phenolic compounds, with antioxidant and anti-inflammatory properties, protect the gut lining and regulate inflammation. Fruit peels also aid in maintaining a diverse gut microbiota, essential for digestion and immune function. Additionally, certain compounds may enhance nutrient absorption. Incorporating fruit peels into the diet can be a natural way to support overall health. Individual responses may vary, and caution is advised for those with specific dietary restrictions or sensitivities. The objective of this study was to develop red banana peel powder incorporated food product and to evaluate the bioactive compounds and antioxidant activity of the developed products by using red banana. Puffed rice ball was developed with various proportions of 5 grams, 10 grams, and 15 grams. The organoleptic evaluation was conducted on these developed products using 9-point hedonic scale. Thirty semi trained panel were evaluated the products. The best-accepted ones were chosen for further analysis. This study aimed to develop fruit peels incorporated functional foods can offer a range of health benefits, including increased nutrient density, fiber content, antioxidant properties, and potential bioactive compounds.

Key words: *Fruit peel, rice ball, bioactive components, health*

Introduction

Food waste is one of the biggest global issues. Every year, 1.3 billion tons of food ends in waste, and it is estimated that in less than 10 years, food waste will reach two billion tons per year. Not only is food waste management unsustainable, both from an economic and an environmental point of view, but also, huge amounts of water were consumed for the irrigation of fields, so as to produce these foods. The sustainable management of food waste is mandatory; however, it is a major challenge. Value-added products refer to goods or services that have additional features or enhancements that go beyond the basic functionality of the original product. These enhancements can include improved quality, additional features, or modifications that make the product more desirable to customers. The incorporation of red banana peel, orange peel, and grape peel, along with ingredients like jaggery and puffed rice, into various food products has gained attention due to the potential health benefits associated with these unconventional additions. This innovative approach not only reduces waste but also introduces diverse nutritional elements into the diet. Red banana peels, often discarded, are rich in fiber, vitamins, and antioxidants. The incorporation of red banana peels into food products can contribute to increased dietary fiber, promoting digestive health and potentially aiding in weight management. Orange peels, known for their citrusy flavor, bring additional vitamins and flavonoids, contributing to antioxidant properties that may support overall health. Grape peels, abundant in polyphenols, can enhance the nutritional profile, providing anti-inflammatory and antioxidant benefits. Jaggery, a traditional sweetener, adds sweetness to the incorporated products while offering essential minerals like iron and magnesium. Puffed rice provides calories and energy, which are essential for maintaining overall health. The immune system requires energy to function optimally. The amalgamation of these diverse ingredients creates value-added products that not only minimize food waste but also provide a range of health benefits. From digestive support to antioxidant properties, the incorporation of red banana peel, orange peel, grape peel, jaggery, and puffed rice into products offers a holistic approach to nutrition, appealing to those seeking both flavor and functional benefits in their dietary choices. This innovative utilization of fruit peels aligns with sustainable practices, promoting a circular economy while fostering healthier food alternatives.

Objectives

1. To minimally process the fresh fruit peel such as oranges, grapes and red bananas.
2. To develop and standardize the fruit peel incorporated food products.
3. To evaluate the organoleptic properties of fruit peel incorporated food products.

To analyse the nutrients and phytochemical of fresh fruit peels and fruit peel incorporated food products (best accepted variation)

Methodology

1. Selection of functional ingredients

The red banana peel, orange peel and grapes peel powder which are used as a functional ingredient for the study such should be free from microbes and contamination. The fruits were collected from the local markets of virudhunagar. The other ingredients used for the present study like puffed rice ball, palm jaggery were purchased from the local markets of virudhunagar.

2. Dehydration of fruit peels

The drying time for red banana, grape, and orange peels varied based on several factors, including the thickness of the peels, the drying method used, and environmental conditions. Generally, orange peels took longer to dry compared to red banana and grape peels due to their higher moisture and natural oil content. The presence of oils made orange peels more resilient to drying, resulting in a longer time for them to become completely brittle.

Red banana peels, being relatively thin, dried faster, especially when sliced thinly. Grape peels, also thin, could dry relatively quickly, but the drying time depended on whether they were from red or green grapes, with red grape peels potentially containing more moisture.

Hot air oven was used to expedite the drying process for all three types of peels. Different temperatures and times were employed to dehydrate the fruit peels until they reached a moisture content of less than 10 percent. This ensured the peels were thoroughly dried and could be stored for longer periods without losing quality.

2.1. Processing of the fruit peels by hot air-drying method

The HTLP 45L Thermostatically Controlled Double Wall Hot Air Oven was employed for this study, the drying process continued until the peels became brittle, ensuring the complete elimination of any residual moisture less than 10 percent. the peels of the fruits such as orange was dried at 80°C for 8 hours, followed by red banana peel was dried at 70°C for 8 hours and grape peel was dried at 75°C for 10 hours. Once dried, the peels were allowed to cool to room temperature. They were then transferred to a blender or grinder and processed into a fine powder, with occasional pauses to scrape the sides for even grinding. If necessary, the resulting powder was sifted through a fine mesh sieve to remove any coarse particles. The final step involved storing the powder in an airtight container, placed in a cool, dry location away from direct sunlight to maintain its quality. The powder could be utilized in various

culinary applications, such as smoothies, baked goods, or as a seasoning, providing a versatile and flavorful addition to dishes.

2.2. Processing of the fruit peels by cabinet drying method

The Optima Stainless Steel Tray Dryer-Cabinet Dryer, Electric was employed for this study to dry the fruit. The drying process was prolonged until the peels attained a brittle texture, ensuring the thorough elimination of residual moisture to less than 10 percent. The orange peels were dried at 95°C for 8 hours, followed by red banana peels at 80°C for 8 hours and grape peels at 80°C for 10 hours. Following the drying phase, the peels were allowed to cool to room temperature and made in to fine powder. Fruit peel powder stored in an airtight container.

2.3 Development and standardization of fruit peels powder incorporated food products

The fruit peels powders were incorporated to develop value-added products, such as red banana peel powder-incorporated puffed rice ball, orange peel powder-incorporated puffed rice ball, and grape peel powder-incorporated puffed rice ball. These fruit peels powders were standardized by applying various temperatures to dehydrate them without affecting the sensorial attributes and nutritional quality of the fruit peel powder.

2.3.1 Development of fruit peels powder incorporated puffed rice ball

Incorporating fruit peels powder such as red banana peel, orange and grape into puffed rice ball at different percentages at 5%, 10% and 15% respectively.

Table 1-Ingredients used for the preparation of fruits Peels Powder Incorporated Puffed rice ball

Ingredients used	Control sample	Experimental Sample A	Experimental Sample B	Experimental Sample C
Puffed rice ball	25g	25g	25g	25g
Jaggery syrup	20ml	20ml	20ml	20ml
Red banana peel powder		5g	10g	15g
Orange peel powder		5g	10g	15g
Grape peel powder		5g	10g	15g

The above table revealed that, ingredients used for the development of fruit peels powder incorporated value added products. In the formulation of fruit peels-based products, various experimental samples were created alongside a control sample to investigate the impact of incorporating different fruit peels powders. The control sample maintained a standard composition, consisting of 25g of puffed rice and 17.5ml of jaggery syrup. The experimental samples, labeled A, B, and C, introduced

red banana peel powder, orange peel powder, and grape peel powder, respectively, in increasing quantities of 5g, 10g, and 15g.

2.4 Sensory evaluation of the fruit peels incorporated value added food products

The developed fruit peels-incorporated value-added products were evaluated through sensory analysis. Eight panel members assessed the products using a 10-point hedonic scale.

2.5 Determination of nutritional composition of the dehydrated fruit peels powder and the fruit peels powder incorporated food product

The proximate composition of the fruit peels powder and fruit peels powder incorporated value added product were analysed such as moisture, ash, fibre, protein carbohydrate, phosphorus, Calcium, Vitamin C and Iron.

2.6 Analysis of phytochemicals present in the fruit peels powder

The investigation involved the analysis of phytochemicals found in fruit peels powder specifically red banana, orange, and grapes. The study focused on evaluating the phytochemicals of developed food product with fruit peels powder incorporated value added products. The value-added products were analyzed. The assessment of phytochemicals in the fruit peels was conducted using a method inspired by the procedure outlined by Rolim et al. (2018),

2.7 Analysis of microbial load

The microbial load was carried out to find out the shelf life of fruit peels powder using standard plate count method. The microbial load was determined for 1 day interval using standard plate count method.

Results and Discussion

1 Determination of Weight of the Fruit Peels

The weight of the fresh peels and dried peels was determined under cabinet drier and hot air oven are given in table 2

Table 2-Estimation of weight of the fruit peels

Name of the functional ingredients	Cabinet dryer (60C-80C)				Hot air oven (75C)			
	Fresh weight of the peels (g)	Dry weight of the fruit peels (g)	Dehydrated fruit peels powder weight (g)	Dehydrated fruit peels powder weight (per 100g)	Fresh weight of the peels (g)	Dry weight of the fruit peels (g)	Dehydrated fruit peels powder weight (g)	Dehydrated fruit peels powder weight (per 100g)
Red banana	820	410	450	54.87	-	-	-	-
Orange	-	-	-	-	450	225	220	48.88
Grapes	540	240	240	44.44	-	-	-	-

The functional ingredients in the study include red banana, orange, and grapes, with a focus on the impact of different drying methods—cabinet dryer (60°C-80°C) and hot air oven (75°C)—on the weight and composition of the fruit peels. For red banana, the initial fresh weight of the peels was 820g, yielding a dehydrated fruit peels powder weight of 450g in the cabinet dryer (54.87g per 100g). However, the hot air oven results for red banana are not provided. In the case of oranges, the fresh weight of the peels was 450g, leading to a dehydrated fruit peels powder weight of 220g in the hot air oven (48.88g per 100g). Data for grapes includes a fresh weight of the peels at 540g, resulting in a dehydrated fruit peels powder weight of 240g in the cabinet dryer (44.44g per 100g). The study thus explores the influence of drying methods on the transformation of fresh fruit peels into dehydrated powder form, providing insights into the efficiency of cabinet dryers and hot air ovens for different fruit varieties.

2 Sensory evaluation of the fruit peels incorporated food product

The fruit peels powder incorporated value added products were subjected to sensory evaluation with eight semi trained panel members. The mean scores were obtained for these products and statistically analyzed.

2.1. Sensory evaluation of Red banana peel incorporated food product

Characteristics	Standard	Sample A (5%)	Sample B (10%)	**Sample C (15%)**
Appearance	8.30 ± 0.4	8.23 ± 0.5	8.57 ± 1.2	**8.87 ± 1.0**
Color	8.40 ± 0.4	8.13 ± 0.5	8.27 ± 1.1	**8.83 ± 1.1**
Flavor	8.63 ± 0.5	8.10 ± 0.7	8.43 ± 1.3	**8.90 ± 0.2**
Taste	8.40 ± 0.7	8.17 ± 0.8	8.37 ± 0.9	**8.67 ± 0.8**
Texture	8.60 ± 0.5	7.93 ± 0.5	8.50 ± 0.8	**8.67 ± 0.9**
Overall Acceptability	8.40 ± 0.5	8.07 ± 0.8	8.43 ± 1.2	**8.87 ± 0.6**

Table 3

From the above table, the developed food product, enriched with varying percentages of specific ingredients (Samples A, B, and C), were meticulously assessed with the standard. In terms of appearance, Sample C, containing 15% of the specified ingredient, displayed the highest score (8.87 ± 1.0), surpassing both the standard (8.30 ± 0.4) and the other samples. Similarly, Sample C excelled in color (8.83 ± 1.1), outperforming the standard (8.40 ± 0.4) and the other samples. Notably, Sample B, with 10% of the ingredient, demonstrated the highest flavor rating (8.90 ± 0.2), exceeding both the standard (8.63 ± 0.5) and other samples.

In the realm of taste evaluation, Sample C (8.67 ± 0.8) and Sample A (8.40 ± 0.7) were competitive with the standard (8.40 ± 0.7). However, Sample B, with10% of the ingredient, exhibited a slightly lower taste score (8.17 ± 0.8). Regarding texture, Sample C (8.67 ± 0.9) and the standard (8.60 ± 0.5) received comparable ratings, while Sample B (7.93 ± 0.5) showed a slight deviation. Overall acceptability mirrored the trends observed in the individual characteristics, with Sample C (8.87 ± 0.6) outshining the other samples and aligning closely with the standard (8.40 ± 0.5). Considering the mean values and nutritional aspects, panel members favored sample C as the most acceptable product among the options of sample A and sample C

2.2. Sensory evaluation of orange peel incorporated food product

Characteristics	**Standard**	**Sample A (5%)**	**Sample B (10%)**	**Sample C (15%)**
Appearance	8.30 ± 0.4	7.57 ± 1.2	**8.23 ± 1.1**	8.87 ± 0.7
Color	8.50 ± 0.4	7.27 ± 1.1	**8.13 ± 1.0**	8.13 ± 1.1
Flavor	8.43 ± 0.5	7.43 ± 1.3	**8.10 ± 1.0**	8.10 ± 0.2
Taste	8.60 ± 0.7	7.37 ± 0.9	**8.17 ± 0.6**	8.57 ± 0.8
Texture	8.30 ± 0.5	7.50 ± 0.8	**8.93 ± 0.5**	7.67 ± 0.9
Overall Acceptability	8.40 ± 0.5	7.43 ± 1.2	**8.31 ± 0.6**	8.00 ± 0.8

Table 4

The evaluation of food product characteristics, varying in ingredient percentages (Samples A and B), against the standard, highlights distinct sensory profiles. Sample B, featuring 10% of the ingredient, exhibits notable improvements in appearance (8.23 ± 1.1), color (8.13 ± 1.0), flavor (8.10 ±

1.0), taste (8.17 ± 0.6), and texture (8.93 ± 0.5), contributing to an enhanced overall acceptability (8.31 ± 0.6).In contrast, Sample A, with 5% of the ingredient, shows more conservative changes across all sensory attributes. The standard serves as a benchmark, maintaining a consistent level of sensory qualities.

These findings underscore the impact of different ingredient percentages on the sensory attributes of the food product. Adjustments in formulation can be guided by these results to achieve an optimal balance that aligns with consumer preferences and overall acceptability. Considering the mean values and nutritional aspects, panel members favored sample B as the most acceptable product among the options of sample A and sample C

2.3. Sensory evaluation of grapes peels incorporated food product

Characteristics	**Standard**	**Sample A (5%)**	**Sample B (10%)**	**Sample C 15%)**
Appearance	8.70 ± 0.4	8.23 ± 0.5	7.47 ± 1.2	**8.77 ± 1.0**
Color	8.40 ± 0.4	8.13 ± 0.5	7.37 ± 1.1	**8.23 ± 1.2**
Flavor	8.73 ± 0.5	7.10 ± 0.7	7.53 ± 1.3	**8.10 ± 0.3**
Taste	8.90 ± 0.7	8.17 ± 0.8	7.47 ± 0.9	**8.67 ± 0.9**
Texture	8.20 ± 0.5	7.93 ± 0.5	7.50 ± 0.8	**7.57 ± 0.8**
Overall Acceptability	8.01 ± 0.5	8.00 ± 0.8	7.43 ± 1.2	**8.56 ± 0.6**

Table 5

The assessment of food product characteristics across varying ingredient percentages (Samples A, B, and C) compared to the standard reveals distinctive sensory profiles. Sample C, featuring 15% of the ingredient, stands out with notable improvements in appearance (8.77 ± 1.0), color (8.23 ± 1.2), flavor (8.10 ± 0.3), taste (8.67 ± 0.9), and overall acceptability (8.56 ± 0.6). Despite a slightly lower texture score (7.57 ± 0.8), Sample C demonstrates a well-rounded enhancement in sensory attributes. Sample B, with 10% of the ingredient, exhibits improvements in appearance (8.23 ± 0.5), color (7.37 ± 1.1), flavor (7.53 ± 1.3), and overall acceptability (7.43 ± 1.2). While maintaining a competitive profile, Sample B shows room for refinement in texture (7.50 ± 0.8).

These findings emphasize the discernible impact of varying ingredient percentages on the sensory qualities of the food product. Formulation adjustments can be guided by these results to achieve an optimal balance that aligns with consumer preferences and overall acceptability. Considering the

mean values and nutritional aspects, panel members favored sample C as the most acceptable product among the options of sample A and sample B

3 Nutrient analysis of fruit peels powder and fruit peels incorporated food products

Nutrient such as moisture, ash, fibre, protein carbohydrate, phosphorus, calcium, Vitamin C and iron. Fruit peel powder and fruit peel incorporated food products (best accepted variation) were analyzed for the best accepted variation

Table 6-Nutrient analysis of fruit peels powder and fruit peels incorporated food products

Nutritional components	Red Banana peel	Red Banana Product	Orange peel	Orange peel product	Grapes Peel	Grapes Peel Product
Energy (Kcal)	89	106	97	123	104	136
Carbohydrates(g)	22.84	23.34	25	26.7	27.33	28.9
Fibre(g)	2.6	3.9	11	12.4	1.4	2.5
Protein(g)	1.09	3.2	1.5	1.67	1.09	1.5
Fats (g)	0.33	0.2	0.2	0.09	0.24	0.1
Potassium (mg)	358	389	212	254	288	254
Magnesium(mg)	27.0	24	20	13.54	11	8.9
Phosphorus(mg)	22.0	23.4	10	11	30	30.9
Vitamin C(µg)	8.7	9.7	136	147	4.8	5.3
Calcium(mg)	5.0	5.5	0.8	0.6	20	14.65
Sodium(mg)	1.3	1.2	3.0	1.0	3.0	1.9
Vitamin B9 (µg)	13.6	14.9	40	43.2	3	1.42

The nutritional analysis of red banana peel, orange peel, and grape peel, both in their raw form and as processed products, provides valuable insights into their respective compositions. Red banana peel, when compared to the banana itself, exhibits lower energy content, carbohydrates, and potassium but is notably higher in fiber. The processed red banana peel product retains this nutritional profile, offering a source of fiber, albeit with slightly increased energy content.

Similarly, orange peel demonstrates higher energy, carbohydrates, and vitamin C levels compared to the orange fruit. The processed orange peel product retains these characteristics, showcasing a notable increase in vitamin C content. Orange peel is a particularly rich source of dietary fiber.

Grape peel, in its raw form, is lower in energy, carbohydrates, and fiber compared to the grape fruit. However, the processed grape peel product exhibits a significant increase in fiber content. While

grapes are known for their natural sugars, the processed peel product provides an alternative with enhanced fiber.

In terms of minerals, all peel products display lower levels of potassium, magnesium, phosphorus, and calcium compared to their respective fruits. Sodium content is generally low in both fruits and their peel products.

Overall, the nutritional components of these fruit peels and their processed products offer a diverse range of dietary elements, with potential health benefits attributed to their fiber, vitamin, and mineral content. These findings underscore the potential utility of fruit peels as functional food ingredients, contributing to a balanced and nutrient-rich diet.

4 Analysis of phytochemical present in the fruit peels powder and fruit peels incorporated food products.

Table 7

Tests	**Red banana peel**	**Orange peel**	**Grapes peel**
Phenol	+	+	+
Tannins	+	+	+
Steroide	-	-	-
Terpenoids	-	-	-
Flavonoids	+	+	+
Alkaloids	+	+	+
Coumarins	+	+	+
Saponins	+	+	+
Quinones	-	-	-
Fatty acids	-	-	-
Starch	-	-	-
Reducing sugar	+	+	+

The table outlines the results of various tests conducted on red banana peel, orange peel, and grape peel, focusing on different chemical components present in each. Red banana peel exhibits a significant presence of phenols (+), flavonoids (+), alkaloids (+), coumarins (+), saponins (+), and reducing sugars (+). In contrast, sterols, terpenoids, quinones, fatty acids, starch, and sterols are absent. Orange peel, on the other hand, demonstrates a notable presence of phenols (+), tannins (+), flavonoids (+), alkaloids (+), coumarins (+), saponins (+), and reducing sugars (+). Sterols, terpenoids, quinones, fatty acids, starch, and sterols are not detected. Lastly, grape peel presents a significant presence of phenols (++), tannins (+), flavonoids (+), alkaloids (+), coumarins (+), saponins (+), and reducing sugars

(+), with sterols, terpenoids, quinones, fatty acids, starch, and sterols absent. This analysis provides valuable insights into the chemical composition of these fruit peels, aiding in understanding their potential applications and benefits.

5 Microbial analysis of the fruit peels powder and fruit peels incorporated food products

Microbial load in the fruit peels powder and fruit peels incorporated food products powder were determined. The microbial load in the fruit peels powder and fruit peels-incorporated food products powder was assessed at different storage periods, and the results are tabulated. The samples include red banana peel powder, orange peel powder, grape peel powder, control puffed rice ball, red banana peel puffed rice ball (sample B), orange peel puffed rice ball (sample A), and grape peel puffed rice ball (sample B). The microbial load for each sample is reported as "TFTC" (Too Few To Count), indicating that at various storage periods (initial, ½ day, 1 day, and 6 days), the microbial count was either too few or too numerous to be accurately enumerated. This notation signifies the limitations in quantifying the microbial population at specific time points, emphasizing the need for proper microbial control and monitoring throughout the storage period to ensure product safety and quality.

Summary and Conclusion

In this study, fruit peels powders were prepared using a minimally processed approach, and puffed rice ball was subsequently produced by incorporating these fruit peels powders. During sensory evaluation, Sample B of the value-added red banana peel-incorporated puffed rice ball, Sample B of the value-added orange peel-incorporated puffed rice ball, and Sample B of the value-added grape peel-incorporated puffed rice ball received higher mean scores than other fruit peels-incorporated puffed rice ball and the control group. Furthermore, the study investigated the carbohydrate, protein, fibre, moisture, ash, calcium, phosphorus, and vitamin C content of the value-added puffed rice ball products. Additionally, qualitative analysis of phytochemical tests was conducted for the fruit peels powders and fruit peel-incorporated food products. Microbial load determination using the spread plate technique revealed that the developed value-added puffed rice ball and fruit peels powder exhibited microbial counts too few to count on the initial day, ½ day, 1 day, and 6 days. This suggests that the fruit peels products may be safe for consumption over an extended period.

In conclusion, this study suggests that fruit peels powder could be utilized as ingredients to enhance the nutritional value of various food products. The findings also highlight potential opportunities for entrepreneurship in the food processing field, particularly for small and medium enterprises, paving the way for the development of innovative and nutritious functional foods.

References

1. Fu, X., Cheng, S., Liao, Y., Huang, B., Du, B., Zeng, W., & Yang, Z. (2018). Comparative analysis of pigments in red and yellow banana fruit. Food chemistry, 239, 1009-1018.
2. Ramírez Damián M, Meza-Márquez OG, Osorio-Revilla G, Gallardo-Velázquez T, Téllez-Medina DI, Ramos-Monroy OA. (2022), Microencapsulation of Red Banana Peel Extract and Bioaccessibility Assessment by In Vitro Digestion. *Processes*. 10(4):768.
3. Chen, Z. T., Chu, H. L., Chyau, C. C., Chu, C. C., & Duh, P. D. (2012). Protective effects of sweet orange (Citrus sinensis) peel and their bioactive compounds on oxidative stress. Food chemistry, 135(4), 2119-2127.
4. Athanasiadis, V.; Chatzimitakos, T.; Kotsou, K.; Palaiogiannis, D.; Bozinou, E.; Lalas, S.I .(2022), Optimization of the Extraction Parameters for the Isolation of Bioactive Compounds from Orange Peel Waste. *Sustainability*, *14*, 13926.
5. Tang, G.-Y.; Zhao, C.-N.; Liu, Q.; Feng, X.-L.; Xu, X.-Y.; Cao, S.-Y.; Meng, X.; Li, S.; Gan, R.-Y.; Li, H.-B. (2018), Potential of Grape Wastes as a Natural Source of Bioactive Compounds. *Molecule*, *23*, 2598.

A KNOWLEDGE ON GEN Z DIET CULTURE

Vaishnavi. M
I PG Student, Jamal Mohamed College, Trichy
vaishuvanitha0007@gmail.com

Abstract

Generation Z, also referred to as the Generation, holds the capability to redefine standards for health and wellness, expand the influence of global cuisine, and elevate kitchen innovation, based on recent studies from Mintel. Unveiled today (July 16) at IFT18, Mintel discloses how the eclectic and technologically adept Generation Z will revolutionize food and beverage formulation in the near future. This transient shift in Gen-Z's eating habits reflects a broader societal trend towards responsible consumption. As this generation navigates their way through peer influence and social media pressure, they are learning to strike a balance in their food choices and embrace a more thoughtful approach to eating.

Keywords: *Generation, Peer Pressure, Social Media, Nature of work, Globalization and Zoomers.*

Introduction

Our society has been made by various generations and ages. Over the past 20 years, there has been an increased strength of the evolving nature of work, the multigenerational workforce. Those Work and organizations are being significantly shaped by shifting characteristics of the people. Anyone is able to see an increase in the lifespan of a knowledge worker given the current social and technological developments in the countries, such as the rise in birth control, China's rules against single parenting, lower fertility rates, and longer human lifespans (Gratton, 2011). With workers as young as 19 years old interacting with workers as elderly as 65+ years old, this element would logically result in a greater age range for the working population, creating a very multigenerational workforce.

Generation of diet based on the working positions.

Generation X

Those born between 1961 and 1979 are often referred to as 'latchkey kids' (children aged between 5 and 13 who regularly look after themselves without an adult presence before and after school) due to the fact that both parents were typically employed, leading to extended periods of unsupervised time (Erickson, 2009). This generation experienced significantly less parental oversight compared to their predecessors and consequently developed a strong sense of self-reliance. During this era, telecommunication was becoming a common feature in Indian households. Concurrently, the Indian populace was growing accustomed to democratic ideals and the acceptance of diverse viewpoints (Erickson, 2009).

Generation Y

Individuals known as Generation Y or Millennials were born between the years 1980 and 1995. They have witnessed and actively participated in the remarkable technological revolution, characterized by the widespread adoption of mobile phones and social networking platforms (Gaidhani et al., 2019). Millennials are often considered to be impatient by older generations due to their strong preference for immediacy and living in the present moment (Erickson, 2009). In Indian society, many Millennials have grown up as only children in nuclear families, which has become increasingly common (Thangavel et al., 2021). The defining events that shaped this generation include significant social incidents such as the Babri Masjid demolition and the subsequent inter-communal riots, as well as economic events such as the liberalization and privatization of public sector organizations.

Generation Z

People who were born between 1995 and 2012.This is the generation which is the newest society to enter the workforce with a well technologized generation. They are the most highly connected to the social media web and multimedia. This is the concept that had its origin in the Western context. India has become more of a global talent rather than only being working professionals for India with the help of globalization and liberalization. (Basu, 2013)

After liberalization, the Indian economy has grown steadily and moved away from a developing country to an emerging economy of global significance. Hence, the workforce in general andmultigenerational workforce has gained crucially.

Diet Culture Goes Multicultural to Appeal to Gen Z

The record rates shows that younger generation are taken towards the Gen Z diet culture **By Emily Auerbach** the dietary preferences of Gen Z are gradually developed among teenagers, providing them with satisfaction. To cater to their tastes, nutrition brands should embrace international flavors and cuisines. Younger generations are increasingly adopting diets, with a record 52% of Americans aged 18-34 following a diet or eating pattern in 2021. Two years later, this rate has surged by 14 points to reach 66%, the highest among any generation. These diets typically involve calorie-counting and focus on clean eating, mindful eating, and plant-based options, which require specialized foods or behaviors and contribute to their sense of identity. Gen Z is particularly interested in clean label and plant-based products, especially in categories like beverages and prepackaged foods that feature whole plants.

The Gen-Z Diet: What They Eat and Why:

Gen-Z is the generation born between 1997 and 2015. In 1991, India began to open its economy to the world, which allowed Western companies to establish themselves in the country. One of the most iconic examples of this is the arrival of Coca-Cola in India.

Fast food chains gained popularity in India in the 2000s, after the popularization of the brand in United States in the 1950s and the United Kingdom in the 1970s. This intimate the people's eating habits of Gen Z diet culture has been developed later. In developed countries, fast food became popular in the 1950s and 1970s. Countries like the US and Uk has been exposed to fast food from a young age and therefore consume more of it. In comparison to developing and underdeveloped countries, the study has analyzed that the consumption of junk food has increased significantly, but it is still lower than in developed countries and has been for a shorter period of time.

Shift in Eating Habit

In the early 2010s, there was a significant trend toward the popularity of the vegan diet and a thing noticeable on the people which shifted towards healthier food choices instead of depending on junk food. This generation has become an identity on increasing concern about the environmental impact of their food decisions and their potential contribution to climate change and being. As a result, they adopted sustainability and plant-based diets.

During this period, the vegan diet experienced a large level increase among the people popularity as more and more, particularly among Gen-Z, adopted this lifestyle, which involves abstaining from animal products and embracing an animal rights philosophy.

Role of Social Media

Gen-Z is the generation that was born during the rise of Mobility in the internet and now with socialmedia and multimedia etc. This generation's thought process was indirectly proportional to keeping aware ofthe surroundings by us and the world but in reality, especially through social media, it has altered our basic understanding of the self and the world too.

Counting and managing calories became a new trend among this generation. The motivation for this change was not solely based on moral grounds; rather, peer pressure and social media influence played an equal role in encouraging Gen Z to alter their eating habits positively. As most to the specification of the ideal physique popularized by their beloved influencers, this generation is inclined and mostly encouraged towards adopting healthier lifestyles and wellbeing.

A Balanced Perspective

It is essential to approach the topic with nuance and avoid sweeping generalizations about an entire generation's eating habits. While some Gen-Z individuals have wholeheartedly explored their healthy eating habits and embraced healthier diets and conscious eating, others haven't completely abandoned junk foodbut are consuming healthier alternatives.

Consumption of diet depends on the healthy way, carrying this transient shift in Gen-Z's eating habits cloned a broader societal trend towards responsibilities of health. As this generation navigates their way through peer influence and social media pressure, they are learning to strike a balance in their food choices and embrace a more thoughtful approach to eating.

Food Trends That Appeal to Gen Z

Based on the findings of the International Food Information Council's (IFIC) 2022 Food and Health Survey, Gen Z recognizes the significance of sustainability in shaping their food choices and defining their identity. A full hundred percent of respondents indicated that fifty percent of their food and beverage choiceshave a notable environmental impact.

Gen Z is exerting a significant influence on the food industry, shaping the majority of people's decisions regarding their food consumption. They show a strong preference for street food, as evidenced by the widespread presence of food trucks. According to Technomic's College and University Trend Report, 42% of Gen Z individuals express interest in street food options on menus. Additionally, 46% of them favor chicken as their protein choice for dinner. This generation demonstrates a particular fondness for plant-basedofferings, fermented foods (such as wines, beers, juices, cakes, and pastries), as well as popular dishes like pizzas and bowls (including burrito bowls, poke bowls, and acai bowls).

Nevertheless, the focus is on immersive dining experiences. Diners seek to explore new culinarydelights and are attracted to establishments showcasing eco-friendly, trendy, and socially media-popular menus, as well as organic, locally sourced offerings. Transparency in ingredients and fair wages is highly valued by Gen Z. They gravitate towards specialty beverages, bottled water, smoothies, and fruit juices, as well as canned goods like meats and associated products.

Consumption Trends.

The study on dietary habits has revealed that the data on Gen Z's actual or stated buying behaviors, attitudes, and food preferences primarily originate from gray literature. There exists a significant shortage of data on this topic, with most studies focusing on declared preferences.

Therefore, these outcomes should be considered with a degree of skepticism.

- It is suggested to cater to the preferences for unique, individualized, and organic products and experiences over material goods, though these conclusions are not based on studies conducted in the UK.
- Social media, online 'influencers', and digital marketing play a significant role in shaping Gen Z'sfood buying decisions.
- Despite the popularity of online shopping platforms among Gen Z, a substantial number of themexpress a preference for in-person shopping and high street retail.
- According to marketing studies, Gen Z shows a tendency towards 'innovative' and creatively presented foods.

Food Attitudes and Behaviors

- Generation Z is characterized by a diet that is typically associated with teenagers, consisting of a low consumption of fresh fruits and vegetables and a higher consumption of pre-packaged sandwiches, ready-to-eat meals, and hamburgers. This dietary pattern is attributed to the effects associated with their current life stage.
- Compared to individuals over the age of 55, those in Generation Z are more inclined towards a vegandiet, yet they are less likely to adopt vegetarian or flexitarian diets than those in the 25-34 and 35-44 age brackets. Additionally, Generation Z and Millennials show a slightly higher preference for veganism than older demographics.
- Spending on eating out, including takeaways and fast food, is highest among Generation Z. This group, especially those from lower-income households, frequently consumes takeaways. Among all age groups, Generation Z has the least ability or inclination to cook, a trend that is expected to be influenced by their stage in life.
- Research indicates that obesity rates are stabilizing among certain age groups, with Generation Z's obesity levels in the present day mirroring those of Millennials in 2003, a trend attributed to peer andsocial media influences.
- While limited, available evidence on the factors influencing food choices in this demographic highlight cost as a significant determinant in their food purchasing decisions, more so than in other age groups. Social media also plays a role in shaping Generation Z's dining choices and their willingness to spend on food.

Conclusion

The intricate landscape of Gen Z diet culture demands a nuanced approach in our understanding and discussions. Nurturing a balanced narrative that promotes holistic well-being,

combining nutritional knowledge with body positivity and mental health awareness, is essential for empowering this generation to cultivate a healthy and sustainable relationship with food.

Reference

1. Decline in Teenage Pregnancy', British Pregnancy Advisory Service, (2018)
2. Nokes, C. and others. 'A generation without borders: embracing generation Z.' OC&C Strategy. (2019)
3. Burnie, A. 'Gen Z Attitudes Towards Booze Forcing Brands to Change Their Marketing Tactics.' Red Brick Road. (2019)
4. Burnie, A. 'Gen Z Attitudes Towards Booze Forcing Brands to Change Their Marketing Tactics.' Red Brick Road. (2019
5. Hammond, C. 'All in the mind loneliness experiment'. BBC/WellcomeCollection. (2018)
6. Hammond, C. 'All in the mind – the loneliness experiment'. BBC/Wellcome Collection. (2018)
7. Microsoft Canada Consumer Insights. 'Microsoft Attention Spans Research Report'. Microsoft. (2015)
8. Maybin, S. 'Busting the attention span myth'. BBC News. Health. (2017)
9. Global Web Index. 'Trends 19 – The trends to know for 2019'. Global Web Index. (2019)
10. AP-NORC Center for Public Affairs Research. (2021, December). Gen Z and the toll of thepandemic. https://apnorc.org/projects/gen-z-and-the-toll-of-the-pandemic

.

DEVELOPMENT AND STANDARDIZATION OF *SPHAGNETICOLA CALENDULACEA LEAVES* POWDER INCORPORATED FOOD PRODUCTS

C.Midhuna[1] ,V.Ruthrapriya[2]
Assistant Professor, II PG Student, Department of Home Science-Nutrition and Dietetics
V.V.Vanniaperumal College for Women, Virudhunagar–626 001, Tamil Nadu, India
22702213@vvvcollege.org

Abstract

Sphagneticola calendulaceais an annual plant that belongs to the Asteraceae family. E. prostrata, commonly known as false daisy or bhringraj, is a medicinal plant that has been used in traditional medicine systems, such as Ayurveda, for centuries. It is widely used in treatment of skin problems, hepatic problems such as jaundice, gastrointestinal problems, respiratory problems such as asthma, and other symptoms such as fever, hair loss and whitening of hair, cuts, and spleen enlargement. Sphagneticola calendulaceahas several biological activities, including. Antimicrobial, anticancer, hepatoprotective, neuroprotective, hair growth promoting activities, and more recently against covid-19. The objective of the study was to analyse the phytochemical and pharmacological studies on Sphagneticola calendulacea(L.)Pruski, and to develop Sphagneticola calendulacea(L.)Pruski leaves powder incorporated food products, such as soup, idly powder, and chapatti and to evaluate the bioactive compounds and antioxidant activity of the developed products. The sensory evaluation was conducted with the help of 10 panel members using a 5-point hedonic scale to determine the overall acceptability of the sample. Hence, it could be utilized to prepare low cost nutritious food products to improve health and the nutritional status of the people.

Keywords: *Sphagneticola calendulaceais, development, standerdization, food products*

1. Introduction

In recent years the use of plants in the management and treatment of diseases has gained considerable importance. Plants and fruits are considered as one of the main sources of biologically active compounds. An estimate of the World Health Organization (WHO) states that around 85–90% of the world's population consumes traditional herbal Medicines. Plants have played a significant role in maintain human health and improving the quality of human life for thousands of years. Human have been depended, for their maintainane, the diversity of plant resources for foods, clothes, shelters and medicine[2]. Many plant parts, such as roots, leaves, barks, seeds, fruits and flowers are used in traditional medicine. Most of the people use traditional medicine for the treatment of diseases *Sphagneticola calendulacea.* (L.)Pruski, Belongs to family Asteraceae [3]. The plant is native to Andaman Island, Assam, Bangladesh, Cambodia, India, Japan, Jawa, Korea, Laos, Malaya, Manchuria, Myanmar, Philippines, Sri Lanka, Taiwan, Thailand and Vietnam. In India it is distributed in Coimbatore, Kanyakumari, Madurai, North Arcot, Salem, Tiruchchirappalli, Tirunelveli [2 – 5]. It is a long, prostrate, perennial, spreading or creeping, procumbent herb.The leaves are used as tonic, in cough [5]. The juice of leaves are used as snuff in cephalalgia, and in preparation of pills [1]. It is indicated in the treatment of phelegmon, boils, impetigo, mastitis, abscesses, cystitis, cold and eruptive fever. The decoction of fresh plant is used for bathing babies to prevent lichen tropicus. It is

useful in liver diseases mainly in jaundice, in splenomegaly and chronic kidney disease. In baldness, it is useful externally and internally. It is also useful for greying of hair. The leaves are also used for dyeing hair and for promoting their growth [8]. Due to its medicaments the leaves of the said plant is of importance

The herb contains wedelolactone and dimethyl wedelolactone (Coumestans derivatives) possessing potent anti-hepatotoxic effect and is incorporated as a major ingredient in a number of developed potent anti-hepatotoxic phytopharmaceuticals formulations. It is useful in the treatment of osteoporosis of knee and also possesses anti-inflammatory activity.[8-10] As it contains large amount of phenolic constituents and it is also effective in the treatment of inflammatory conditions, so its wound healing activity was studied in details[6]

. *Sphagneticola calendulacea*(L.) Pruski is a small branched herb locally known as Bhimra or Bhringraj, rich in polyphenols. Traditionally plant leaves are used in herbal medicine due to possessing cough-relieving, antipyretic, detoxification, antiphlogistic, anti-microbial, anti-inflammatory, anticancer, antidiabetic, and CNS-depressant activities As reviewed by Meena et al. (2011), the whole plant is believed to encompass different pharmacological properties and used for treating cough, skin diseases, dermatological disorders, headache, hair loss, lice, lack of blood, strengthening the nervous system, digestive system problems. The leaves juice promotes hair growth and also used in dyeing grey hair. Decoction of the plant is used as deobstruent and provided during menorrhagia and uterine haemorrhage (Kirtikar and Basu, 1975). The accumulation of reactive oxygen species (ROS) is increased in plants subjected to Cd stress, thus resulting in oxidative stress. Membrane lipids, cellular compounds and proteins are oxidized by ROS. At the same time, the production of antioxidants increases because ROS function as signalling molecules (Chmielowska-Bąk et al., 2018; Cuypers et al., 2016). Moreover, oxidative stress can induce the contents of malondialdehyde (MDA), as well as the activities of antioxidant enzymes, including catalase (CAT), peroxidase (POD) and superoxide dismutase (SOD) in response to Cd stress (Bashir et al., 2019).

The plant is reported to contain six new acylated eudesmanoids, germacrene, a-humulene, Caryophyllene, squalene, phellandrene, sit sterol and wedelia-seco-kaurenolide; leaves contain isoflavonoids and wedel lactone. This plant is considered to have different pharmacological properties such as ant hepatotoxicity leaves are used in cough, cephalagia, alopecia and skin diseases; dyeing hair and for promoting hair growth; roots yield a black dye, ethanolic extract of the herb has been shown to inhibit the growth of Ehrlich ascities carcinoma; decoction of the plant is used as DE obstruent and given in uterine hemorrhage and menorrhagia. The compounds of this herb have been reported to have synergistically suppression activity on androgen and growth in prostate cancer cells (Kirtikar and Basu, 1975) .In the present study, phytochemical analysis, pharmacological analysis and nutrient content of leaves and value added food Products on *Sphagneticola calendulacea*(L.)Pruski have been thoroughly investigated.

2. Methodology:

2.1Collection of materials:

Sphagneticola calendulacea leaves were collected from local market of Madurai.

2.2 Other ingredients:

The other ingredients collected used for the present study was black gram dhal, Bengal gram dhal, red chilli, wheat flower, tomato, small onion, garlic purchased at local market.

2.3Preparation of leaves powder:

2.3.1. Processing of Sphagneticola calendulacea leaves:

The quality of the Sphagneticola calendulacea leaves powder was determined by the drying methods. Cabined drying, shadow drying was used for processing the sphagneticola calendulacea.

2.3.2. Cabinet drying method:

Processing of cabinet dried of *leaves* powder. *Sphagneticola calendulacea* leaves under running water. Drained out the water thoroughly. Then spread it on the clean tray. Dehydration by the cabinet dryer at 60°C for 3 hours. Dried under shade and made into fine powder.

2.3.3. Shadow drying method:

Processing of *Sphagneticola calendulacea* leaves powder shadow drying methods. *Sphagneticola calendulacea* leaves washing under running water. Drained out the water thoroughly. The spread it on the clean tray. Dried under shade for 4 days and made into fine powder.

2.4 Determination of vitamin C content present in *Sphagneticola calendulacea* leaves powder.

In this study, ascorbic acid was determinate for the cabinet dry and shadow dry used in *Sphagneticola calendulacea* leaves powder.

2.5 Determination of Antioxidant activity content present in *Sphagneticola calendulacea* leaves powder.

In this study, Antioxidant activity was determinate for the cabinet dry and shadow dry used in *Sphagneticola calendulacea* leaves powder.

2.6 Determination of fibre content present in *Sphagneticola calendulacea* leaves powder.

In this study, fibre was determinate for the cabinet dry and shadow dry used in *Sphagneticola calendulacea* leaves powder.

2.7 Determination of protein content present in *Sphagneticola calendulacea* leaves powder.

In this study, protein was determinate for the cabinet dry and shadow dry used in *Sphagneticola calendulacea* leaves powder.

2.8 Determination of iron content present in *Sphagneticola calendulacea* leaves powder.

In this study, iron was determinate for the cabinet dry and shadow dry used in *Sphagneticola calendulacea* leaves powder.

2.9 Determination of phytochemical content present in *Sphagneticola calendulacea* leaves powder.

In this study, phytochemical was determinate for the cabinet dry and shadow dry used in *Sphagneticola calendulacea* leaves powder.

2.9 Development and standardization of selected leaves powder incorporated food products:

2.9.1 Development and standardization of *Sphagneticola calendulacea* leaves powder incorporated value added products

Various ready to mix product were made by incorporating cabinet dry *Sphagneticola calendulacea* leaves powder. The products developed were idly powder, soup mix, and chapatti**.**

2.9.2Development and standardization of *Sphagneticola calendulacea* leaves powder incorporated idly powder.

The processing raw *Sphagneticola calendulacea* leaves powder was incorporated in to ready to mix 2%, 4%, 6% using and acceptability test was done by ten panel members. The ingredients used for preparing the ready to idly powder.

Table 1

Ingredients used for the preparation of *Sphagneticola calendulacea* leaves powder incorporated idly powder. The ingredients used for preparing the *Sphagneticola calendulacea* leaves powder incorporated idly powder are given in table 1.

Ingredients	**Control**	**Sample A**	**Sample B**	**Sample C**
Black gram dhal(g)	15g	15g	15g	15g
Bengal gram dhal(g)	3g	3g	3g	3g
Red chilli	2g	2g	2g	2g
Sphagneticola calendulacealeave powder(g)	_	2g	4g	6g
Salt	To taste	To taste	To taste	To taste

Grinding the black gram dhal, Bengal gram dhal and red chilli

Mixing with salt,

Addition of *Sphagneticola calendulacea* leaves powder

Roast in the all ingredients

Serve the idly powder

Flow chart 1

Preparation of *Sphagneticola calendulacea* leaves incorporated idly powder

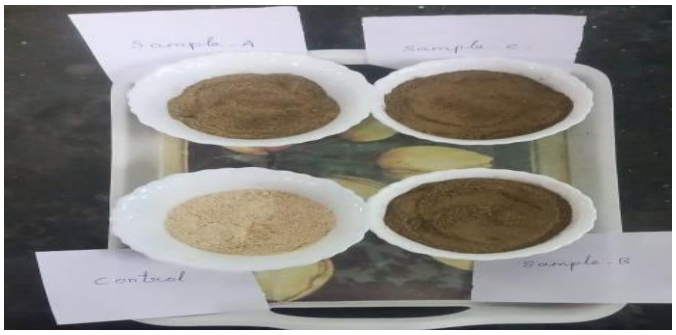


Figure: 2

2.8.3 Development and standardization *Sphagneticola calendulacea* leaves powder incorporated soup mix.

The processing raw *Sphagneticola calendulacea* leaves powder was incorporated into the ready to soup mix at 2%, 4%, 6% using and acceptability test was done by ten panel member. The ingredients used for preparing the ready to soup mix are given table 2.

Table 2

Ingredients used for the preparation of *Sphagneticola calendulacea* leaves powder incorporated soup mix.

Ingredients	**Control**	**Sample A**	**Sample B**	**Sample C**
Tomato (g)	5 g	5 g	5 g	5 g
Onion (g)	8 g	8 g	8 g	8 g
Cabbage (g)	5 g	-	-	-
Garlic (g)	2 g	2 g	2 g	2 g
Sphagneticola calendulacea leaves powder (g)	_	2 g	4 g	6 g
Pepper powder	Pinch	Pinch	Pinch	Pinch
Water (ml)	150 ml	150 ml	150 ml	150 ml
Salt (to taste)	To taste	To taste	To taste	To taste

Take the raw *Sphagneticola calendulacea* leaves incorporated composite powder

↓

Add the other ingredients (tomato, garlic, pepper, and onion, salt)

↓

Add water and well cooked

↓

Make in to soup mix

Flow chart 2

Preparation of raw *Sphagneticola calendulacea* leaves powder incorporated ready to soup mix

Flow chart 2 shows the preparation of the *Sphagneticola calendulacea* leaves powder incorporated Soup mix and plate 4 shows that prepared *Sphagneticola calendulacea* leaves powder incorporated Soup mix

Figure:3

2.8.4 Development and standardization of *Sphagneticola calendulacea* leaves powder incorporated chapatti.

The processing raw *Sphagneticola calendulacea* leaves powder was incorporated in to ready to mix 2%, 4%,6% using and acceptability test was done by ten panel members. The ingredients used for preparing the ready to chapatti given table 3.

Table 3

The ingredients used for preparing the *Sphagneticola calendulacea* leaves powder incorporated chapatti.

Ingredients	**Control**	**Sample A**	**Sample B**	**Sample C**
Wheat flower(g)	25 g	25 g	25 g	25 g
Sphagneticola calendulacea leaves powder(g)	–	2 g	4 g	6 g
Salt	To taste	To taste	To taste	To taste

Mixing with other ingredients (wheat flour, salt)

↓

Addition of *Sphgneticola calendulacea* leaves powder

↓

Add in water and mixing with all ingredients make the dough

↓

Cooked the chapatti

Flow chart 3

Preparation of *Sphagneticola calendulacea* leaves powder incorporated ready to chapatti:

Flow chart 3 shows the preparation of the *Sphagneticola calendulacea* leaves powder incorporated chapatti and plate 4 shows that prepared *Sphagneticola calendulacea* leaves powder incorporated chapatti.

Figure:4

2.9 Sensory evaluation of value added products:

The sensory characteristics of idly powder, soup and chapatti were subjected to sensory evaluation with the help of untrained panel members by using the 5- point hedonic scale to find out the overall acceptability of the sample A. The panellists were asked to give scores for colour, flavour, texture, taste and overall acceptability. The scores of all attributes helped to find the best out of the two samples and control.

3. Result and Discussion:

3.1 Sensory evaluation of *Sphagneticola calendulacea* leaves powder incorporated idly powder

The developed products were subjected to sensory evaluation by 10 panel members with the help of 5 point hedonic scale. The mean score for the *Sphagneticola calendulacea* leaves powder incorporated idly powder was found and statistically analysed. The results are conferred in the following table 1

Table: 1

Mean score obtained in the sensory evaluation of *Sphagneticola calendulacea* leaves powder incorporated idly powder

Sensory characteristics	Control	Sample A	Sample B	Sample C
Colour	4.82± 0.20	4.9 ±0.14	4.62 ±0.25	4.2 ±0.27
Flavour	4.88 ±0.16	4.86 ±0.13	4.56± 0.37	4.24 ±0.23
Texture	4.86 ±0.13	4.92 ±0.10	4.66 ±0.25	4.26± 0.30
Taste	4.84 ±0.23	4.9 ±0.14	4.72± 0.19	4.24 ±0.30
Over all acceptability	4.54 ±.23	4.94 ±0.08	4.68 ±0.19	4.56 ±0.32

The above table 1 shows the mean score of colour, flavour, texture, taste and overall acceptability of the *Sphagneticola calendulacea* leaves powder incorporated idly powder. It was found that overall acceptability of sample A was 4.94. But the other two samples B and C got the overall acceptability of 4.6 and 4.5 respectively. So sample A was selected for the product development.

3.2 Sensory evaluation of *Sphagneticola calendulacea* leaves powder incorporated soup mix:

The developed products were subjected to sensory evaluation by panel members and the score obtained for 2%, 4%, 6%, *Sphagneticola calendulacea* leaves powder incorporated soup mix was found and statistically analysed.

Table: 2

Sensory characteristics	Control	Sample A	Sample B	Sample C
Colour	4.3± 0.29	4.86± 0.11	4.56±.34	4.12 ±0.23
Flavour	4.24 ±0.18	4.78± 0.08	4.44± 0.20	4.16± 0.32
Texture	4.44± 0.13	4.82 ±.08	4.59± 0.11	4.12 ±0.26
Taste	4.74± 0.11	4.64± 0.11	4.44±.30	4.22± 0.30
Over all acceptability	4.56± 0.08	4.80 ±0.1	4.12±0.36	4.24 ±0.32

The above table 2 shows the mean score of colour, flavour, texture, taste and overall acceptability of the *Sphagneticola calendulacea* leaves powder incorporated soup mix. It was found that overall acceptability of sample A was 4.80. But the other two samples B and C got the overall acceptability of 4.12 and 4.24 respectively. So sample A was selected for the product development.

3.3 Sensory evaluation of *Sphagneticola calendulacea* leaves powder incorporated chapatti:

The developed products were subjected to sensory evaluation by panel members and the score obtained for 2%, 4%, 6%, *Sphagneticola calendulacea* leaves powder incorporated was chapatti found and statistically analysed.

Table: 3

Sensory characteristics	Control	Sample A	Sample B	Sample C
Colour	4.34 ±0.30	4.76± 0.20	4.35 ±0.24	4.12 ±0.45
Flavour	4.24 ±0.56	4.64± 0.13	4.24 ±0.45	4.22 ±0.30
Texture	4.45 ±0.45	4.78± 0.08	4.13± 0.56	4.32 ±0.43
Taste	4.19± 0.43	4.50± 0.15	4.34± 0.76	4.16 ±0.35
Over all acceptability	4.24± 0.40	4.68 ±0.13	4.12± 0.35	4.29 ±0.41

The above table 3 shows the mean score of colour, flavour, texture, taste and overall acceptability of the *Sphagneticola calendulacea* leaves powder incorporated chapatti. It was found that overall acceptability of sample A was 4.68. But the other two samples B and C got the overall acceptability of 4.12 and 4.29 respectively. So sample A was selected for the product development.

3.4. Nutrient analysis

The nutrient content of *Sphagneticola calendulacea* leaves powder was analysed and given in table

Nutrient	Value of cabinet dry	Value of shadow dry
Vitamin C	24mg	20mg
Fibre	13.38g	10.2g
Antioxidant activity	78%	70%
Protein	12.56g	9.84g
Iron	3.5g	3.2g

3.5Analysis of phytochemicals present in *Sphagneticola calendulacea* leaves powder

S.NO	PYTOCHEMICALS	Ethanol	Distilled Water
1	Flavonoids	+	+
2	Phenols	+	+
3	Tannin	+	+
4	Fatty acid	-	-
5	Steroids	-	+
6	Terpenoids	+	+
7	Alkaloids	+	+
8	Coumarins	+	+
9	Sponins	+	+
10	Quinones	+	+
11	Starch	-	-
12	Reducing sugar: Benedict	+	+
13	CHO	+	+

Conclusion:

The plant *Sphagneticola calendulacea* (L.) Pruski is used by the aboriginals for curing various illnesses. The use of *Sphagnitecola calendulacea* leaves powder boosts the nutritious value of the product, lowering the risk of lifestyle diseases. Because of its ancient medicinal properties, *Sphagnitecola calendulacea* leaves is an important element in many Ayurveda formulations and phytomedicine compounds. *Sphagnitecola calendulacea* an essential medicinal plant with growth hair prevents post-delivery uterine pain, jaundice, and throat related diseases, liver related diseases, skin diseases and mouth ulcer. In the present study, phytochemical test of leaves extracts of *Sphagneticola calendulacea* (L.) Pruski are detected the presence of Alkaloids, Phenolic compounds, Polyphenols, Reducing sugars, Saponins, Steroids, Tannins and Flavonoids. The data obtained from preliminary phytochemical profiling of the said plants leaves with antioxidant property have revealed the presence of secondary

metabolites of therapeutic importance as a result the powder can be utilized to improve the quality of various medical, pharmaceutical, and food formula. The detail Phytochemistry and pharmacological studies are in progress.

Reference

1. Nithin Manohar R., Padmaja V., Shiji Kumar P. S., C. D. Shaji Selvin1and Ancy P. 2017, Comparing the Pharmacological Activities of *Sphagneticola Calendulaceae* and *Sphagneticola Trilobata* an Over View, 6, 11, 457-467.
2. Md. Wasim Bari, Ariful Islam, Md. Monirul Islam 2021, Determination of in vitro antioxidant activity and in vivo antineoplastic effects against Ehrlich ascites carcinoma of metabolic extract of *Sphagneticola calendulacea* (L.) Pruski, 7, 12.
3. Panel Suprabuddha Kundu, Umme Salma, Md. Nasim Ali, Alok Kumar Hazra, Nir Mandal .2022, Development of transgenic hairy roots and augmentation of secondary metabolites by precursor feeding in *Sphagneticola calendulacea* (L.) Pruski, 6, 9.
4. Pruski. Ah Nge Htwe, Tin Tin Moe, Kiki Win, Morphological, Anatomical and Phytochemical Studies of *Sphagneticola calendulacea* (L.), 2008, 4,11.
5. John Wyson W, Deventhiran M, Sheik Noor Mohamed M, Jai Kumar K, Saravanan P, Anand D, 2021, Phytochemical Screening of *Sphagneticola calendulacea* Leaf Extracts Using Polar and Non-Polar Solvent, 3, 14.
6. Khandekar Ritesh and Bindu Gopal Krishnan, Standardization of *Sphagneticola calendulacea* (L.) Pruski.Stem
7. Panel Qilei Zhang, Guangxin Chen, Ling Shao, 2020, The hybridization between Sphagneticolatrilobata (L.) Pruski and *Sphagneticola calendulacea* (L.) Pruski improved the tolerance of hybrid to cadmium stress, 6, 13.

COGNI SUPPORT: DEMENTIA WELLNESS APP

Lakshmi Prabha.S[1], Vithyasree.V[2], Dharshini.G[3]

[1]Associate Professor, [2,3] III B.Sc. Student, Department of Computer Science, Seethalakshmi Ramaswami College Tiruchirappalli, Tamil Nadu, India.

lpmadam@gmail.com

Abstract

Dementia is a multifaceted neurological syndrome marked by cognitive decline, memory loss, and disruptions in language and problem-solving skills. It encompasses diverse forms, including Alzheimer's disease, vascular dementia, and frontotemporal dementia. As a pervasive global health issue, dementia not only affects individuals but also places a significant burden on families and healthcare systems. The quest for innovative diagnostics and interventions is ongoing, emphasizing the importance of early detection and tailored support to enhance the well-being of those grappling with this challenging condition. As there is no cure for Dementia only overall health management is possible and that can only provide by the caregivers. In this research article we propose a technological health care support to dementia patients by developing a software "COGNI SUPPORT". This application provides activities for the patient to improve her cognitive skills.

Keywords: *Dementia, healthcare systems, technological health care support, Cogni support*

Introduction

Dementia is a progressive neurological condition characterized by a decline in cognitive function, impacting a person's ability to perform daily activities. It is not a specific disease but rather an umbrella term for a range of symptoms associated with a decline in memory, reasoning, and communication skills. Common types of dementia include Alzheimer's disease, vascular dementia, and Lewy body dementia [3]. As the condition advances, individuals may experience changes in behavior and personality. While there is currently no cure for dementia, early diagnosis and appropriate care can help manage symptoms and improve the quality of life for those affected.

Technologies for Dementia

Health care is one of the biggest industry play a vital role in taking care of infants to old aged people. The developed countries are challenged with aging population and these people suffer from numerous chronic diseases. Providing a day-today primary services to the senior citizens are becoming a global issue. As advancement in technologies pave ways for providing solutions for every problem that we face in all walks of our life, there are many digital solutions available to resolve many issues faced by aged people. This provides improvement in quality of life, health, and safety. The following paragraphs describes the literature survey done for this paper.

Rudzicz et al., (2015), discusses technical and other challenges that need to be overcome for robots called irobots to provide speech-based assistance to patients in their homes.

Blackman et al., (2016), Identifies and describes 59 technological tools like smartphones, GPS technologies, Internet, ATM, mobile, and TV systems, dietary assessment and cognitive health monitoring, assistance with navigating outdoors, interactive agenda and diary systems, connection to alert systems.

Kenigsberg et al., (2017), identifies that Information and Communication Technologies (ICT), Assistive Technologies (ATs), AAL, GPS bracelets assist patients not only with their physical needs but also promote their emotional wellbeing.

Qi J et al., (2022), provides a literature survey aims to evaluate the nature and extent of the application of AI technology in patients with dementia at home.

Bucholc et al., (2023), summarizes and critically evaluate current applications of machine learning in dementia research and highlight directions for future research.

The other related works present about usage of neuroimaging, cognitive assessment tools, Virtual Reality(VR)and Augmented Reality(AR) and Smartwatches and fitness trackers which monitor vital signs and activity levels, providing valuable data for healthcare professionals and caregivers.

Methodology and implementation

Technology should make daily life easier for people living with dementia and their caregivers. This paper proposes a software application for a person who is suffering from dementia. Caregivers can use the app to maintain a photo album of the patient's life. The app also lets the user store description along with the photographs. These features assist patients experiencing problems with recalling memories. The caregivers can also store information about the patient and set reminder to do their work. The patient in the initial stage can add

photos and details about it directly in the database. The app also provides quizzes to check the cognitive skills of the patient and can find the progress. This software has three main users/modules: The Patient, Caregiver and the Administrator.

Individual with dementia: This module contains tools and features to help users with memory related challenges, such as reminders for medication, appointments and daily tasks. The patient can register them as a patient by providing their details into it. They also set the reminder for them to do their activities such as daily routines, appointments etc. It provides the task for the patient to stimulate their cognitive skills by conducting quiz.

Caregiver: In this module the caregiver is creating and managing personalized care plans including medication schedules, daily routines and healthcare appointments for the patient. The caregivers can register themselves and also register the patient they going to care. The caregivers can upload the videos, images on the weekly or monthly basis to remind the patient with memory tasks. They can also set the reminder to remind the patient to do their activities.

Administrator: The administrator has tools to manage user accounts, permissions and access levels for both individuals with dementia and their caregivers. This admin is part of a health care system available in the hospital for the overall maintenance of their enrolled dementia patients. The administrator also provide security measures to protect sensitive health information and ensure compliance with privacy regulations.

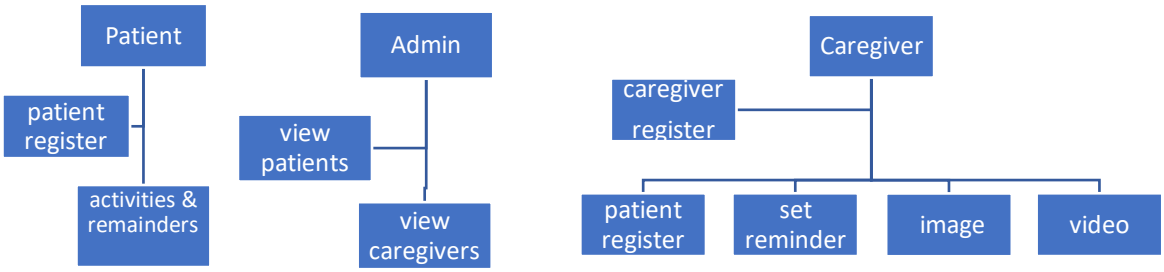


Figure 1-Software Modules

Figure 2-First page of COGNI SUPPORT

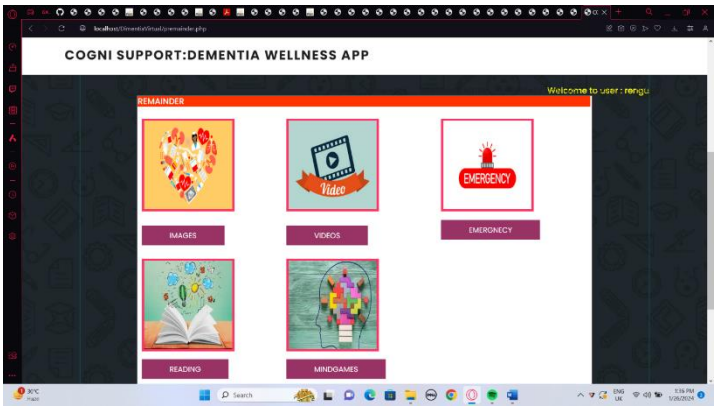
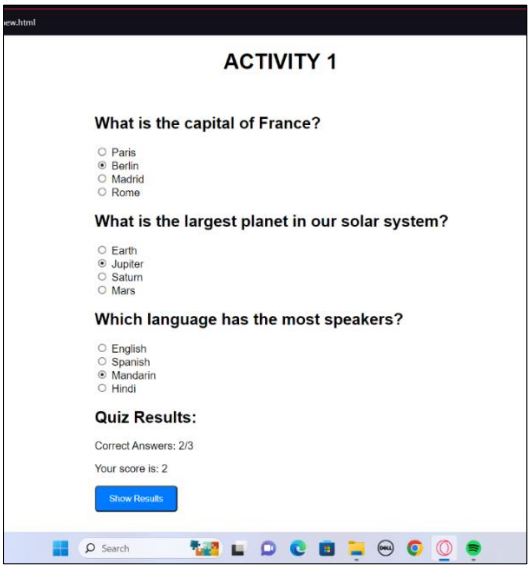


Figure 3-Activities shown in COGNI SUPPORT

Results and Discussion

The application provides activities for the dementia patients in general aptitude, mind games, identifying persons from album and enjoying favourite videos and answering queries. The caregiver helps the patient and may ask questions. The performance of the patient is displayed at the end of quizzes. In this paper a dementia patient's performance is shown in figure 4 &5.

Figure 5 shows the two week activities done by a patient. From this it is identified that activity1, 3&4 in week1 shows better result than same activities in week2. Activity 2 in week2 is better than Week1. From this report the care giver can understand that better performance is shown by the in acivity2. Hence the care giver can update other activities1, 3 and 4 in week3. These activities helped dementia patients feel happier and more involved. This system will improve the quality of life of those affected patient.



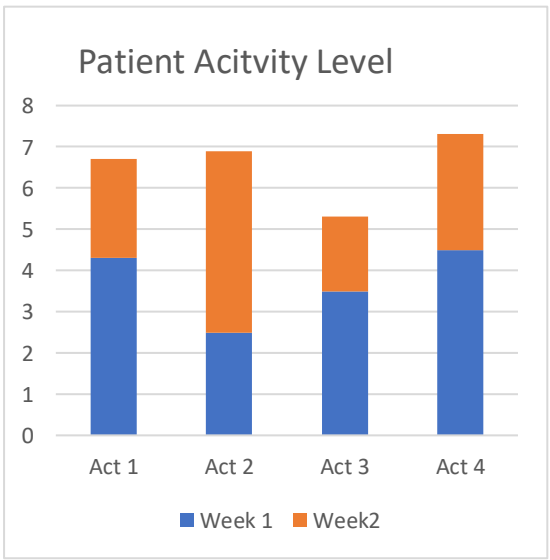


Fig 4-General Quiz in COGNI SUPPORT **Fig 5-Dementia patient Performance**

Conclusion

Dementia is a multifaceted cognitive syndrome marked by a progressive decline in mental abilities, affecting memory, reasoning, and daily activities. To address the complexities of dementia, various technologies have emerged, including digital health applications. These technologies aim to enhance monitoring, diagnosis, and support for individuals with dementia.

In our proposed System, Dementia app aim to help the affected individuals by tracking the fluctuations in their mood. This system consists of different roles such as individual with dementia, caregivers and administrator. This system will improve the quality of life for those affected by this condition and their support networks, fostering a more effective approach to managing dementia. This software can be enhanced in future for the hospitals and other health help organizations who care for dementia patients. One can also appoint a caregiver to a patient on a contract basis to taking care of the patient by extending this application in future.

References

1. Maresova P, Tomsone S, Lameski P, Madureira J, Mendes A, Zdravevski E, Chorbev I, Trajkovik V, Ellen M, Rodile K. (2018), Technological Solutions for Older People with Alzheimer's Disease: Review. Curr Alzheimer Res. 15(10):975-983.
2. Gibson G., Newton L., Pritchard G., Finch T., Brittain K., Robinson L. (2016), The provision of assistive technology products and services for people with dementia in the United Kingdom. *Dementia.* 15(4):681–701.
3. Stages of Azheimers https://www.alz.org/alzheimers_disease_stages_of_Alzheimers.asp
4. l-Shaqi R., Mourshed M., Rezgui Y. (2016), Progress in ambient assisted systems for independent living by the elderly. *Springerplus.* 5(1):624.
5. Lazarou I., Karakostas A., Stavropoulos T.G., (2016), Tsompanidis T., Meditskos G., Kompatsiaris I., et al. A novel and intelligent home monitoring system for care support of elders with cognitive impairment. *J. Alzheimers Dis.* 54(4):1561–1591.
6. Rudzicz F., Wang R., Begum M., Mihailidis A. (2015), Speech interaction with personal assistive robots supporting aging at home for individuals with Alzheimer's disease. *ACM Trans. Access. Comput.* 7(2):6.
7. Ienca M., Fabrice J., Elger B., Caon M., Pappagallo A.S., Kressig R.W., et al. (2017), Intelligent assistive technology for Alzheimer's disease and other dementias: a systematic review. *J. Alzheimers Dis.* 56(4):1301–1340.

8. Blackman S., Matlo C., Bobrovitskiy C., Waldoch A., Fang M.L., Jackson P., et al. (2016), Ambient assisted living technologies for aging well: a scoping review. *J Intelligent Sys.* 25(1):55–69.
9. Qi J, Wu C, Yang L, Ni C, Liu Y. (2022), Artificial intelligence (AI) for home support interventions in dementia: a scoping review protocol. BMJ Open. 12(9):e062604.
10. .Bucholc M, James C, Al Khleifat A, Badhwar A, Clarke N, Dehsarvi A, Madan CR, Marzi SJ, Shand C, Schilder BM, Tamburin S, Tantiangco HM, Lourida I, Llewellyn DJ, Ranson JM. (2023), Artificial Intelligence for Dementia Research Methods Optimization. ArXiv [Preprint].

OPTIMIZING COLLAGEN DYNAMICS: FORMULATING COLLAGEN BOOSTING GUMMIES USING EGGSHELL MEMBRANE FOR SKIN, HAIR AND BONE HEALTH

Manisha Maheswari.C [1], Agalya.E [2]

[1] P.G. Student, [2] Assistant Professor, Department of Food Service Management and Dietetics, Cauvery College for Women, Tiruchirappalli, Tamil Nadu, India.

Abstract

This research article explores the optimization of collagen dynamics through the development of a novel collagen booster in the form of gummies, targeting improvements in skin, hair, and bone health. Collagen, a vital structural protein, is integral to the integrity and elasticity of various tissues. In this study, we present a unique formulation strategy to enhance collagen synthesis and counteract degradation, with a focus on convenient and palatable gummy delivery. A comprehensive sensory evaluation was conducted to assess the acceptability and sensory properties of the developed collagen-boosting gummies. Panel members were engaged in evaluating taste, texture, aroma, and overall palatability. The results of the sensory analysis indicated a high rate of acceptability, with 80% of the total panel members expressing positive feedback. The gummy formulation not only addresses the technical aspect of collagen enhancement but also emphasizes the importance of consumer satisfaction and compliance. The positive reception observed in the sensory evaluation suggests that the collagen-boosting gummies present a viable and appealing option for individuals seeking to improve skin, hair, and bone health. In conclusion, this research demonstrates the successful formulation of collagen boosters in gummy form, providing a user-friendly and enjoyable approach to collagen enhancement. The high acceptability rate among panel members underscores the potential of gummies as an effective delivery system for promoting collagen dynamics and overall well-being. The integration of sensory evaluation results adds a valuable dimension to the research, highlighting the importance of not only technical efficacy but also consumer preferences in the development of health-boosting formulations.

Keywords: *Collagen, booster, palatable, sensory evaluation, user-friendly.*

Introduction

In the realm of health and wellness, the optimization of collagen dynamics stands as a crucial endeavor, and this research embarks on an innovative exploration by introducing a novel delivery system – collagen boosters in the form of enriched gummies. Collagen, a cornerstone protein integral to the structural integrity of skin, hair, and bones, is susceptible to age-related decline and environmental stressors. [4] With the aim of addressing this challenge, our study focuses on formulating collagen-boosting gummies enriched with key nutrients—calcium, zinc, vitamin C, and copper—known for their synergistic role in enhancing collagen production and overall tissue health. The formulation process involves a meticulous selection of ingredients renowned for their collagen-promoting properties. Calcium, a vital mineral, contributes to bone health and collagen synthesis. [1] Zinc plays a pivotal role in the enzymatic reactions involved in collagen formation. [2] Vitamin C is a well-known co-factor in collagen synthesis, supporting the production of hydroxyproline and hydroxylysine, crucial amino acids in collagen structure. [5] Copper acts as a cofactor for enzymes involved in collagen cross-linking, reinforcing its stability and functionality. [3] By combining these nutrients in a gummy matrix, we aim to provide a comprehensive and convenient solution to optimize collagen dynamics. A noteworthy aspect of this research is the incorporation of a sensory evaluation to gauge the acceptability and properties of the developed collagen-boosting gummies. Beyond the technical efficacy of the formulation, understanding consumer preferences and perceptions is essential for successful integration into daily health regimens. Panel members, carefully chosen to represent the target demographic, participated in a thorough assessment of taste, texture, aroma, and overall palatability. This sensory evaluation serves as a bridge between the nutritional science underpinning the gummies and their real-world application. Preliminary results from the sensory evaluation are promising, revealing an 80% rate of acceptability among panel members. This positive response underscores the potential of enriched gummies as a palatable and enjoyable means of collagen supplementation. The synergy of nutrients and the sensory appeal of the gummies position this research at the forefront of collagen optimization strategies, offering not only functional benefits but also a user-friendly approach to promoting skin, hair, and bone health. As we delve further into the study, our focus will expand to explore the sustained efficacy and long-term impact of regular consumption of these enriched collagen-boosting gummies, contributing valuable insights to the intersection of nutrition, sensory experience, and holistic well-being.

Methodology

The meticulous process of preparing collagen-boosting gummies begins with the precise weighing of each ingredient to ensure accurate proportions and contribute to the overall consistency and efficacy of the final product. In this stage, 25 grams each of chickpea flour, oats, eggshell powder with membrane, and pumpkin seeds powder are measured, along with 15 ml of amla juice, 20 grams of brown sugar, and 10 grams of agar agar. The process of obtaining eggshell typically involves processing it along with the eggshell membrane through mechanical methods, resulting in a distinct membrane that can be utilized for various purposes. [6] Equal proportions mixing follows, combining these ingredients in a balanced formulation to ensure each gummy contains an optimal ratio of essential components, enhancing the intended health benefits. Thorough blending of the combined ingredients is then undertaken to achieve a homogeneous mixture, ensuring the uniform distribution of all components, preventing uneven concentration, and promoting consistency in each gummy. Subsequently, the gradual addition of amla juice and integration of brown sugar take place, enhancing the overall taste and palatability of the gummies. Amla juice is added gradually while continuously stirring to prevent lumps, while brown sugar is integrated to ensure an even distribution of sweetness. The activation of agar agar, a critical gelling agent, follows, as it is dissolved in warm water. The resulting solution is added to the mixture and heated until a gentle boil is achieved. This step is paramount for achieving the desired gummy texture and consistency. [7] Subsequently, the final mixture is poured into silicone moulds, allowing it to cool and set. This process facilitates the solidification of the gummies, shaping them into the desired form for easy consumption. In the concluding steps, the resulting gummies are carefully removed, weighed to ensure consistency, and quantified, resulting in a total of 15 gummies. The final products are then stored in a cool, dry place to prevent moisture absorption, setting the stage for subsequent analyses in the study. This detailed breakdown underscores the precision and scientific rigor applied at each stage of the gummy preparation process, ensuring reliability and reproducibility in subsequent analyses.

Figure1-Composite flour and collagen gummies

Results and Discussion

In the sensory evaluation of the developed collagen gummies, conducted with 10 panel members, assessments were made based on five sensory attributes: colour, taste, texture, consistency, and flavour. Among the panel members, 8 found the gummies very acceptable, resulting in an overall acceptance rate of 80%.

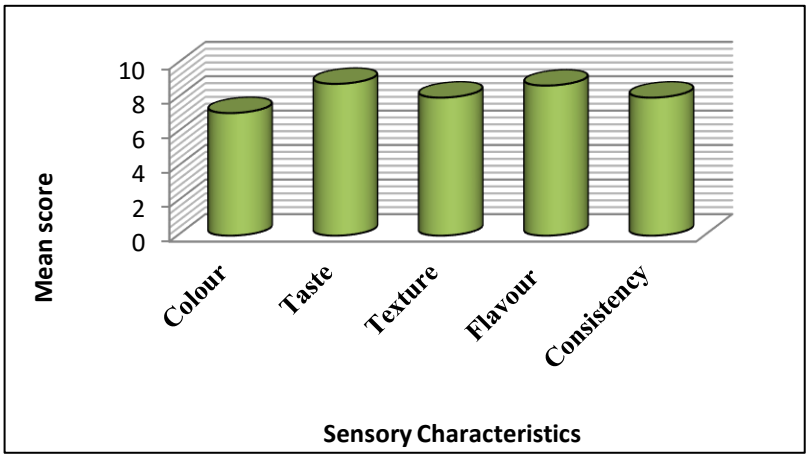


Figure 2-Mean Scores of Sensory Evaluation

Conclusion

This research marks a significant advancement in the optimization of collagen dynamics through the innovative development of collagen-boosting gummies. The unique formulation strategy not only enhances collagen synthesis and counters degradation but also prioritizes consumer satisfaction and compliance through a convenient and palatable gummy delivery system. By emphasizing both technical efficacy and consumer satisfaction, this research contributes a valuable dimension to the field of health-boosting formulations. The comprehensive sensory evaluation conducted revealed an impressive 80% positive feedback from the panel members, affirming the high acceptability of the collagen-boosting gummies. This positive reception underscores the gummies' potential as an effective and enjoyable approach for individuals seeking improvements in skin, hair, and bone health.

References

1. Arnaud, M. J., Milne, D. B., & Nielsen, F. H. (2019). Dietary calcium, vitamin D, and vitamin K as determinants of bone health. In *Nutritional Influences on Bone Health* (63-80). Springer.

2. Chasapis, C. T., Loutsidou, A. C., Spiliopoulou, C. A., & Stefanidou, M. E. (2012). Zinc and human health: an update. *Archives of Toxicology*, *86*(4), 521–534.
3. Harris, E. D. (1992). Copper-induced activation of aortic lysyl oxidase in vivo. *Proceedings of the National Academy of Sciences*, *89*(23), 11471–11474.
4. León-López, A., Morales-Peñaloza, A., Martínez-Juárez, V. M., Vargas-Torres, A., & Zeugolis, D. I. (2019). Type I Collagen and Biomimetic Collagen: Biochemical and Biophysical Applications. *Bioengineering*, *6*(3), 55.
5. Pullar, J. M., Carr, A. C., & Vissers, M. C. (2017). The Roles of Vitamin C in Skin Health. *Nutrients*, *9*(8), 866.
6. Sibilla, S., Borumand, M., & Daily, J. (2017). An overview of the beneficial effects of hydrolysed collagen as a nutraceutical on skin properties: Scientific background and clinical studies. *The Open Nutraceuticals Journal*, *10*(1), 29–42.
7. Teixeira-Lemos, E., Almeida, A., Vouga, B., Morais, C., Correia, I., Pereira, P., & Guiné, R. (2021). Development and characterization of healthy gummy jellies containing natural fruits. *Open Agriculture*, *6*(1), 466-478.

DIETARY STATUS AND ANTHROPOMETRIC MEASUREMENTS OF ADULTS DIAGNOSED WITH MULTIPLE SCLEROSIS

Hasna Arshia[1], Sheba Jeyaraj[2]

[1]Ph.D. Research Scholar, [2]Associate Professor, Department of Home Science,

Women's Christian College, Chennai, India.

hasu5arsh@gmail.com

Abstract

Multiple sclerosis (MS) is an inflammatory and a demyelinating disorder of the central nervous system that affects more women than men. The objective is to assess the dietary status and anthropometric measurements of adults with multiple sclerosis. Adults in the age group of 18-70 yrs. (n=80) diagnosed with multiple sclerosis and registered with the Multiple Sclerosis Society of India were included for the study. Anthropometric and dietary assessment were conducted. In the result, a majority of the subjects were females (68.75%). Majority of the male (32%) and female (52.7 %) subjects consumed meat weekly. Animal fat and hydrogenated fat was consumed daily by majority of the male (48%) and females (58.2%). Fish was consumed only once in two weeks by male subjects (28%) and female subjects (25%). Lower intake of fruits and vegetables was reported by the subjects. The nutrient intake showed an increase in the mean fat intake of male (49.9± 24.8 gm) and female (42.4± 16.6 gm) participants. Mean fiber intake also showed an increment in males (40.1± 11.4 gm) and females (37.9± 11.4 gm). A decrease in the mean energy, carbohydrate, saturated fat, vitamin D, calcium, zinc and iron intake was observed. A slight increase in body weight and BMI of both male and female subjects was observed. Mean body fat percentage was found to be 29.8± 8.2% for males and 35.0±7.6% for females, which shows a higher body fat percentage in both the groups compared to the reference values. A lower mean percentage of skeletal muscle was found in male (27.9± 3.7%) and female (23.7± 4.5%) participants. Conclusion: The study had significantly brought to light the poor nutritional status in people with MS and the need for dietary intervention strategies in young adults affected with this crippling disease.

Keywords: *Nutritional status, multiple sclerosis, women, Body Mass Index, dietary intake.*

Introduction

Multiple sclerosis (MS) is an inflammatory demyelinating disorder of the brain and spinal cord where the myelin sheath is affected. During the initial course of the disease, inflammation is transient and remyelination occurs; i.e. episodes of neurological dysfunction

are followed by recovery. But, over a time period as the disease progresses, chronic neurodegeneration occurs that can lead to progressive disability (1).

The disease is common in individuals between the ages of 20 and 50 years, with a peak age of 29, and females being predominantly affected than men with a ratio of 2:1. MS lesions develop in various areas of the brain and spinal cord which, in turn, lead to the development of a wide array of clinical manifestations. Some of the signs and symptoms of MS include vision, sensory and speech problems, tremor, spasticity, bladder and bowel problems, difficulties with respect to gait and psychological problems (2).

According to the Atlas of MS (2013), the estimated number of people with MS increased from 2.1 million in 2008 to 2.3 million in 2013. In India, the disease came to be identified only in the 1960s when physicians trained in neurology returned to India from the west. In an earlier study by Singhal, the prevalence of MS was estimated to be approximately 1.33/100,000 and the most common was the optico-spinal forms of MS in India (3).

Need for the Study

MS affects the productivity of a nation and hinders the younger generation from leading a productive life and is often termed as "Crippler of the young adults." The unpredictable nature of MS and the eventually occurring disability requires a high level of care that often exceeds family resources and abilities. Without appropriate management of the disease, people with MS might be at a serious risk for clinical deterioration, injury, inadequate nutrition and hydration (4).

Although nutrition may play a role in the etiology of MS, association between diet and risk factors leading to MS are still not clear. According to a study, that was conducted to compare the dietary pattern of patients with MS and healthy controls, the results indicated that the prevalence of MS was higher in patients whose dietary pattern was high in animal fats, potato, meat products, sugars and hydrogenated fats, and low in whole grains, fruits and vegetables. A diet low in high-fat dairy products, saturated fat and high in whole grains, soy, fruits, vegetables and fish was inversely related to the risk of MS (5). The need of the hour is to identify individuals at a higher risk so that early diagnosis and intervention is facilitated, and also provide solutions in the management of the disease in individuals already affected to prevent accumulation of further disability.

Methodology

The present study was carried out to assess the nutritional status of male and female subjects affected with Multiple Sclerosis (MS). Subjects were included from four chapters of the Multiple Sclerosis Society of India (MSSI). Information pertaining to demographic details, anthropometric measurements and dietary status was obtained from the participants. The design of the study comprised of a descriptive design.

Purposive sampling technique was used to select 80 subjects in the age group of 18-70 years registered with the MSSI. Of the 80 subjects, there were 55 women and 25 men registered with various chapters of the MSSI. Distribution of subjects according to the various chapters is as follows:

Chapters of MSSI	**Number of Subjects**
Chennai chapter	45
Mumbai chapter	20
Pune chapter	10
Bangalore chapter	5

Criteria for sample selection

Inclusion criteria

1. Men and women diagnosed with multiple sclerosis, and registered with various chapters of Multiple sclerosis society of India willing to participate in the study.
2. Subjects with all types of multiple sclerosis were selected.

Exclusion criteria

1. Pregnant women and participants who were severely disabled were excluded.

Tools used for the study

Data from the following tools was obtained directly from subjects of the Chennai chapter who were able to attend the monthly meetings, whereas secondary data was used to obtain this information from participants registered with other chapters of India.

1. Questionnaire/Interview schedule: A questionnaire was used to elicit information on age, socio-economic status, personal information and dietary pattern of the subjects.

2. Anthropometric Measurements

a) Height: Height of the subjects in Chennai chapter was recorded using a flexible non-stretchable tape. For measuring height, the subjects were requested to remove their footwear and stand with head and heel against the wall and height was recorded to the nearest 0.1 cm.

b) Body weight: Body weight of the subjects from Chennai chapter was measured using a karada scan. After setting to zero, subjects were asked to remove their footwear and stand still

on the measurement platform without touching anything, with the body weight equally distributed on both feet.

c) Body Mass Index (BMI): BMI of the participants was calculated as weight in kilogram divided by height in meters square.

3. In-body assessment

In-body assessment of only the participants who attended the monthly meetings at Chennai chapter (n=30) was measured using a Karada scan which helped in identifying subcutaneous fat percentage, muscle percentage, visceral fat, percentage body fat and resting metabolic rate. Participants were asked to remove their footwear and step onto the measurement platform with feet placed on the foot electrodes and body weight evenly distributed. After measuring Body weight, subjects were told to extend their arms straight at 90° angle without moving or bending their knees. Once values were displayed, measurements were recorded.

4. Dietary pattern: Dietary pattern of the subjects was assessed using a food frequency questionnaire and a one day 24-hour dietary recall to estimate the nutrient composition in the diet of the subjects.

Statistical Analysis

Data analysis was performed using Statistical Package for Social Sciences (SPSS version 21.0) software. Descriptive statistics such as frequency and percentage were used for categorical variables whereas mean and standard deviation was used for continuous variables. Student's t test was carried out to check the statistical difference between continuous variables.

Results and Discussion

Table 1-Percentage distribution of subjects according to age, state of residence, type of family and marital status

Parameter	**Number of subjects (n=80)**	
Age range (in years)	No.	%
18-25	10	12.5
26-35	26	32.5
36-45	24	30
46-55	17	21.3
56-65	1	1.3
66-70	2	2.5
State of residence	No.	%
Tamil Nadu	45	56.3
Maharashtra	30	37.5
Karnataka	5	6.3
Type of Family	No.	%
Nuclear family	54	67.5
Joint family	24	30
Extended family	2	2.5

Most of the subjects were distributed between 25 and 45 years of age. According to studies, MS typically affects adults in the age range of 20 to 45, and is termed as the "Crippler of the young Adults" (6). Type of family plays an important role in the course of the disease, as family can be a source of support in terms of social, moral, financial and overall wellbeing. When more members are present in the family, looking after patients can be an easier task. However, MS in a family member can also create psychological stress among other members as well as on functioning within families.

According to the food frequency questionnaire, majority of the male (32%) and female (52.7 %) subjects consumed meat weekly. Chicken was also consumed weekly by most of the males (44%) and females (58.2%). Animal fat and hydrogenated fat like dalda, ghee and butter was consumed daily by majority of the male (48%) and females (58.2%) subjects. Foods high in animal fat and saturated fat are linked to increased risk of MS. Subjects were found to have increased consumption of animal fat and meat before MS onset. According to a study, the prevalence of MS was higher in those who consumed high animal fat and saturated fat (5). Dairy products were consumed daily by both the subjects. According to Swank and Dugan.(1990), a higher intake of dairy products was found in areas with high prevalence of MS. Studies have shown that higher intake of saturated fat and lower intake of polyunsaturated fat can increase the risk for MS (7). Fish was consumed only once in two weeks by male subjects (28%) and female subjects (25%). Fish is a source of protein, omega 3 fatty acids and vitamin D which are known to play a protective role in MS. According to a study, frequent fatty fish intake before the onset of MS was associated with a decreased risk of MS (8). Nuts were only consumed rarely by the subjects. Nuts are considered a protective factor in MS and are nutrient-dense foods rich in omega 3 and omega 6 polyunsaturated fatty acids and other nutrients (8). Fruits were consumed only once in two weeks by majority of the male (44%) and female (38%) subjects and vegetables were also consumed weekly by the subjects. Lower intake of fruits and vegetables was reported by the subjects.

According to the 24-hr dietary recall, a higher intake of fat in male (49.9± 24.8 gm) and female (42.4± 16.6 gm) subjects was observed. Mean fiber intake also showed an increment in males (40.1± 11.4 gm) and females (37.9± 11.4 gm). A decrease in the mean energy, carbohydrate, saturated fat, vitamin D, calcium, zinc and iron intake was observed. According to a study in Iran, analysis of dietary intake showed that daily intake of vitamin D, folate, calcium and magnesium were significantly lower than dietary reference intake in all of the patients (5).

Table 2-Mean body weight and BMI of male and female subjects based on their initial and current values

Subjects	Body Weight (kg) (Mean±S.D)		't' value	'p' value
	Initial	Current		
Male (n=25)	75.9±11.3	79.6±13.2	-3.05	0.01*
Female (n=55)	63.09±15.3	64.15±16.2	-2.427	0.02*
Subjects	BMI (kg/m^2) (Mean ± S.D)		't' value	'p' value
	Initial	Current		
Male (n=25)	27.42± 3.9	28.29±4.7	- 3.14	0.01*
Female (n=55)	25.2± 5.6	25.79± 6.5	-2.71	0.01*

*p< 0.05

From the above table, a slight increase in body weight and BMI of both male and female subjects was observed before the diagnosis of MS (initial) and after the diagnosis of MS (current values). This could be due to the sedentary lifestyle of the subjects; steroid therapy often prescribed to reduce inflammation and flair ups can also lead to weight gain in the subjects after the onset of MS (9).

Table 3-Mean body fat percentage, visceral fat, RMR, subcutaneous body fat and skeletal muscle percentage of subjects

Subjects	In-body assessment parameter Mean±S.D				
	Body fat %	Visceral fat %	Resting metabolic rate (RMR) kcal	Subcutaneous fat %	Skeletal muscle %
Male (n=10)	29.8± 8.2	18.9± 5.0	1923.9±200.5	27.1± 5.2	27.9± 3.7
Female (n=20)	35.0±7.6	16.9± 5.5	1559±130.8	32.6±9.5	23.7± 4.5

Mean body fat percentage was found to be 29.8± 8.2% for males and 35.0±7.6% for females, which shows a higher body fat percentage in both the groups compared to the reference values (10). According to a recent study, people with MS who have greater disability have a higher body fat and lower bone tissue content and density than with those who have mild disability. Body fat was associated with cardio respiratory fitness and symptoms related to pain whereas fat-free tissue and bone mass was primarily associated with muscular strength (11).

A lower mean percentage of skeletal muscle was found in male (27.9± 3.7%) and female (23.7± 4.5%) subjects. Studies have shown that MS patients experienced fatigue and muscle weakness of the lower limbs (11).

Conclusion

To summarize, the results of the present study have significantly brought to light the nutritional status in male and female subjects diagnosed with Multiple sclerosis in India. Majority of the subjects in this study had a sedentary lifestyle, were obese and between the ages of 20-30 which are the prime years of life. Most of the subjects were in their initial stages of the disease and were put on disease modifying drugs, but due to financial constraints and lack of awareness, chose to quit drugs and opted for other alternative options. Participants had a higher intake of saturated fat and a lower intake of iron, zinc, calcium and vitamin D. All these factors have highlighted the poor nutritional status in subjects with MS in India and the need for nutrition education and dietary intervention programs in this population.

References

1. Compston, A., and Coles, A., (2009), Multiple sclerosis, *The Lancet*, 2008, *372*(9648), 1502–1517.
2. Staff, N. P., Lucchinetti, C. F., and Keegan, B. M., Multiple sclerosis with predominant, severe cognitive impairment, *Archives of Neurology*, 66(9), 1139–1143
3. Browne, P., Chandraratna, D., Angood, C., Tremlett, H., Baker, C., Taylor, B. V, and
4. Thompson, A. J., (2014), Atlas of Multiple Sclerosis 2013: A growing global problem with widespread inequity. *Neurology*, *83*(11), 1022–1024.
5. Minden, S. L., Frankel, D., Hadden, L. S., Srinath, K. P., and Perloff, J. N. (2004), Disability in elderly people with multiple sclerosis: An analysis of baseline data from the Sonya Slifka Longitudinal Multiple Sclerosis Study, *NeuroRehabilitation*, 19(1), 55–67.
6. Jahromi, S. R., Toghae, M., Jahromi, M. J. R., and Aloosh, M., (2012), Dietary pattern and risk of multiple sclerosis, *Iranian Journal of Neurology*, 11(2), 47–53.
7. Goldenberg, M. M., (2012), Multiple sclerosis review. P & T: *A Peer-Reviewed Journal for Formulary Management*, 37(3), 175–184.
8. 7.Bjørnevik, K., Chitnis, T., Ascherio, A., and Munger, K. L., (2017), Polyunsaturated fatty acids and the risk of multiple sclerosis, *Multiple Sclerosis Journal*, 23(14), 1830–1838.
9. Bäärnhielm, M., Olsson, T., and Alfredsson, L., (2014), Fatty fish intake is associated with decreased occurrence of multiple sclerosis. *Multiple Sclerosis Journal*, 20(6), 726–732.

10. Tremlett, H. L., Luscombe, D. K., and Wiles, C. M., (1998), Use of corticosteroids in multiple sclerosis by consultant neurologists in the United Kingdom. *Journal of Neurology, Neurosurgery, and Psychiatry*, 65(3), 362–365.
11. Mohajan, D., & Mohajan, H., (2023), A Study on Body Fat Percentage for Physical Fitness and Prevention of Obesity: A Two Compartment Model. *Journal of Innovations in Medical Research*, 2(4), 1-10.
12. Pilutti, L. A., and Motl, R. W., (2019), Body composition and disability in people with multiple sclerosis: A dual-energy x-ray absorptiometry study. *Multiple Sclerosis and Related Disorders*, 29, 41–47.

HARMONIZING HEALTH: THE ONE HEALTH APPROACH FOR GLOBAL SECURITY AND SUSTAINABLE FOOD SYSTEMS

Shital Chopde, M. R. Jawale, A.P. Dhok, P.R. Suryawanshi & P. V. Nandedkar

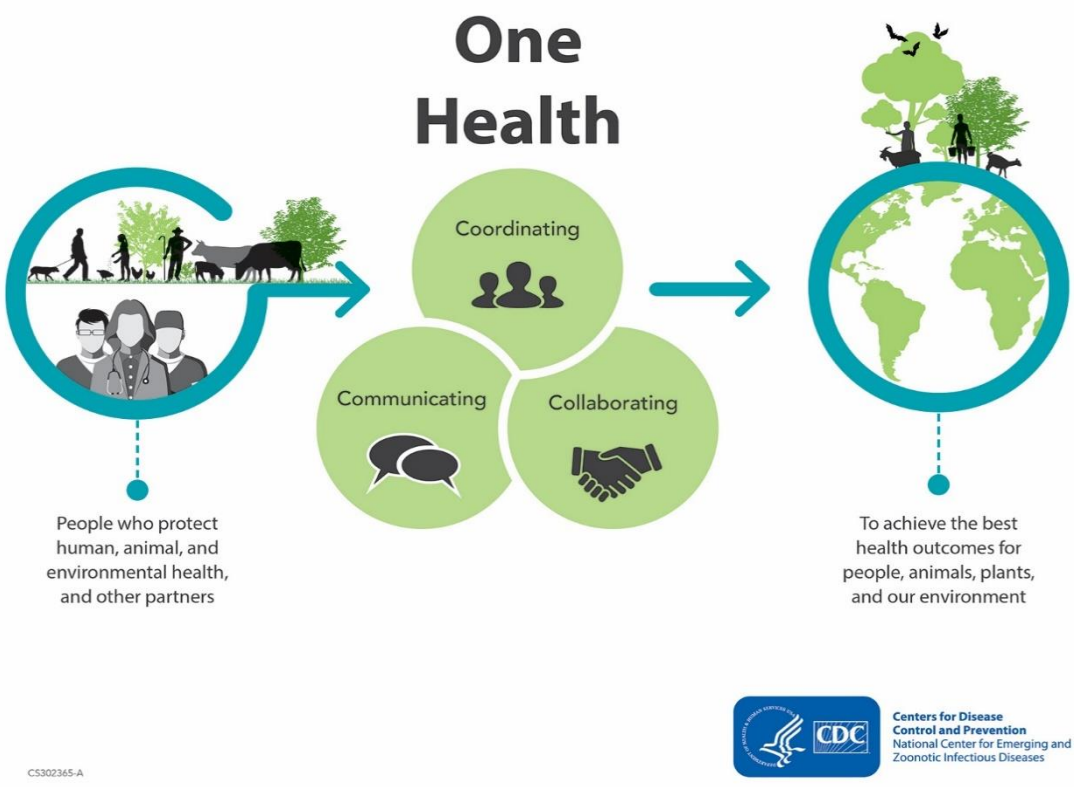
Maharashtra Animal and Fishery Sciences University, Nagpur

Abstract

The book chapter explores the interconnectedness of human, animal, and environmental health through the lens of the One Health approach. Originating in the early 19th century and gaining momentum in response to emerging infectious diseases and antimicrobial resistance, One Health is a collaborative and interdisciplinary strategy that addresses health issues at the interface of these domains for optimal health outcomes. The chapter discusses the importance of One Health in understanding global health security and the interconnectedness of human, animal, and environmental health. It examines the threats posed by zoonotic diseases and the challenges in predicting, detecting, and mitigating their impact. Case studies and success stories illustrate the tangible benefits of One Health in disease prevention and control. Moreover, the chapter addresses policy implications, challenges, and future directions for One Health. It emphasizes the need for interdisciplinary collaboration, sustainable funding, and addressing social determinants of health to overcome challenges and achieve sustainable development goals. In conclusion, the chapter underscores the vital role of the One Health approach in addressing complex health challenges, safeguarding ecosystems, and enhancing global prosperity. Through continued commitment to One Health principles and collaborative action, we can build a healthier, more resilient world for all.

Introduction

The One Health approach is a collaborative and interdisciplinary strategy that recognizes the interconnectedness of human, animal, and environmental health (CDC, 2021). Rapid climate and environmental changes have led to the emergence and re-emergence of infectious and non-infectious diseases [Figure 1]. It emphasizes addressing health issues at the interface of these domains for optimal health outcomes (WHO, 2021). Originating in the early 19th century, One Health gained momentum in the 21st century in response to emerging infectious diseases and antimicrobial resistance (CDC, 2021).



One Health acknowledges that factors like urbanization, deforestation, and globalization contribute to disease emergence. Stakeholders from various sectors collaborate to address these health issues. Zoonotic diseases like Ebola and COVID-19 highlight the interconnectedness of health across species (WHO, 2021). Environmental degradation exacerbates health risks for humans and animals, emphasizing the importance of environmental conservation (AVMA, 2021). One Health has gained traction as a framework for addressing emerging health threats and promoting sustainable development. Organizations worldwide increasingly embrace One Health principles to combat infectious diseases and ensure food security (WHO, 2021).

Understanding Global Health Security:

Global health security aims to prevent, detect, and respond to health threats crossing borders (Katz et al., 2017). It includes initiatives to safeguard against infectious diseases and biological threats (WHO, 2021). Emerging pandemics like Ebola, Zika, and COVID-19 underscore the need for coordinated global action (Gostin et al., 2014).

Efforts focus on enhancing surveillance, laboratory capacity, and public health infrastructure (Katz et al., 2017). International collaboration is vital for sharing information and resources (Gostin et al., 2014). The WHO leads initiatives like the International Health Regulations and Global Outbreak Alert and Response Network (WHO, 2021). COVID-19 emphasizes the need for a multi-sectoral approach to health security.

Collaboration across disciplines and sectors is crucial to address root causes and build resilient health systems (Katz et al., 2017). In conclusion, global health security is vital for

protecting global populations. Strengthening surveillance, response capacity, and collaboration can mitigate health threats and build a resilient global health system.

The Role of Sustainable Food Systems in Public Health:

Sustainable food systems are integral to public health, ensuring access to safe, nutritious food while minimizing environmental impact. Emphasizing the link between food, health, and the environment, there's a global shift toward sustainability (Willett et al., 2019).

Central to sustainable food systems is food security, ensuring access to safe, nutritious food for all. This involves addressing factors like availability, affordability, and sustainability in food production (FAO, 2020). These systems promote dietary diversity, reducing the risk of diet-related diseases like obesity and diabetes (Willett et al., 2019). They prioritize food safety throughout the supply chain, implementing standards to prevent contamination (Hawkes et al., 2017).

By minimizing environmental impact, sustainable food systems support practices like organic farming and sustainable fisheries management. They also enhance social equity by supporting smallholder farmers and local food systems (FAO, 2019). In conclusion, sustainable food systems are crucial for public health and global development, ensuring access to nutritious food while promoting environmental sustainability and social equity.

Interconnectedness of Human, Animal, and Environmental Health:

The interconnectedness of human, animal, and environmental health underscores the importance of the One Health approach in addressing complex health challenges (Grace et al., 2014). Approximately 60% of all known infectious diseases and 75% of emerging infectious diseases are zoonotic, highlighting the need for a collaborative and interdisciplinary strategy (World Health Organization, 2020).

The "One Health triad" emphasizes the interdependence of human, animal, and environmental health, recognizing that disruptions in one domain can impact the others (Kahn et al., 2017). Changes in land use, habitat destruction, and human activities like industrial agriculture can lead to increased interactions between humans, animals, and wildlife, facilitating the transmission of zoonotic diseases (Jones et al., 2013).

Domestic animals and wildlife can serve as sentinels for environmental health threats, offering early warning signs of contamination or ecosystem disturbances that may affect human health (World Health Organization, 2020). Effective management of zoonotic diseases requires an interdisciplinary approach that integrates knowledge from multiple disciplines, including human and veterinary medicine, ecology, and public health (Kahn et al., 2017).

Zoonotic Disease Threats and Challenges:

Zoonotic diseases pose significant threats to public health, food security, and global stability (Taylor et al., 2001). Factors such as population growth, urbanization, and globalization contribute to their emergence and spread (Jones et al., 2008). Challenges include predicting and detecting emerging pathogens, addressing antimicrobial resistance, and

mitigating health disparities among vulnerable populations (WHO, FAO, & OIE, 2018; Cleaveland et al., 2017; Hoelzer et al., 2017; Welburn et al., 2015).

A One Health approach offers a comprehensive strategy for preventing and mitigating the impact of zoonotic diseases (Atlas, 2013). By fostering collaboration among stakeholders, implementing surveillance systems, and promoting responsible antimicrobial use, we can safeguard public health and food security worldwide.

The implementation of One Health strategies involves collaborative efforts across various sectors to address health challenges at the human-animal-environment interface (Mariner et al., 2012). By emphasizing the interconnectedness of health systems, this approach aims to combat emerging infectious diseases and other health threats effectively (World Health Organization, 2019).

Case studies and success stories

The case studies and success stories illustrate the effectiveness of One Health strategies in disease prevention and control (Lembo et al., 2012). For instance, coordinated vaccination campaigns and surveillance efforts have led to the eradication of rinderpest, showcasing the impact of integrated interventions (Mariner et al., 2012).

Similarly, collaborative vaccination programs targeting both domestic animals and wildlife reservoirs have contributed to the control of rabies in several regions (Lembo et al., 2012). Additionally, improvements in food safety practices along the food chain have reduced the burden of foodborne diseases, highlighting the benefits of One Health interventions (Grace et al., 2015).

Policy Implications

Policy implications underscore the importance of coordinated action to address complex health challenges (Gibbs et al., 2014). Effective policies should facilitate interdisciplinary collaboration, data sharing, and early warning mechanisms to detect and respond to health threats promptly (World Health Organization, 2020).

International collaboration is essential for implementing One Health strategies and addressing global health challenges (Keusch et al., 2017). Initiatives such as the Global Health Security Agenda aim to build capacity and enhance coordination among countries to prevent, detect, and respond to infectious disease threats (WHO, 2019).Looking ahead, the future of One Health lies in advancing interdisciplinary collaboration, leveraging technology, and addressing emerging challenges (King et al., 2021).

Challenges Ahead:

Despite the potential benefits of the One Health approach, several challenges remain in its implementation. One challenge is the need for enhanced coordination and communication among diverse stakeholders, including policymakers, researchers, and community members (Vandersmissen et al., 2020). Overcoming disciplinary silos and fostering a culture of collaboration is essential for addressing complex health issues.

Additionally, ensuring sustainable funding and resource allocation for One Health initiatives poses a significant challenge. Limited financial resources and competing priorities may hinder the implementation of integrated health programs and research efforts. Moreover, addressing social and cultural factors that influence health behaviors and practices is essential for the success of One Health interventions. Engaging communities, promoting health literacy, and addressing disparities in access to healthcare are critical for achieving equitable health outcomes.

In conclusion, the One Health approach is essential for addressing the interconnected health challenges facing our planet. By recognizing the interdependence of human, animal, and environmental health, and integrating diverse disciplines and sectors, we can enhance global health security, achieve sustainable development goals, and ensure food security.

The implementation of One Health strategies requires interdisciplinary collaboration, innovative research, and effective policy interventions. Through case studies and success stories, we have seen the tangible benefits of One Health in disease prevention and control, highlighting the importance of integrated approaches in mitigating health risks. However, challenges persist, including the need for improved coordination, sustainable funding, and addressing social determinants of health. Overcoming these challenges requires collective action, strengthened partnerships, and a commitment to promoting health equity and resilience.

Looking ahead, the future of One Health lies in advancing education and training, leveraging technology and data analytics, and fostering international collaboration. By addressing emerging challenges and harnessing opportunities for innovation, we can build a healthier, more resilient world for generations to come.

In summary, the One Health approach offers a holistic framework for promoting health and well-being, safeguarding ecosystems, and enhancing global prosperity. Through continued commitment to One Health principles and collaborative action, we can address complex health challenges and achieve sustainable development for all.

References

1. American Veterinary Medical Association (AVMA). (2021). One Health Initiative.
2. Atlas RM. One Health: its origins and future. *Curr Top Microbiol Immunol*. 2013; 365:1-13.
3. Centers for Disease Control and Prevention (CDC). (2021). One Health.
4. Cleaveland, S., Sharp, J., Abela-Ridder, B., Allan, K. J., Buza, J., & Crump, J. A. (2017). One Health contributions towards more effective and equitable approaches to health in low- and middle-income countries. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 372(1725), 20160168.
5. FAO. (2019). Sustainable Food Systems.
6. FAO. (2020). Food security. Gibbs, E. Paul J., et al. (2014). Emerging Infectious Diseases: The Role of Social Sciences. *The Lancet*, 384(9937), 1694-1696.
7. Godfroid, J., Käsbohrer, A., & Schelling, E. (2013). Brucellosis in Extensively Managed Livestock in Tajikistan. *One Health Newsletter*, 6(1), 12–15.

8. Gostin, L. O., Friedman, E. A., & Wetter, S. A. (2014). The future of the World Health Organization: lessons learned from Ebola. *JAMA*, 312(13), 1295-1296.
9. Grace, D., Mutua, F., Ochungo, P., Kruska, R., Jones, K., Brierley, L., Lapar, L., et al. (2014). Mapping of Poverty and Likely Zoonoses Hotspots. Zoonoses Project 4. *Report to the UK Department for International Development. Nairobi, Kenya: ILRI*.
10. Hawkes, C., Ruel, M., Salm, L., Sinclair, B., & Branca, F. (2017). Double-duty actions: seizing programme and policy opportunities to address malnutrition in all its forms. *The Lancet*, 395(10218), 142-155.
11. Hoelzer, K., Wong, N., Thomas, J., Talkington, K., Jungman, E., Coukell, A., & Sargeant, J. M. (2017). Antimicrobial Drug Use in Food-Producing Animals and Associated Human Health Risks: What, and How Strong, Is the Evidence? *BMC Veterinary Research*, 13(1), 211.
12. Hotez, P. J. (2019). Neglected Tropical Diseases in the Anthropocene: The Cases of Zika, Ebola, and Other Infections. *PLoS Neglected Tropical Diseases*, 13(12), e0007155.
13. Jones, K. E., Patel, N. G., Levy, M. A., Storeygard, A., Balk, D., Gittleman, J. L., & Daszak, P. (2008). Global Trends in Emerging Infectious Diseases. *Nature*, 451(7181), 990–993.
14. Kahn, L. H., Kaplan, B., Steele, J. H., & Conolly, M. A. (2017). One Health in Action. In L. H. Kahn, B. Kaplan, J. H. Steele, & M. A. Conolly (Eds.), *The Need for an Integrated and Fully Operational One Health Approach* (pp. 1–17). Springer.
15. Keusch, G. T., Pappaioanou, M., Gonzalez, M. C., & Scott, K. A. (2017). One Health: Past Successes and Future Challenges in Three Global Health Areas. *PLoS Neglected Tropical Diseases*, 11(5), e0005444.
16. King, L. J., Anderson, L. R., Blackmore, C. G., Blackwell, M. J., Lautner, E. A., Marcus, L. C., Meyer, T. E., et al. (2021). One Health Education in Veterinary Medicine and Public Health: Collaboration for the Future. *Journal of Veterinary Medical Education*, 48(3), 183-191.
17. Lembo, T., Attlan, M., Bourhy, H., Cleaveland, S., Costa, P., De Balogh, K., Dodet, B., et al. (2016). Sustainable One Health Operational Framework for Global Disease Detection. *Emerging Infectious Diseases*, 19(12), e130-131.
18. Mariner, J. C., Karesh, W. B., & Corwin, M. P. (2012). One Health: A Multisectoral Approach to Emerging Diseases. *Ecohealth*, 9(3), 228-230.
19. Taylor, L. H., Latham, S. M., & Woolhouse, M. E. (2001). Risk Factors for Human Disease Emergence. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 356(1411), 983–989.
20. Vandersmissen, A., Welburn, S. C., & McKinley, T. J. (2020). One Health in Practice: A Critical Reflection of a Multisectoral Collaboration Project to Control Anthrax in Western Uganda. *Social Science & Medicine*, 265, 113480.
21. Welburn, S. C., Beange, I., & Ducrotoy, M. J. (2015). Okello, A. L., The Neglected Zoonoses—The Case for Integrated Control and Advocacy. *Clinical Microbiology and Infection*, 21(5), 433-443.
22. World Health Organization (WHO). (2019). One Health.
23. World Health Organization. (2020). Zoonoses.

24. World Health Organization, Food and Agriculture Organization of the United Nations, & World Organisation for Animal Health. (2018). Monitoring Global Progress on Addressing Antimicrobial Resistance: Analysis Report of the Second Round of Results of AMR Country Self-Assessment Survey. World Health Organization.
25. World Health Organization. (2021). Global Health Security.

QUALITY EVALUATION OF DIGESTIVE COOKIES USING JACKFRUIT SEED FLOUR AND FINGER MILLET FLOUR

Subha.R[1], Pooja.A[2]

[1]Assistant Professor, [2]II M.Sc. Student, Department of Home Science, V.V. Vanniaperumal College for Women, Virudhunagar, Tamil Nadu, India.

subha@vvvcollege.org, **22702211@vvvcollege.org**

Abstract

Food is a primordial need for our survival and wellbeing. Lifestyle diseases are increase in frequency as countries become more industrialized. Recently, dietary fibres are being studied comprehensively to understand its role in prevention of heart diseases, obesity, diabetes, cancer, etc. Dietary fibres reduce serum LDL cholesterol and blood pressure preventing heart diseases. Dietary fibre consumption also helps in reducing BMI via inducing satiety signals and provides bulking effect. Both finger millet and jackfruit seed flour are rich sources of dietary fibre. Jackfruit seeds are edible fruits that grow inside jackfruit, used in various Asian dishes. Jackfruit seeds are underutilized and less acknowledged by people but has considerable nutritional benefits such as low calories, high dietary fibre, low water and fat-absorption capacities which helps to prevent weight gain. Digestive cookies were prepared by replacing wheat flour with jackfruit seed flour and finger millet in different ratios 25/75, 50/50 and 75/25 with 100% wheat flour cookies as control. The proximate, physical and sensory properties of the cookie samples were evaluated using standard laboratory procedures. The cookies with 50% jackfruit seed flour and 50% finger millet flour had higher sensory scores. The cookies developed with jackfruit seed flour and finger millet possess better nutraceutical appeal, leading to increased consumer acceptability.

Keywords: *Jackfruit seed flour, finger millet flour, dietary fibre, cookies.*

Introduction

Modern consumers are increasingly interested in their personal health and expect the foods eat to be beyond tasty and attractive also safe and healthy. As interest in the link between diet and health gathers pace, many consumers seek ways to feel well and stay healthy by eating nutritionally designed foods. Supported by extensive scientific research today, health products continue to stimulate great interest and demonstrate potential for future growth (1).

Finger millet, Eleusine coracana Garten L., is a cereal grown for food in Africa and Southern Asia, mainly India (the states of Uttar Pradesh, Bihar, Tamil Nadu, Karnataka, and

Andhra Pradesh) and Nepal (3). Finger millet (*Eleusine coracana*), one of the minor cereals, known for several health benefits and some of the health benefits are attributed to its polyphenol and dietary fibre contents. It is an important staple food in India for people of low-income groups (2). Finger millet is reported to have anti-ulcerative properties and finger millet diets lowered blood glucose and cholesterol in diabetic rat models. Finger millet seed coat matter which is a rich source of dietary fibre and phenolic compounds were found to exhibit blood glucose and cholesterol lowering, nephroprotective and anti-cataract genic properties in streptozotocin induced diabetic rat models. Finger millet extracts were also reported to possess free radical scavenging, anti-protein glycation, anti-cataract genic and antimicrobial properties in 'in vitro'. Regular consumption of finger millet is known to reduce the risk of diabetes mellitus and gastrointestinal tract disorders (7).

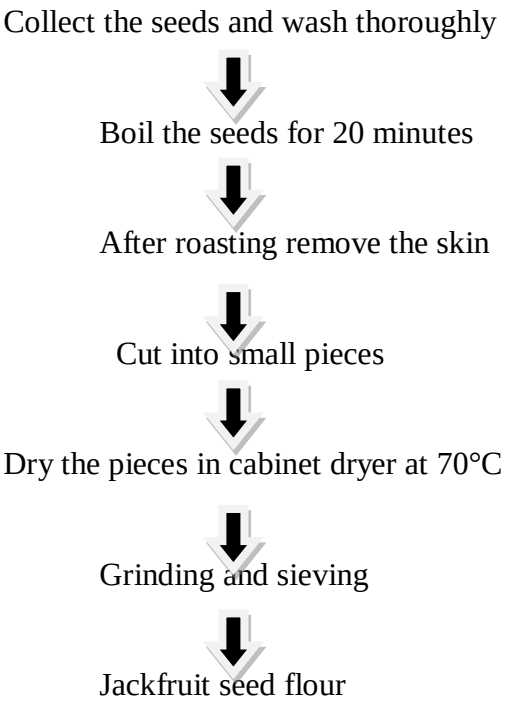
The Jackfruit (*Artocarpus heterophyllus)* is a well-known fruit in many Asian countries. Jackfruit seeds are underutilized and less acknowledged by people, but they have considerable nutritional benefits and can be considered as a potential functional food ingredient. The phytonutrients such as lignans, saponins, and isoflavones present in the seeds, plays beneficial role in human health). The addition of the jackfruit seed flour to deep-fried products results in a reduction in fat absorption up to a certain limit. The seeds are rich in dietary fibre and B-complex vitamins and due to their high fibre content, they help lower the risk of heart disease, prevent constipation and promote weight loss. Jackfruit seeds also contain resistant starch, which controls blood sugar and keeps the gut healthy. Jackfruit seeds possess anti-microbial activity, which prevents foodborne diseases (9). Cookies are Ready-To-Eat (RTE), convenient, inexpensive and shelf-stable food products for all age groups. Cookies hold an important position in the snack food industry due to variety in taste, crispiness and digestibility (4). Cookies are widely accepted and consumed by almost all profiles of consumers from many countries and therefore offer a valuable supplementation vehicle for nutritional improvement (1).

Methodology

1. Collection of materials

Good quality functional ingredient jackfruit seed was selected for the study. Raw jackfruit seed were purchased from local market in Virudhunagar. Other raw materials such as finger millet, butter, salt, jaggery and baking powder were purchased from local market in Virudhunagar and stored in good conditions.

2. Preparation of jackfruit seed flour



3. Nutritional composition: (values per 100g)

Nutrients	Finger millet flour	Jackfruit seed flour
Carbohydrates(g)	72	25.7-38.4
Protein(g)	7.3	6.6-7.04
Fat(g)	1.3	0.40-0.43
Calcium(mg)	344	50.0
Iron(mg)	3.9	1.5
Phosphorus(mg)	283	38.0-97.0

Source: (Mushtari et al., 2017), (6)

4 Preparation of jackfruit seed flour and finger millet incorporated digestive cookies

Plain cookies were prepared from wheat flour as per standard recipe and treated as control sample. The jackfruit seed flour was incorporated in finger millet flour at different levels (25/75, 50/50, 75/25). The cookies were prepared by using the following ingredients such as flour, butter, jaggery, baking powder and salt. The butter was creamed with jaggery until it became fluffy, this was then followed by adding dry ingredients (salt, baking powder and flour). The dough was thoroughly kneaded for four minutes and then rolled manually to thickness of 1cm using rolling pin. The sheeted dough was cut with a 4.5 cm diameter cookie cutter. All shaped dough was baked on greased tray for 15 minutes at 150°C in an oven. The cookies were cooled at room temperature for 30 minutes before packing in an airtight plastic container prior to analysis.

5. Physical parameters of digestive cookies

The cookies were selected randomly for physical analysis (weight loss, diameter, thickness, and spread ratio). The weight of the cookies before and after baking was taken to calculate weight loss. The height and diameter were measured with a caliper before and after baking. To determine the diameter of cookies, four samples were placed next to another and the total diameter was measured. All the cookies were rotated at an angle 90° and the new diameter was measured, this was then repeated for angles of 180, 270, and 360°. The average of diameter was recorded. Thickness of the cookies was measured by four cookies stacking above the others restacking four times. The average of thickness was recorded. The spread ratio was calculated by dividing diameter of cookies with thickness of cookies (10).

6. Organoleptic evaluation of digestive cookies

For evaluating sensory characteristics, the three different ratios of the jackfruit seed flour and finger millet flour incorporated digestive cookies were assessed by 10 panel members. The panelist was asked to determine the sensory evaluations on the basis of 5-point hedonic scale such as appearance, colour, flavour, taste and texture. The overall acceptability was evaluated by the mean score all the attributes.

Results and Discussion

Table 1-Physical properties of digestive cookies

Samples	Weight(g)			Diameter(mm)			Thickness(mm)			Spread ratio		
	V1	V2	mean	V1	V2	mean	V1	V2	mean	V1	V2	Mean
Control	14	13	13.5	50	49	49.5	10	10	10	11.1	8.8	9.95
Sample A	15	16	15.5	50	50	50	5	7	6	11.1	11.1	11.1
Sample B	16	14	15	48	47	47	5	8	6.5	6.6	2.2	4.4
Sample C	12	13.5	13.25	46	48	48	10	10	10	2.2	11.1	6.65

The physical properties (weight, diameter, thickness and spread ratio) of cookies are tabulated. The cookies with 25% jackfruit seed flour and 75% finger millet flour (Sample A) had significantly greater size, weight and they exhibited a higher spread ratio compared to other samples. The cookies with 75% jackfruit seed flour and 25% finger millet flour (Sample C)had greater thickness compared to other samples. Regarding the shape of the cookies sample with 50% jackfruit seed flour and 50% finger millet flour (Sample B) and 75% jackfruit seed flour and 25% finger millet flour (Sample C)found to exhibit reduced spread ratio and diameter. The

variations in jackfruit seed flour incorporation shows significant changes in the physical properties of digestive cookies

Sensory Evaluation of Jackfruit Seed Flour and Finger Millet Flour Incorporated Digestive Cookies

Cookies were subjected to sensory evaluation by 10 panel members and the mean score were obtained and analysed statistically.

Table 2-Mean scores obtained in the sensory evaluation of jackfruit seed flour and finger millet flour incorporated digestive cookies

Characteristics	Control	Sample A	Sample B	Sample C
Color	4±0.15	3.9±0.4	4.72±0.09	4.2±0.25
Flavor	4±0.15	4±0.27	4.74±0.09	4±0.41
Taste	4.1±0.24	3.9±0.4	4.66±0.09	4±0.35
Texture	4.2±0.25	4±0.27	4.56±0.16	4.2±0.2
Overall acceptability	4±0.41	3.9±0.33	4.8±0.12	4.1±0.36

The digestive cookies were prepared by substituting jackfruit seed flour and finger millet flour in different ratios (25:75, 50:50, and 75:25) with 100% wheat flour cookies as a control. The cookies prepared with a 50:50 ratio of jackfruit seed flour (sample B) was found to be acceptable in sensory evaluation.

Conclusion

Cookies are widely accepted and consumed by almost all profiles of consumers also hold an important position in the snack food industry due to variety in taste, crispiness and digestibility and therefore offer a valuable supplementation vehicle for nutritional improvement. The results of this study indicate that there is significant difference between sample A with the terms of diameter, thickness and spread ratio. Sample B was highly accepted in organoleptic

evaluation. The underappreciated jackfruit seeds and finger millets emerge as innovative functional food in future.

References

1. Arshad, M. U., Anjum, F. M., & Zahoor, T. (2007). Nutritional assessment of cookies supplemented with defatted wheat germ. *Food Chemistry*, 123–128
2. Devi, P. B., Vijayabharathi, R., Sathyabama, S., Malleshi, N. G., & Priyadarshini, V. B. (2014). Health benefits of finger millet (Eleusine coracana L.) polyphenols and dietary fibre: a review. *Journal of food science and technology*, *51*, 1021-1040
3. Dida, M. M., & Devos, K. M. (2006). Finger millet. In *Cereals and millets* (pp. 333-343). Berlin, Heidelberg: Springer Berlin Heidelberg
4. Kulkarni, D. B., Sakhale, B. K., & Chavan, R. F. (2021). Studies on development of low gluten cookies from pearl millet and wheat flour. *Food Research*, *5*(4), 114-119.
5. Mushtari, B. J., Shamshad, B. S., Vidya, K., Sahoo, M., & Vijayakumari, J. (2017). Nutritional evaluation of decorticated finger millet (Finger millet-Rice) and its diversified nutri-rich products. *International Journal of Complementary and Alternative Medicine*, *7*(6), 00244
6. Rukshana, M. R. F., & Jemziya, F. (2023). Development and quality assessment of composite string hoppers developed by using the jack seed flour (artocarpus heterophyllus L.) and the rice flour (oryza sativa).
7. SK, M., & Sudha, K. (2012). Functional and phytochemical properties of finger millet (Eleusine coracana L.) for health. *International journal of pharmaceutical, chemical and biology sciences*, *2*(4), 431-438.
8. Tuhoy, K.M., Probert, H. M., Smejkal, C.W., and Gibson, G.R. (2003). Using probiotics and prebiotics to improve gut health. *Drug Discovery Today*, 8(15), 692-700.56
9. Waghmare, R., Memon, N., Gat, Y., Gandhi, S., Kumar, V., & Panghal, A. (2019). Jackfruit seed: an accompaniment to functional foods. *Brazilian Journal of Food Technology*, *22*, e2018207
10. Zoulias, E. I., Piknis, S., & Oreopoulou, V. (2000). Effect of sugar replacement by polyols and acesulfame-K on properties of low-fat cookies. *Journal of the Science of Food and Agriculture*, 2049–2056

DEVELOPMENT AND STANDARDISATION OF RAGI INCORPORATED COTTON SEED MILK

Jeevarathinam.A[1], Bharathi.M[2], Gumutha Sri.K[2], Malathi.A[3] and Mugitha.R[3]

[1]Assistant Professor, [2]II M.Sc. Students, [3]III B.Sc. Students, Department of Home Science, V.V.Vanniaperumal College for Women, Virudhunagar.

Abstract

Ragi, also known as finger millet, is a nutritious cereal crop that is widely grown in India and Africa. It is rich in protein, calcium, phosphorus, iron, fiber and vitamin content. Its gluten free nature and low glycemic index make it suitable for regular consumption, promoting digestive health and overall well-being. Ragi is considered as a great food option for infant and young kids to regulate their bowel movements. Cotton seed milk helps to flush out bad cholesterol, helps in maintaining blood pressure, helps in healing, prevents cancer and improves blood circulation and digestion. Keeping these facts in view, the present investigations was carried out to formulate cotton seed milk blended with protein rich ragi flour. The ragi was first germinated for 24 hrs. 48 hrs., 72 hrs. and 96 hrs. The protein content of germinated flours were compared. The germinated flour which contained high protein content was selected for the product development. The selected ragi flour was incorporated to the cotton seed milk in different variations (25%, 50%, 75%, and 100%). From the present study, it was concluded that 25% ragi flour incorporated cotton seed milk was selected by the organoleptic evaluation.

Key words: ragi, cotton seed milk, germinated.

Introduction

Finger millet (Eleusine coracana L.) is also known as ragi and in India. It is a good source of nutrients especially of calcium, iron, phosphorus, zinc, potassium, other minerals, fiber and variety of phenolic compounds which may have health benefits. Polyphenols has been known to impart antimicrobial, anti-diabetic, antimutagenic properties. Germination is an inexpensive and simple method of improving nutritive value of legumes. It considered a potentially process for legumes seed transformation which may decreases undesirable components such as alkaloids and phytates increase nutrition quality. (Muquiz and oboh et al., 1998). This sprouting method was reported to be more superior to any of the processing method. Sprouting process is known as a way to promote changes in the biochemical, sensual and nutritional characteristics of cereal grains. (Masood et al, 2014). According to World Health Organization (WHO), Malnutrition refers to deficiencies, excesses or imbalances in person's intake of energy and or nutrients (Amudha. J, 2018). Cotton seed milk is mostly used in India among south India where they are traditionally used in various household as welcome drink (k.Jeshi, 2018). It is popularly known as Paruthi Paal (Paruthi means cotton seed and Paal means milk). Cotton seed milk is considered as "triple-nutrient" as it is a very rich source of protein, essential fatty acids and

sugars. It is helpful in flushing out bad cholesterol, in improving blood circulation and digestion, reduces body heat, good function of pancreas, bone marrow and nervous system (Amudha, J, 2018). So keeping paper was designed to incorporate this points in mixed the germinated finger millet into the cotton seed milk to promote the health of human being.

Methodology

Procurement of raw materials: Ragi flour, cottonseeds milk (Paruthi), rice flour, jaggery, cardamom powder, grated coconut, dry ginger powder.

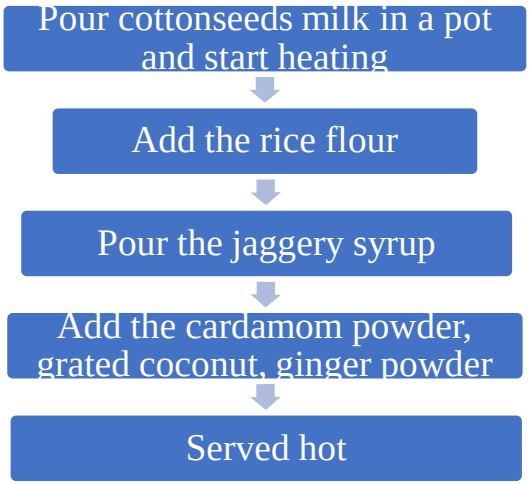
Germination of ragi seeds: The seed was washed and soaked by submerging the sample in distilled water in transparent container for 6 hours at room temperature. Thereafter, the seeds were taken out to a tray covered with a muslin cloth and kept in a room temperature after removing the adherent moisture with an absorbent cloth. The sample was allowed to germinated/sprout for 24 hrs. 48 hrs., 72hrs and 96 hrs. After overnight, the sprout were harvested and dried in an oven at 63^{o} C, processed into flour stored in an air tight container.

Analysis of protein content: Protein content of germinated flour Ragi flours were determine by AOAC standard procedure of Lowry's method.

Development of Ragi flour incorporated Paruthi paal: Ragi Paruthi paal were prepared using rice flour and germinated ragi flour in the ratio of 75:25, 50:50, 25:75 and 0:100 as sample A, B, C, D respectively. Cotton seed required for the study was obtained from the nearby market. The cotton seeds were soaked for 12 hours in water and it was drained. After the process it was grinded using the food processor and milk was removed using a stainless-steel strainer. The following proportions of finger millet flour and cotton seed milk was used in the preparation of ragi Paruthi paal.The control was prepared by using rice flour with cottonseed milk.

Table 1-Different proportions of germinate ragi incorporated paruthi paal

Trials	**Rice flour**	**Ragi flour**	**Paruthi paal**
Control	100 g	-	100 ml
Sample A	75 g	25 g	100 ml
Sample B	50 g	50 g	100ml
Sample C	25g	75 g	100ml
Sample D	-	100 g	100ml



Flow chart 1- Basic procedure for preparation of Paruthi paal

Results and Discussion

The finger millet was germinated for different time (24 hours, 48 hours, 72 hours, 96 hours). The impact of germination on protein content was evaluated and its depicts in the figure 1.

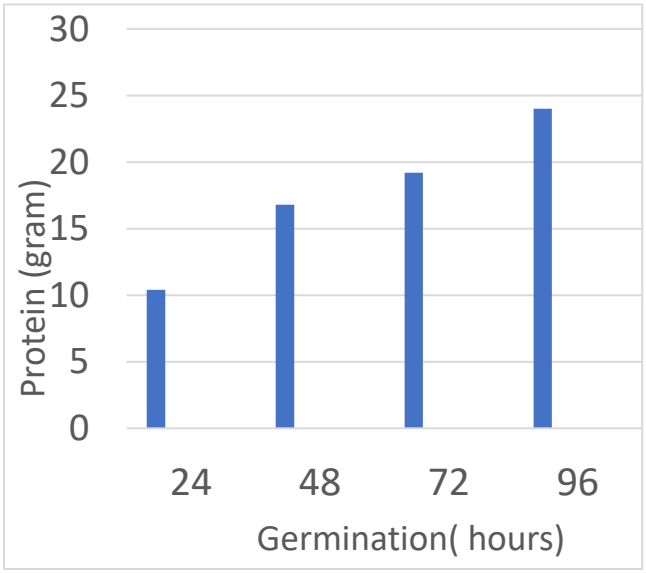


Figure 1- Effect of germination time on protein content of finger millet

The result revealed that the protein content in ragi flour was increased with the germination hours. So the 96 hours germination had higher protein content than the other germination hours.

Sensory evaluation of ragi incorporated paruthipaal

The sensory characteristics of finger millet incorporated Paruthipaal such as appearance (colour), flavour (Aroma), taste, texture and overall acceptability were evaluated by a panel. The ragi Paruthi paal prepared from different proportions of ragi flour, rice flour and cotton seed milk were subjected to sensory evaluation and scores recorded for different parameter.

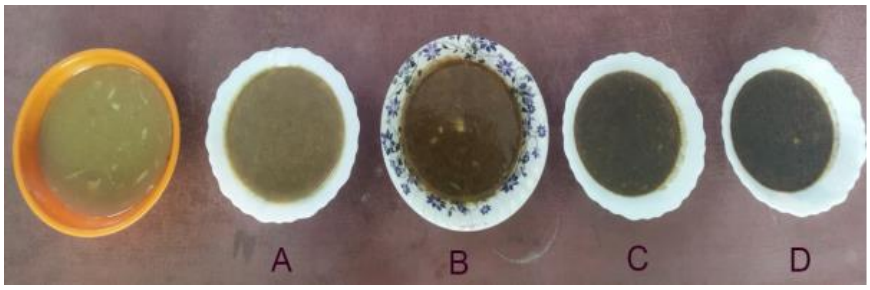


Table 2-Sensory scores of germinated ragi incorporated Paruthi paal

Sensory characteristics	Control	Sample A	Sample B	Sample C	Sample D
Colour	4.25±0.26	4.32±0.24	4.00±0.42	4.20±0.42	3.3±0.42
Flavour	4.15±0.26	4.10±0.32	4.10±0.45	3.85±0.42	3.5±0.42
Texture	4.30±0.25	4.20±0.42	4.77±0.42	3.45±0.36	2.85±0.36
Taste	4.22±0.24	4.11±0.34	4.66±0.35	3.85±0.48	3.1±0.48
Overall acceptability	4.35±0.24	4.72±0.59s	4.05±0.39	3.40±0.35	3.05±0.35

It was found that the sample A which has 75% rice flour and 25% germinated ragi flour was selected through sensory evaluation.

Conclusion

It was proved that germination allows the modification of the protein content and also enhancing the nutritive value of ragi flour. From the result it was proved that the ragi can include in the regular diet to enhance the nutritional benefits and to improve the nutrient availability.

References

1. Amudha, J. (2018), Cotton seed milk and its products. Cotton association of India, 1-3.
2. Dykes L, Rooney L. W. (2007), Phenolic compounds in cereals grains and their health benefits. *Cereal food world*. ; *52:105*-111.
3. Jeshi, k. (December 18). The taste of good health, The Hindu.

4. Kumar, M. (2019). Paruthi Paal, a nutrient-rich healthy drink from cotton seed: An Indian delicacy. Journal of Ethnic Foods, 6(1), 1–6.
5. Masood T, H, U, Shan and A. Zeb (2014). Effect of sprouting time on proximate composition and ascorbic acid level of mung bean and chick pea seeds. *The journal of animal & plant sciences*, 24(3), 850-859
6. Obab HA, Muzquiz M, (1998). Effect of germination on the inositol phosphate content and phytase activity in under- utilised legumes seed grown in Nigeria.

DEVELOPMENT AND STANDARDIZATION OF INSTANT SOUP MIX UISNG *MORINGA OLEIFERA* LEAVES POWDER

Balasaraswathi.S[1], Veera Jeyanthi.C[2]

[1]Assistant Professor, [2]II M.Sc. Student, Department of Home Science, V.V.Vanniaperumal College for Women, Virudhunagar, Tamil Nadu, India.

Abstract

In the Hurry burry life, everybody wants the food items which require less time for cooking and convenient for preparation, due to changing lifestyle, there is change in food habits of people. Instant soups play an important role in balancing the nutrients needed for people to stay healthy and can be used as an alternative breakfast food. This view paved the way to conduct the study on Development and Standardization of Instant Soup Mix using Moringa oleifera leaves powder" .Moringa oleifera (Moringaceae) is traditionally known as mystical miracle tree or 'The tree of life'. The leaves being the most nutritious part of the plant is a significant source of protein, fat, calcium, iron, copper, zinc, manganese and have high levels of Vitamin B, C, K and β-Carotene. Moringa oleifera is one of the best examples, which contains all essential nutrients, enzymes, omega oils, minerals, antioxidants and phytochemical compounds. The fresh Moringa oleifera leaves contain seven times more Vitamin C than in orange, four times more calcium than in milk, three times more iron than in spinach, three times more potassium than in banana, four times more Vitamin A than in carrot and proteins as much as in egg . In this study instant soup mix was developed with various ratios of moringa leaves powder. The developed instant soup mix were subjected to sensory evaluation to find out the overall acceptability of the sample.

Keywords: Instant soups, Moringa oleifera, antioxidants , phytochemical sensory evaluation.

Introduction

Moringa (*Moringa oleifera* Lam). Is a type of local medicinal Indian herb which has turn out to be familiar in the tropical and subtropical countries? The other terms used for Moringa are Horseradish tree, Mulangay, Mlonge, Benzolive, Drumstick tree, Sajna, Kelor, Saijihan and Marango. *Moringa oleifera* is shown in scientific division to become from Kingdom: Plantae, Division: Magnoliphyta, Class: Magnoliopsida, Order: Brassicales, Family: Moringaceae, Genus: Moringa, Species: M. oleifera (Fahey, 2005).

Moringa oleifera is one of the vegetables of the Brassica order and belongs to the family Moringaceae. The Moringaceae is a single genus family with 13 known species (Khawaja et al., 2010). *Moringa oleifera* is a small native tree of the sub-Himalayan regions of North West India, which is now indigenous to many regions in Africa, Arabia, South East Asia, the Pacific and Caribbean Islands and South America. Traditionally, besides being a daily used vegetable among people of these regions, the Moringa is also widely known and used for its health benefits. Among commoners, it has earned its name as 'the miracle tree' due to its amazing healing abilities for various ailments and even some chronic diseases. Several investigations were carried out to isolate bioactive compounds from various parts of the plant due to its various applications (Guevara et al., 1999). Therefore, herbal plants in medicine or known as phytomedicine are still trustworthy and widely applied as one of the alternative way in medicinal field due to its affordable cost (Abalaka et al., 2009).

For centuries and in many cultures around the world, the medicinal usage of the Moringa has been used to treat problems such as skin infections, anaemia, anxiety, asthma, blackheads, blood impurities, bronchitis, catarrh, chest congestion, cholera and many other illnesses (Khawaja et al., 2010; Hamza, 2010; Singh et al., 2012). *Moringa oleifera* also consists of anti-inflammatory, anti-pyretic, anti-ulcer, anti-epileptic, diuretic, cholesterol lowering, renal, anti-diabetic, (Paliwal et al., 2011; Sharma et al., 2012) and hepatoprotective activities (Lai et al., 2010; Huang et al., 2012). It has also long been labelled for its great cosmetic value in which in recent years, the Moringa has commonly been found to be used in various health care products including body and hair moisturisers and conditioners. It was also discovered that Moringa oil was used in skin ointments ever since the Egyptian times. The Moringa was claimed to be 'the most nutrient-rich plant yet discovered' by Khawaja et al. (2010).

Material and Methodology

Material

1. Collection of materials

Moringa oleifera were purchased from local market in Aruppukottai. The raw purchased *Moringa oleifera* were placed in a tray and the damaged drumstick leaves and with all other extraneous matter were removed by hand and washed with water. The tomato, onion, garlic, cumin, pepper, salt, corriander leaves, asafoetida, foxtail millet flour used for the development of value added *Moringa oleifera* soup mix food product.

2.Equipment used for Analysis

Weighting Balance

Figure 1-Digital weighing balance

3.Cabinet Dryer

Cabinet dryer was used to dry samples, functional raw materials and other supportive ingredients.

Figure 2- Cabinet Dryer

Methodology

Development and Standardization of Value Added *Moringa oleifera* soup mix Food Product

Value added product such as *Moringa oleifera* Instant Soup Mix were developed for this study. They are discussed under the following headings.

1. Preparation of value added *Moringa oleifera* instant soup mix food product

Moringa oleifera stem were chopped into an equal size. And, Cabinet dryer was used for dehydrate at 90oc for 5-6hr. And, other supportive ingredients were individually dehydrated in the dryer.

2. Ingredient used for the development and standardization of *Moringa oleifera*

Moringa oleifera instant soup mix was developed by trial and error method. For this study, three different samples such as A, sample B, sample C were developed by using *Moringa oleifera* in different ratio such as 5%, 10%, 15% respectively. Developed Moringa Soup Mix was subjected

to sensory evaluation to find out the overall acceptability of the sample. Control was prepared by using tomato and onion. Table 1 shows the ingredients used for the development of *Moringa oleifera* instant soup mix in varying proportions.

Table 1

Ingredient	**Control**	**Sample A**	**Sample B**	**Sample C**
Moringa oleifera	-	10 g	20 g	30 g
Tomato	30 g	20 g	10 g	5 g
Onion	20 g	20 g	20 g	10 g
Garlic	10 g	10 g	10 g	10 g
Cumin	6 g	6 g	6 g	6 g
Black pepper	10 g	10 g	10 g	10 g
Coriander Leaves	6 g	6 g	6 g	6 g
Turmeric	4 g	4 g	4 g	4 g
Asafetida	4 g	4 g	4 g	4 g
Corn flour	10 g	-	-	
Foxtail flour	-	10 g	10 g	10 g
Salt	To taste	To taste	To taste	To taste

Table 2 shows the ingredients used for the preparation of the *Moringa oleifera* Instant Soup Mix

3. Sensory evaluation of *Moringa oleifera* instant soup mix

The quality of food when assed by humans by means of sensory organs then it is said to be sensory evaluation. The sensory characteristics of the soup mix were subjected to sensory evaluation with the help of 10 panel members. The panelist was asked to determine the sensory attributes on the basis of 5 point Hedonic scale and they were scored on the basis of sensory qualities such as appearance, colour, taste, texture, odour. The overall acceptability was evaluated by the mean score of all attributes.

Figure 3-Prepared *Moringa oleifera* instant soup mix

Results and Discussion

The result and the discussion of the study on "Development and Standardized of Instant Soup Mix Powder using *Moringa oleifera* .

1. Sensory evaluation of the *Moringa oleifera*

Table 2-Mean scores of the development and standardization of *Moringa oleifera* instant soup mix

Characteristics	Control	Sample A	Sample B	Sample C
Flavour	4.2	4.6	3.8	4.1
Taste	4.4	4.8	3.6	4.2
Colour	4.5	4.8	3.9	4.4
Texture	4.5	4.9	3.4	4.2
Overall Acceptability	4.5	4.7	3.7	4.2

Table 2 shows the mean score of the development and standardization of instant soup mix using *Moringa oleifera* . Evaluation of the organoleptic attributes of the instant soup mix powder for colour, texture, flavour, taste and overall acceptability of 10% dehydrated *Moringa oleifera* was excellent with the mean score of 4.7 than the other two variations. Therefore, 10% *Moringa oleifera* instant soup mix powder was selected for futhur analysis.

Conclusion

In this study, the results illustrate that consuming of *Moringa oleifera* soup is good for health. *Moringa oleifera* is rich in vitamin C and vitamin E. *Moringa oleifera* is one of the best examples, which contains all essential nutrients, enzymes, omega oils, minerals, antioxidants and phytochemical compounds. The fresh *Moringa oleifera* leaves contain seven times more Vitamin C than in orange, four times more calcium than in milk, three times more iron than in spinach, three times more potassium than in banana, four times more Vitamin A than in carrot and proteins as much as in egg . In this study instant soup mix was developed with various ratios of moringa leaves powder.

References

1. Khatoniar, S., & Das, P. (2022). Millet based multigrain mix: its physico-chemical properties and value addition-a review. *Journal of Postharvest Technology*, 10 (3), 27-40.

2. Abdallah H M, El-Bassossy H, Mohamed GA, El-Halawany AM, Alshali K Z, Banjar Z M. (2016) Phenolics from *garcinia mangostana* inhibit advanced glycation endproducts formation: effect on amadori products, cross-linked structures and protein thiols. *Molecules*.21 (2):251.
3. Adekunle AA, Ellis-Jones J, Ajibefun I, Nyikal RA, Bangali S, Fatunbi AO, *et al*. Agricultural innovation in sub-Saharan Africa: Experiences from multiple stakeholder approaches. Accra, Ghana: *Forum for Agricultural Research in Africa* (FARA).
4. Agrawal R, Singh CK, Goyal A, editors. (2021) Advances in Smart Communication and Imaging Systems: Select Proceedings of MedCom 2020. *Springer Nature*.
5. Altintas O, Park S, Lee S J. (2016) The role of insulin/IGF-1 signaling in the longevity of model invertebrates, C. elegans and D. melanogaster. BMB reports. 29; 49 (2):81.
6. Brennan M A, Menard C, Roudaut G, Brennan C S. (2016) Amaranth, millet and buckwheat flours affect the physical properties of extruded breakfast cereals and modulates their potential glycaemic impact. Starch-Stärke. 64 (5):392-8.
7. Byrne N J, Rajasekaran N S, Abel E D, Bugger H. Therapeutic potential of targeting oxidative stress in diabetic cardiomyopathy.
8. Bora P, Ragaee S, Marcone M. Effect of parboiling on decortication yield of millet grains and phenolic acids and *in vitro* digestibility of selected millet products. *Food Chemistry*. 2019, 15; 274:718-25.

DEVELOPMENT AND STANDARDIZATION OF SATTU BASED FOOD PRODUCTS

Devi.T[1], Lakshana.K.P[2]

[1]Assistant Professor, [2]II M.Sc. Student, Department of Home Science, V.V.Vanniaperumal College for Women, Virudhunagar, Tamil Nadu, India

Abstract

Sattu is a traditional food in India. It is a mixture of roasted grains and nuts. A variety of sattu is prepared by people according to the ingredients prevalent in their area. In this study, three different types of sattu flour were prepared with different ingredients. Sample A was prepared using chick pea, wheat and jowar. Sample B was prepared using Bengal gram dhal, green gram dhal and ground nut. Sample C of sattu was made with bajra, barley and almonds. Sattu is a power house of energy and called as Poor man's protein. The millets added in the sattu mix are a great source of fiber and prevents constipation. It aids in weight loss and is a good source of antioxidants. It regulates blood pressure and is a great option for diabetics. It lowers cholesterol level and protects against heart diseases. The prepared sattu is used for the development of value added products i.e. Kebab and Kachori. The sensory evaluation of products was done to determine the consumer acceptability. The sattu products prepared using sample A was much liked by the untrained panel members as compared to the sattu products prepared from other samples.

Keywords: *sattu, value added products, sensory evaluation.*

Introduction

Traditional foods have played an important role in our diet for generations. Amongst various traditional foods, cereals and pulses based products still occupy an important place in diets of people particularly in developing countries (Mridhula *et al*, 2006). Sattu is a traditional food in India. It is roasted pulse or cereal flour and used as ready – to – eat (RTE) snack food in northern parts of India, particularly in rural areas. It is traditionally prepared from either roasted cereal particularly barley, maize or roasted bengal gram or combination of these (Singh *et al*, 2021). Roasting is a simple and more commonly used household and village level technology, which increases shelf life and acceptability of the products. Roasting improves the flavour, texture and nutritive value of the grains, eliminate most of anti-nutritional or toxic effects of grains, partially or wholly (Mridhula *et al*, 2006). Sattu is wonder flour preferred for its high fiber content and medium to low Glycaemic Index. High fiber foods normalize the bowel movement. The soluble fiber found in sattu may help lower

total blood cholesterol level and insoluble fiber, promote the movement of material through digestive system and increase stool bulk. Sattu can be consumed uncooked. The cooling properties of sattu make it a perfect summer choice. It is one of the highest sources of vegetarian proteins that is easily digestible and also of calcium and magnesium. As it provides iron too, it is very healthy option for anemia (Fatma *et al*, 2017*)*. Though traditional Sattu mix is already available an attempt was taken to prepare instant sattu mix using multigrain and pulses, which has the goodness of chick pea, barley, wheat, maize etc. These grains enhance the nutritional quality which reflects increased health benefit as compared to the traditional sattu (Shakeb *et al*, 2021).

The objectives of this study is

1. To prepare three different sattu mix samples using nutrient rich cereals, millets, pulses and nuts.
2. To develop and standardize sattu based food products i.e., kebab and kachori
3. To analyze the protein content of the sattu mix
4. To determine the phytochemicals present in the sattu mix

Methodology

A.Procurement of raw material

The ingredients such as chick pea, wheat, jowar, bengal gram dhal, green gram dhal, ground nut, bajra, barley and almonds were procured from local market of Virudhunagar.

Preparation of sattu mix

Table 1-Ingredients used for preparation of sattu mix

Sample A	**Sample B**	**Sample C**
Chick pea (25g)	Bengal gram dhal (35g)	Bajra (40g)
Jowar (35g)	Green gram dhal (40g)	Barley (35g)
Wheat (40g)	Ground nut (25 g)	Almond (25g)

The ingredients are roasted separately. The roasted ingredients of each sample is ground into fine powder and sieved.

Codeterminations of protein in the sattu mix

The protein content was estimated by Lowry method. The amount of protein present was calculated from the nitrogen concentration on the sample.

D. Phytochemical screening of the sattu mix

The qualitative analysis of phytochemicals like phenols, steroids, terpenoids and alkaloids were determined.

E. Development of sattu kebab

Generally, kebab is prepared based on the following procedure. In a mixing bowl, combine besan flour, mashed potatoes, finely chopped onions, green chilies, ginger-garlic paste, coriander leaves, and all the spices. Add lemon juice to the mixture. Mix all the ingredients thoroughly until well combined. Divide the mixture into small portions and shape them into kebabs. In a pan heat some cooking oil, and cook the kebabs until they are golden brown. In this study, keeping the sattu obtained from the local Anganwadis as control sample, the kebabs are prepared by substituting the three samples of prepared sattu flour instead of besan flour.

Figure 1-Sattu Kebab

F. Development of sattu kachori

Make a dough using 100g of maida. For the stuffing, in a pan heat oil and add asofoetida, cumin seeds, green chillies and ginger. Add 25g of the prepared sattu and sauté well. Add fennel, coriander and chilli powder, garam masala, salt. Split the dough into small balls and keep the stuffing in each dough. Fry the kachori in oil.

Figure 2-Sattu Kachori

Sensory evaluation of value added products

The sensory characteristics of sattu kebab and sattu kachori were subjected to sensory evaluation with the help of untrained panel members by using the 5- point hedonic scale to find out the overall acceptability of the sample. The panelists were asked to give scores for colour, flavor, texture, taste and overall acceptability. The scores of all attributes helped to find the best out of the three samples and control.

Statistical analysis of value added products

The mean value and standard deviation of value added products were analysed statistically by using Mean and Standard deviation.

Results and Discussion

A.Determination of protein in the sattu mix

The results of the protein analysis of the sattu mix are presented in the table 2

Table 2-Protein content of the sattu mix

CONTROL	SAMPLE A	SAMPLE B	SAMPLE C
23.2g	36g	66.4g	64.8g

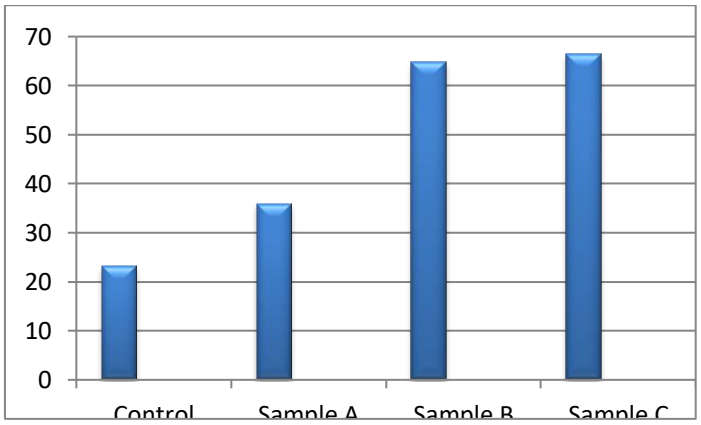


Figure 3-Protein content of the sattu mix

The results revealed that the protein content present in the Control, Sample A, Sample B, Sample C are 23.2g, 36g, 66.4g and 64.8g respectively. Among these Sample B which is made up of Bengal gram dhal, green gram dhal and groundnut has the highest protein content.

Phytochemical screening of the sattu mix

Qualitative analysis of the phytochemical content of the different sattu mix is presented in the table 3.

Table 3-Phytochemical analysis of the sattu mix

PHYTOCHEMICALS	CONTROL	SAMPLE A	SAMPLE B	SAMPLE C
Phenols	+	+	+	+
Steroids	+	-	+	+
Terpenoids	+	-	+	+
Alkaloids	-	-	-	-

Table 3 shows that the phytochemicals phenols are present in all the samples. Steroids and terpenoids are present in all samples except sample A. Alkaloids are absent in all the samples.

Sensory evaluation of the sattu kebab

The kebab developed by using different sattu samples was subjected to sensory evaluation by untrained panel members with the help of a 5-point hedonic scale. The mean scores obtained from statistical analysis are presented in the following Table 4.

Table 4-Sensory scores of the sattu kebab

Sensory characteristics	Control	Sample A	Sample B	Sample C
Colour	4.0±0.1	4.7±0.4	4.2±0.3	4.1±0.2
Flavor	4.4±0.1	4.7±0.2	3.6±0.1	4.4±0.5
Texture	4.2±0.4	4.8±0.2	3.8±0.4	4.2±0.3
Taste	4.2±0.4	4.9±0.1	3.7±0.2	3.9±0.6
Overall acceptability	4.0±0.1	4.8±0.1	3.8±0.3	3.5±0.7

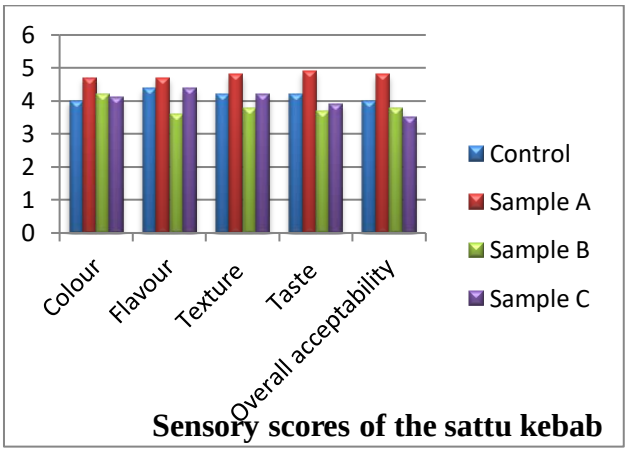


Figure 4

Sensory scores of the sattu kebab

From the results it was revealed that Sample A which has chick pea, wheat and jowar were found to be acceptable by the panel members.

D.Sensory evaluation of the sattu kachori

The kachori developed by using different sattu samples was subjected to sensory evaluation by untrained panel members with the help of a 5-point hedonic scale. The mean scores obtained from statistical analysis are presented in the following Table 5.

Table 5-Sensory scores of the sattu kachori

Sensory characteristics	Control	Sample A	Sample B	Sample C
Colour	4.0±0.1	4.3±0.3	3.5±0.5	3.9±0.4
Flavor	4.2±0.3	4.7±0.3	3.3±0.6	3.9±0.4
Texture	4.2±0.3	4.7±0.3	3.3±0.6	3.8±0.7
Taste	4.7±0.3	4.7±0.3	3.3±0.6	3.8±0.5
Overall acceptability	4.2±0.3	4.7±0.3	3.3±0.3	3.7±0.9

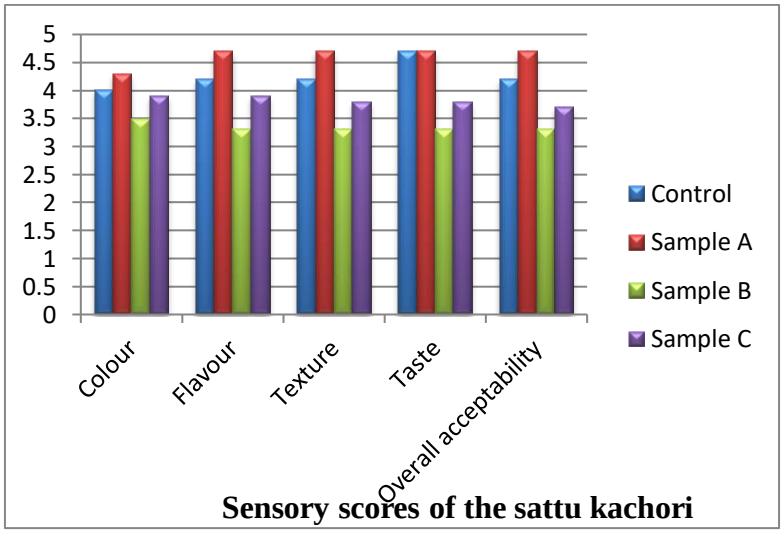


Figure 5-Sensory scores of the sattu kachori

From the results it was revealed that Sample A which has chick pea, wheat and jowar were found to be acceptable by the panel members.

Conclusion

Sattu is a traditional food of India with ample health benefits. It helps to keep our body fit and healthy for people of all age groups. Hence, in this study three samples of sattu are prepared with different ingredients. The sattu preparation is very convenient and affordable to all people. The protein content is rich in sample B as compared to other samples. The samples contained phytochemicals like phenols, steroids and terpenoids whereas alkaloids are absent in all the samples. The sattu prepared with good combination of cereals, millets, pulses and nuts are used to develop value added products like kebab and kachori. Among the three samples, the sattu kebab and kachori prepared with Sample A were preferred by the panel members. Thus the study results concluded that since using traditional foods to enhance overall health has become more common in recent years, sattu flour of different formulations can be utilised in the preparation of value added products which helps in preventing the occurrence of several lifestyle diseases.

References

1. Mridula, D., Manikantan, M. R., Goyal, R. K., & Wanjari, O. D. (2006), Effect of roasting on quality of bajra and sattu. *Journal of Agricultural Engineering*, 43(4), 65-70
2. Fatma, N., Jaiswal, M., Agrahari, K., & Singh, A. (2017), Enrichment of sattu products by using nutrient rich powders. *International Journal of Home Science*, 3(1), 272–276.
3. Singh, P., Vyas, H., Vasava, A., Vasani, D., & Patil, S. (2021). Standardization and sensory evaluation of Sattu-Mantha: A traditional energy drink. *Int J Ayurvedic Med*, 12, 583-7.
4. Shakeb, M., Dharanya, E. K., & Pandey, S. (2021), Standardization and quality profile of sattu mix. *Journal of Food Science and Technology*, 1-15.

ROLE OF NUTRIENTS IN IMMUNE HEALTH- AN OVERVIEW

Sri Gayathri.A, Malarvizhi.R, Babykala.R

PG & Research Department of Chemistry,

Seethalakshmi Ramaswami College, Tiruchirappalli, Tamil Nadu, India

srigayathrichem@gmail.com

Abstract

Nutrition plays an important role in the regulation of optimal immunological response by providing adequate nutrients in sufficient concentrations to the immune cells. Thus, the immune system can initiate effective responses against pathogenic micro-organisms. When the dietary nutrients are insufficient or inefficient, the supply of these elements to the immune cells is significantly spared and immunity is compromised. Certain micronutrients such as Vitamins and Minerals and some macronutrients like specific amino acids are found to exert a very important role in the regulation of optimal immunological response. Nutrients play a major role against various viral diseases. They can either directly interact with the viral pathogen or activate immune cells as part of the adaptive immune system. A sufficient, well-balanced diet combined with frequent exercise equals good nutrition. Reduced immunity, more susceptibility to illness, hampered mental and physical growth and decreased productivity are all consequences of poor diet.

Keywords: *immune system, macronutrients, micronutrients.*

Introduction

It is widely acknowledged now that diet plays a significant role in influencing immunological responses. Nutritional deficits change immune competence and increase the risk of infection, according to epidemiologic and clinical studies. This vulnerability is exacerbated by filthy living conditions, inadequate personal cleanliness, tainted food and water, overcrowding, and a lack of information about nutrition. Research conducted in the past 25 years has verified that weakened immunity plays a crucial supporting role in infections linked to malnutrition. This is applicable to all age groups in all populations worldwide with eating problems and patients suffering from a range of major debilitating diseases. It is not limited to young children in underdeveloped nations.

The immune system

There are two primary categories of host resistance mechanisms: antigen-specific and nonspecific. The skin and mucous membranes, phagocytic cells, mucus, cilia, complement, lysozyme, interferon, and other humoral substances are examples of nonspecific defences.

These intrinsic mechanisms exist inherently and are unaffected by previous exposure to the infectious pathogen. They impede the spread of over infection and serve as the initial line of defence. The T cell system of cell-mediated immunity and the B cell system of antibody production are examples of antigen-specific systems. Due to their particular reactions triggered by previous exposure to the micro-organism on its antigenic determinants, these systems are both adaptive and triggered. They work well to stop the illness from spreading and to get rid of the invasive organism.

Prophylactic immunization against common communicable diseases includes measles, respiratory illnesses caused by Hemophilus influenza, and systemic disorders caused by Salmonella is based on specific immune responses. The body combines its antigen-specific and non-specific defensive mechanisms.

Macro nutrients

The three macronutrients—fat, protein, and carbohydrate—provide energy and are necessary for life to exist. Glycerol and fatty acids make up fat; amino acids aggregate to form protein; and simple sugars, such as starch, are chains of linked monosaccharides whose bonds are either hydrolysed to form monosaccharides in the human small intestine or are resistant to hydrolysis (dietary fibre). We need a combination of these macronutrients in our diet to sustain health and lifespan. Human populations have historically survived on diets with wildly varying quantities of these macronutrients, expressed as a percentage of energy to the diet.

For instance, it was discovered that an Alaskan Inuit group's animal-based diet consisted of 26% carbohydrates, 41% fat, and 33% protein. This eating pattern was thought to be cardioprotective since it was associated with lower dental caries, however this was later proven to be an incorrect assumption. The diet of Irish farm labours, on the other hand, consisted primarily of potatoes and skim milk and had 12% protein, 1% fat, and 87% carbohydrates. This diet was linked to a remarkably low rate of death from diabetes mellitus over time. Using a rice-based diet, Kempner and colleagues described how high-carb diets have also been utilized to treat vascular diseases and diabetes. Rice and potatoes contain primarily starch, and starch-based diets that provide 12% protein, 7% fat, and 81% carbohydrate have been shown to improve health markers over a seven-day period. For a period of 12 months, overweight or obese patients with comorbidities who followed a similar low-fat (7–15%) diet that promoted starchy foods along with whole grains, legumes, vegetables, and fruits, saw improvements in their metabolic risk factors and weight loss. From an evolutionary perspective, human starch digestion is well adapted. The amounts of macronutrients supplied by high-starch diets centred on root vegetables, legumes, and unrefined grains, however, would

typically be viewed as inconsistent with an acceptable macronutrient distribution range (AMDR), despite the obvious health benefits of doing so.

Micro nutrients

Vitamins and minerals are referred to as micronutrients; they are further classified as Macro minerals, trace minerals, and water- and fat-soluble vitamins. A balanced diet is frequently the goal in order to obtain an adequate number of micronutrients. Four categories exist for vitamins and minerals: macro-minerals, trace minerals, fat-soluble vitamins and water-soluble vitamins.

Water soluble vitamins

Vitamin B_1 (Thiamine)- Aids in the conversion of foods into energy.

Vitamin B_2 (Riboflavin)- Required for the synthesis of energy, cellular activity, and the metabolism of fat.

Vitamin B_3 (Niacin) - Promotes the conversion of food into energy.

Vitamin B_5 (Pantothenic acid) - Essential for the production of fatty acids.

Vitamin B_6 (Pyridoxine) - Aids in the body's production of red blood cells and the release of sugar from stored carbs for energy.

Vitamin B (Biotin) - Metabolism of glucose, amino acids, and fatty acids.

Vitamin B_9 (Folate) - Necessary for healthy cell division.

Vitamin B_{12} (Cobalamine) - Essential for the production of red blood cells as well as healthy nerve and brain function.

Vitamin C (Ascorbic acid) - Necessary for the synthesis of neurotransmitters and collagen, the primary protein in your skin.

Fat soluble vitamins

Vitamin A: Essential for healthy eyesight and organ performance.

Vitamin D: Aids in calcium absorption, bone growth and immune system maintenance.

Vitamin E: Promotes immunological response and functions as an antioxidant to shield cells from damages.

Vitamin K: Necessary for healthy bone formation and blood clotting.

Macrominerals

Calcium: Required for the healthy development and operation of teeth and bones and supports the contraction of blood vessels and muscle function.

Phosphorus: A component of cell membranes and bones.

Magnesium: Supports more than 300 enzyme processes, including blood pressure regulation.

Sodium: An electrolyte that helps with blood pressure maintenance and fluid balance.

Chloride: Used to generate digestive juices and to help maintain fluid balance, it is frequently seen in combination with sodium.

Potassium: An electrolyte that supports muscle and nerve function as well as the fluid balance of cells.

Sulphur: Part of every living tissue and contained in the amino-acids methionine and cysteine.

Trace minerals

Iron: Aids in the production of several hormones and helps to supply oxygen to muscles.

Manganese: Supports the metabolism of cholesterol, amino acids, and carbohydrates.

Copper: Essential for healthy brain and nervous system function as well as the creation of connective tissue.

Zinc: Required for healthy immune system operation, wound healing and normal growth.

Iodine: Helps to control the thyroid regulation.

Fluoride: Required for the growth of teeth and bones.

Selenium: Essential for the health of the thyroid, reproduction, and protection against oxidative damage.

Conclusion

It is commonly known that inadequate nourishment significantly compromises the immune system's ability to operate. Furthermore, it is becoming more widely acknowledged that consuming more nutrients than what is generally advised may improve immune function, regulate autoimmune and chronic inflammatory diseases, and lower the risk of infection. This encompasses phytochemicals, functional foods (probiotics and green tea), and both macronutrients (lipids like n-3 PUFA) and micronutrients (zinc, vitamin D, and vitamin E). The ability of many of these nutrient-dense and non-nutritive food ingredients to maintain or enhance immune function is related. These include the ability to modulate cell-mediated immunity, promote anti-inflammatory functions, inhibit pro-inflammatory mediators, change the function of the innate and adaptive immune systems, and communicate with one another.

References

1. Chandra RK (1996), Nutrition, immunity and infection: From basic knowledge of dietary manipulation of immune responses to practical application of ameliorating suffering and improving survival. *Proc Natl Acad Sci* US., 93, 14304-14307
2. Bang G., Kristoffersen T. (1972), Dental caries and diet in an Alaskan Eskimo population. *Scand. J. Dent.Res.*; 80:440–444.

3. Fodor J.G., Helis E., Yazdekhasti N., Vohnout B. (2014), “Fishing” for the origins of the “Eskimos and heart disease” story: Facts or wishful thinking? *Can. J. Cardiol.*; 30:864–868.
4. Chandra RK, New-berne PM (1977), Nutrition, immunity and infection. Mechanisms of interactions. Plenum, New York.
5. Crawford E.M. Death rates from diabetes mellitus in Ireland 1833–1983: (1987), A historical commentary. *Ulster Med. J.*; 56:109–115.

THE ROLE OF CHEMISTRY IN FOOD PRESERVATION - AN OVERVIEW

Gomathi.V[1], Kayathridevi.K[2], Pradeepalakshmi.G.M[2]

[1]Associate Professor, [2] II PG Student, PG & Research Department of Chemistry,

Seethalakshmi Ramaswami College, Tiruchirapalli-620002.

vemathi@gmail.com

Abstract

Food chemistry and microbiology play pivotal roles in ensuring the safety, quality and nutritional value of the food we consume. Chemistry investigates the composition and properties of food component delving into molecular structure and reaction that influence taste, texture and shelf life. Microbiology explores the complex world of microorganism, examining their impact on food through fermentation, spoilage and food borne illness. Compounds derived from natural sources, synthetic compounds and packaging material contribute a crucial role in food preservation. This paper reviewsthe role of chemistry in food preservation from spoilage.

Keywords: *Natural sources, curcumin, turmeric, zein, synthetic compounds*

Introduction

Food is wasted in number of ways like making, supply and storage. The deterioration of food is caused by microorganisms and oxidation reactions (Tkaczewska, 2020). Therefore, the search for ways to increase the shelf life of food and slow the rate of spoilage could reduce the pressure on food to meet the needs of the global population. The progress of safe, effective preservatives is a major challenge in the food industries.

Compounds derived from natural sources and synthetic compounds in food preservation

Curcumin, a natural polyphenolic active compound derived from turmeric, has good biocompatibility and low toxicity with food. Curcumin plays a significant role in food preservation as a natural food preservative with efficient antimicrobial and antioxidant properties. Due to environmental instabilities, curcumin is highly susceptible to degradation when applied directly to foods. Recently, the protection and control release of sensitive substances by encapsulation technology has made it possible to be generally used in food preservation [1].

Essential Oils are a complex mixture of volatile compounds regarded as by a strong smell and flavor that are variables depending on the chemical composition. This review

explores the potential of essential oils as eco-friendly food preservatives, detailing their antibacterial, antioxidant, and antimicrobial properties. Extracted from various plant parts, EOs offer versatile applications in the food industry, with over 3000 identified types. The paper discusses extraction techniques, biological activities, and safety considerations, emphasizing the need for a thorough assessment of EOs' chemical properties. It addresses the antibacterial mode of action and preservative efficacy in food systems, highlighting the challenge of selecting EOs that maintain food taste, aroma, and flavor. Overall, the study underscores EOs as promising, natural**,** and eco-friendly alternatives to synthetic chemicals for food preservation [2].

The microbiological stability of soft drinks is regularly based on pasteurization method, the addition of additives such as sorbate or benzoate salts, and the low pH resulted from the addition of citric or lactic acid. The purpose of this study is the addition of a propolis extract in a non-carbonated orange soft drink, pointing to the replacement of synthetic preservatives and increase of the product's bioactivity. Soft drink including propolis extract showed higher antioxidant activity and total phenolic content, compared to these including potassium sorbate [3].

Natural sources have been used as alternatives to synthetic food preservatives because of their safety and antibacterial activity.Betel leaves have a scientific name called *Piper betel*, which is a plant species in the pepper family, distributed mainly in Asian countries such as India, China, Indonesia, Malaysia, and Vietnam. Phenolic compounds in betel leaf extract, such as hydroxychavicol, chromanol, eugenol, chavicol, and sesquiterpenes in essential oils, have great antibacterial, antifungal, and antioxidant properties [4].

Artificial preservatives are chemical substances that stop or delay the growth of bacteria, spoilage and discoloration. They can be added to the food or spewed on the food. Benzoates, Nitrites, Sulphites, Erythorbic Acid, Benzoic acid, Sodium Benzoate, Calcium Sorbate[5].

The antiyeast activity of a chemically synthesised antimicrobial peptides, Snakin-1 from potato tubers, was determined. The peptide was found to cause membrane permeabilisation in Zygosaccharomycesbailii.The peptide was stable, to some extent, at high temperature, acidic pH and varying salt concentrations.This peptide is responsible for the defence of the potato plant against external environmental pathogens and has been previously extracted and revealed to be a 63-amino acid residue peptide [6].

Bioactive peptides and protein hydrolysates show great potential as antioxidant additives to food because they be able to act in several ways: by reducing hydro peroxides,

scavenging free radicals, ROS inactivation, prooxidative transition metal chelation and modifying the physical properties of the products. Due to their surface-active properties, peptides and proteins derived from protein hydrolysatesmight be located at the level of the oil-water interface in food emulsions [7].

Packaging material in food preservation

Zein is a hydrophobic plant protein and has a broad application prospects in many areas including pharmaceutical, biomedical, and food because it is non-toxic, high thermal stability, biodegradable, biocompatible and oxygen-barrier properties.In this work, an edible GZ/CT nanofiber film was successfully prepared by electro spinning technology. Since CA and THY displayed synergistic antibacterial properties, they were introduced into gelatin and zein matrix to endow the prepared GZ/CT nanofiber film with excellent antibacterial performance [8].

The in-package plasma technique is very effective for bacterial and sporal sterilization with inadequate thermal and adverse effects on food quality while requiring low energy inputs and no additional potentially hazardous food preservatives. In-package plasma technology with cold plasma discharges generated and thus-generated reactive species retained within the packaging vessels is a promising approach for food processing and preservation, without noticeable thermal degradation effects. This review discusses five main aspects of in-package plasma processing for foods [9].

In recent years, innovative techniques such as in-package plasma technology have emerged as a transformative tool to address pathogenic microorganisms in food while preserving its quality throughout its shelf-life. A review suggests that exploring oxygen-reduced atmospheres and advanced biopolymer materials could help overcome limitations, making in-package plasma a promising and sustainable solution for reshaping the landscape of food preservation amid the increasing demand for safe and eco-friendly processing [10].

Conclusion

Based on food preservation, the review article outlined, curcumin has been used as an alternative to synthetic preservatives in food preservation. Zein is a hydrophobic plant protein and in-package plasma a promising and sustainable solution for reshaping the landscape of food preservation amid the increasing mandate for safe and eco-friendly processing in food preservation.

References

1. Xiang Lan , Yueyue Liu , Lei Wang , Haiyan Wang , Zhe Hu , Hao Dong , Zhiwen Yu, Yongkai Yuan, (2023),A review of curcumin in food preservation: Delivery system and photosensitization, Food Chemistry, 424, 136464.
2. Hanen Falleh, Mariem BenJemaa, Mariem Saada, Riadh Ksouri, (2020),Essential oils: A promising eco-friendly food preservative, Food Chemistry, 330, 127268.
3. Athanasia Vasilaki, Magdalini Hatzikamari, Alkiviadis Stagkos-Georgiadis, Athanasia M. Goula, Ioannis Mourtzinos, (2019),A natural approach in food preservation: Propolis extract as sorbate alternative in non-carbonated beverage, Food Chemistry, 298, 125080.
4. Viet Thanh Tran, Tran Bao Nguyen, Ha Chi Nguyen, Nga H.N. Do, Phung K. Le, (2023), Recent applications of natural bioactive compounds from *Piper betle (*L.*)* leaves in food preservation, Food control, 154, 110026.
5. Josiane K. Rutz , Caroline D. Borges, Rui C. Zambiazi, Cleonice G. da Rosa, Médelin M. da Silva, (2016),Elaboration of microparticles of carotenoids from natural and synthetic sources for applications in food, Food Chemistry, 202, 324.
6. Laila N. Shwaiki, Elke K. Arendt, Kieran M. Lynch, (2020),Study on the characterisation and application of synthetic peptide Snakin-1 derived from potato tubers – Action against food spoilage yeast, Food control, 118, 107362.
7. Joanna Tkaczewska, (2020), Peptides and protein hydrolysates as food preservatives and bioactive components of edible films and coatings - A review, Trends in Food Science and Technology, 106, 298.
8. Xing Wu, Zeng Liu, Shu He, Jia Liu, Wei Shao, (2023), Development of an edible food packaging gelatin/zein based nanofiber film for the shelf-life extension of strawberries, Food Chemistry, 426, 136652.
9. Renwu Zhou, Adel Rezaeimotlagh, Rusen Zhou , Tianqi Zhang, Peiyu Wang , Jungmi Hong , Behdad Soltani, Anne Mai-Prochnow, Xinyu Liao, Tian Ding, Taoshao, Erik W. Thompson, Kostya, Patrick J. Cullen, (2022), Trends in Food Science & Technology", 120, 120, 59.
10. Susham Talegaonkar, (2017),"Smart biodegradable packaging material for foodpreservation" Academic Press, 3, 79-110.

A STUDY ON IMPACT OF PROTEIN INTAKE ON HUMAN HEALTH – PROS AND CONS

Rama. I[1], Subashini. A[2]

[1]Associate Professor, PG and Research Department of Chemistry,
Seethalakshmi Ramaswami College, Tiruchirappalli, Tamil Nadu, India
rama14jai@yahoo.co.in

Abstract

Protein supplements, commonly consumed by athletes and individuals involved in fitness activities, are a valuable source for increasing protein intake, building muscle mass, and aiding in recovery. These supplements, available in various forms such as powders, bars, and shakes, have been found to have positive effects on multiple body systems. For instance, regular consumption of whey protein-based supplements is associated with lower systolic blood pressure, while soy-based protein supplements have been shown to decrease both systolic and diastolic blood pressures. Additionally, soy protein consumption has favourable effects on serum lipid profile, lowering levels of low-density lipoprotein and triglycerides, and can indirectly contribute to reducing diabetes-related complications. However, caution should be exercised to avoid excessive consumption, as it may lead to kidney-related issues such as hyperfiltration and increased urinary calcium excretion, potentially contributing to the development of chronic kidney disease. This review examines the evidence regarding the dietary protein requirement and the health effects of different protein intake levels in healthy adults.

Key words: *plant protein, protein, healthy aging, sarcopenia.*

Introduction

The review discusses the importance of protein intake for maintaining muscle mass and strength in aging adults. The current dietary recommendations for protein may be insufficient, and increasing the intake of high-quality protein could be beneficial. Additionally, the environmental impact of animal-protein production is a concern, prompting the consideration of more sustainable protein sources, such as plant proteins, for older adults at risk of malnutrition. Adequate protein intake plays a key role in maintaining independence and overall health in later life by preventing the loss of muscle mass and associated health issues. The focus is on the optimal quantity and distribution of protein intake in aging adults to support healthy aging and prevent muscle-related conditions[1-3]. The current food industry is not effectively

meeting the needs of the aging population by providing affordable, tasty, and convenient food options. There is a lack of focus on developing suitable food solutions that cater to the specific dietary requirements of older individuals. This highlights a gap in the market for food products that are both accessible and beneficial for the aging demographic.

Muscle strength is closely linked to muscle mass and starts to decline rapidly after the age of 50. This highlights the importance of implementing dietary changes around the age of 40 to prevent or delay the onset of sarcopenia, a condition characterized by loss of muscle mass and strength in aging adults. Previous research has concentrated on determining the best protein quantity, timing, and type for preventing sarcopenia, a condition characterized by muscle loss. Several studies have indicated that consuming more protein than the Recommended Daily Allowance (RDA) could be beneficial in maintaining muscle mass and function in older adults. This suggests that exceeding the RDA for protein intake may help in preserving muscle health as individuals age.

In addition, the pattern of protein consumption has greater importance over the total daily amount consumed for muscle health[4-7]. It mentions that while studies have investigated the effects of various types of animal proteins on muscle health, research on the effects of plant proteins, excluding soy, is lacking. This suggests a need for further exploration into the impact of plant proteins on muscle health and the development of a more comprehensive understanding of dietary choices for optimal muscle function in ageing adults[8-10].

Categories of protein sources

Animal protein is broadly recognised as having higher nutritional quality than plant-based protein. This refers to its amino acid composition, digestibility and ability to transport other important nutrients such as calcium and iron. In addition, its technological functionality such as gelling, emulsification, and foaming, which gives food its appealing texture and sensory attributes, is considered superior to plant-based protein[11]. Proteins from animal sources, particularly dairy proteins, are important for providing adequate nutrition for human, particularly infants for their cognitive and physical development. Numerous reports and recommendations support the use of animal protein sources in food aid products.

Proteins from plant sources have attracted increased interest. Consumers increasingly look for plant-based food options, either for sustainability, health or ethical reasons, and food companies are responding with many new plant-based alternatives. The early plant protein products had dissimilar textural and flavour characteristics compared to animal protein products. In general, plant proteins offer lower nutritional values due to unbalanced amino acid composition (e.g. lack of some Essential Amino Acids (EAAs), such as lysine), and slow or

reduced digestibility due to their molecular structures, for example. However, they still provide a good protein source for humans and can contribute to a balanced diet.

The inherent structural differences between animal and plant proteins hamper direct substitution in many products including major impact on sensory properties. However, by discovering more about the characteristics of all types of proteins, modifying their attributes through processing, and maximising their function, we have the capability to design increasingly innovative plant protein solutions that are acceptable to the consumer.

The sources of dietary protein, highlighting that globally, plant-based foods contribute the most to daily protein intake, followed by meat, dairy, fish, and other animal products. However, in the UK, animal-based foods are the primary source of protein, accounting for nearly two-thirds of total daily protein intake. The distribution of protein sources in the British diet varies by age group, with plant proteins mainly coming from cereals and cereal products, while animal-based proteins are derived from meat, dairy, fish, and eggs. In Western countries, alternative protein sources like mycoproteins, mainly found in vegetarian meat substitutes, are not commonly consumed. However, over the past thirty years, mycoproteins have gained popularity and are expected to continue growing in the future. On the other hand, cultured meat, produced in labs as an alternative protein source, is not extensively researched, and its future viability and acceptance among consumers are uncertain.

Optimal protein intake

The current international Recommended Dietary Allowance (RDA) for protein is 0.8 grams per kilogram of body weight, regardless of age. However, recent research suggests that older adults may need higher protein intake due to physiological changes like anabolic resistance and decreased muscle mass with age. Organizations like the PROT-AGE Study Group recommend 1.0-1.2 grams of protein per kilogram of body weight for healthy individuals over 65 years, with higher amounts for those with illnesses or injuries. Studies suggest that consuming two to three meals a day, each containing around 25-30 grams of high-quality protein, is optimal for stimulating muscle protein synthesis in healthy adults. Additionally, some research indicates that consuming a higher dose of protein in one daily occasion (pulse feeding) may lead to a higher anabolic response compared to spreading smaller doses across multiple meals, particularly in older adults.

In Western societies, people tend to consume less protein in the morning and more in the evening, as shown by studies analysing dietary habits over the years. Older adults may benefit from a more even distribution of protein intake throughout the day to stimulate muscle protein synthesis effectively and reduce the risk of frailty, even if they meet the recommended

daily protein intake. Ensuring a sufficient amount of high-quality protein in each meal, including before sleep, can help optimize muscle health and overall nutritional status in older adults[12].

The uneven distribution of protein intake in older adults may lead to inadequate stimulation of muscle protein synthesis (MPS), even if the recommended daily protein intake is met. It emphasizes the importance of having a meal containing around 25-30 grams of protein during the main meal to optimize MPS. Additionally, the study suggests that the distribution of protein intake throughout the day is crucial for older adults, as an uneven distribution may be associated with frailty indicators like lower walking speed and higher exhaustion.

Advantages of using plant proteins

The substitution of plant-based proteins for animal-based proteins and various mortality outcomes, including all-cause mortality, cancer mortality, and cardiovascular disease-specific mortality. Different studies show that replacing animal proteins with plant proteins, such as red meat with plant protein, can lead to reduced risks of cancer mortality, cardiovascular disease mortality, and overall mortality, particularly when specific plant proteins like beans and legumes are used as substitutes. These findings highlight the potential health benefits of incorporating plant-based proteins into the diet in place of certain animal-based proteins.

The impact of substituting plant proteins for animal proteins on mortality risks related to cardiovascular diseases (CVD). The findings suggest that replacing animal proteins with plant proteins, particularly from sources like bread, cereal, and pasta, can lead to reduced mortality risks associated with CVD, such as coronary heart disease and stroke. These studies highlight the potential health benefits of incorporating plant proteins into the diet as a way to lower the risk of CVD-related mortality.

The impact of substituting plant protein for animal protein on the risk of various aging-related diseases, such as cancer, type 2 diabetes, hypertension, and chronic kidney disease is highly positive. Different studies show mixed results, with some indicating a reduced risk of certain diseases like colorectal cancer and type 2 diabetes when plant protein replaces animal protein, while others show no significant associations with diseases like hypertension. Overall, the findings suggest that dietary choices involving plant protein substitutions may play a role in reducing the risk of certain aging-related diseases.

The review suggests that replacing animal-based protein with plant-based protein in a balanced manner may lower the risk of all-cause and cardiovascular disease mortality. Specifically, substituting bread, cereal, and pasta protein for red meat protein seems to have a protective effect. However, more research is needed with diverse populations to confirm these

findings and explore the potential health benefits of introducing plant protein-rich sources to prevent aging-related diseases and promote healthy aging.

Negative impact of protein consumption

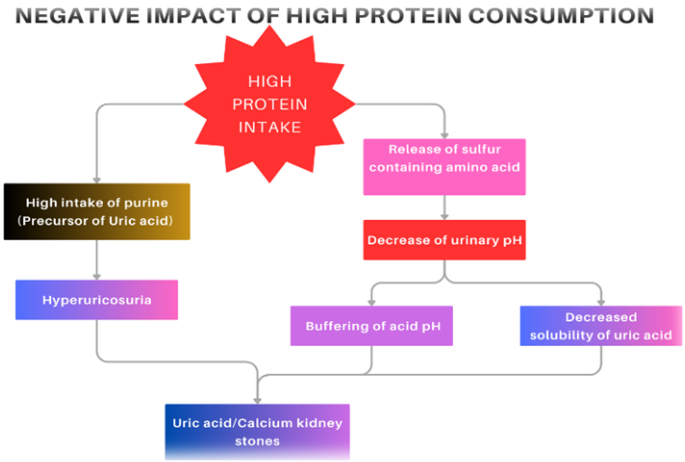
Excessive calcium lose and bond disorder

A high-protein diet leads to increased acid levels in the body, prompting the kidneys to excrete more acid while the bones release calcium to counterbalance the acidity. This process can result in excessive calcium loss, known as hypercalciuria, and increased risk of bone resorption. Studies have shown that elevated protein intake can lead to higher urinary calcium levels, negative calcium balance, and potential bone loss due to changes in renal calcium reabsorption and bone turnover markers.

The potential risks associated with excessive consumption of high-protein diets, particularly in healthy individuals. While short-term high-protein diets may be beneficial in certain medical conditions, overconsumption can lead to metabolic strain on organs like the bones, kidneys, and liver. It is emphasized that adherence to established dietary guidelines based on clinical evidence is crucial, and excessive intake of high-protein/high-meat diets beyond recommended levels for healthy adults may pose health risks, including an increased likelihood of coronary heart disease and cancer.

Renal function disorder

Low fluid intake and excessive intake of protein are significant risk factors for kidney stones. Protein consumption leads to increased renal acid excretion, potentially causing calcium release from bones and resulting in protein-induced hypercalciuria, which can contribute to the formation of calcium kidney stones. Animal protein, a major source of purines, is associated with hyperuricosuria and can lead to the development of uric acid stones due to changes in urinary pH and citrate excretion rates.



Dietary practices play a significant role in the development of breast, bowel, and prostate cancers, with high meat diets showing positive associations. Red meat and processed meat have been consistently linked to colorectal cancer due to the formation of heterocyclic amines during cooking. These compounds, along with saturated fats found in red meat, may increase the risk of cancer by promoting tumor growth and genetic mutations in the colon. The study shows that consuming red meat frequently may increase the risk of various cancers, such as stomach, colon, and pancreatic cancer. Additionally, it highlights the potential negative effects of a high-protein/high-meat diet on liver function and the progression of coronary artery disease. The study also suggests that reducing red meat intake and being cautious with high-protein diets may help lower the risk of certain health issues[13].

Conclusion

The current recommended protein intake for older adults may not be enough to maintain muscle mass and strength. To address the negative health and environmental impacts of excessive animal protein consumption, incorporating sustainably sourced plant proteins is suggested. While more research is needed, replacing animal proteins with plant-based options could have positive effects on appetite, especially for individuals of normal weight or those who are overweight/obese. The review suggests that replacing animal-based protein with plant-based protein in a calorie-matched manner may lower the risk of all-cause and cardiovascular disease mortality. The protective effect is notably seen when substituting bread, cereal, and pasta protein for red meat protein. However, more research is needed across diverse populations to strengthen these findings and explore the potential benefits of plant protein in preventing aging-related diseases and promoting healthy aging. The review also highlights that while short-term high protein diets may be necessary for certain health conditions, excessive protein intake can be harmful for healthy individuals. Many people, including athletes and bodybuilders, may unknowingly put themselves at risk by self-prescribing protein supplements due to misconceptions about their benefits. It is emphasized that following dietary guidelines based on established evidence is crucial, and currently, there is no scientific basis to recommend high protein or high meat intake beyond the recommended levels for healthy adults.

References

1. Wolfe, R.R. (2012). The role of dietary protein in optimizing muscle mass, function and health outcomes in older individuals. *Br. J. Nutr.,* 108, S88–S93.
2. Bauer, J.; Biolo, G.; Cederholm, T.; Cesari, M.; Cruz-Jentoft, A.J.; Morley, J.E.; Phillips, S.; Sieber, C.; Stehle, P.; Teta, D.; et al. (2013). Evidence-based recommendations for optimal dietary protein intake in older people: A position paper from the PROT-AGE Study Group. *J. Am. Med. Dir. Assoc.*, 14, 542–559.
3. Bradlee, M.L.; Mustafa, J.; Singer, M.R.; Moore, L.L. (2017). High-Protein Foods and Physical Activity Protect Against Age-Related Muscle Loss and Functional Decline. *J. Gerontol. A Biol. Sci. Med. Sci.*, 25.
4. Campbell, W.W.; Trappe, T.A.; Wolfe, R.R.; Evans, W.J. (2001). The recommended dietary allowance for protein may not be adequate for older people to maintain skeletal muscle. *J. Gerontol. A Biol. Sci. Med. Sci.*, 56, M373–M380.
5. Wolfe, R.R.; Miller, S.L.; Miller, K.B. (2008). Optimal protein intake in the elderly. *Clin. Nutr.*, 27, 675–684.
6. Deutz, N.E.; Bauer, J.M.; Barazzoni, R.; Biolo, G.; Boirie, Y.; Bosy-Westphal, A.; Cederholm, T.; Cruz-Jentoft, A.; Krznariç, Z.; Nair, K.S.; et al. (2014). Protein intake and exercise for optimal muscle function with ageing: Recommendations from the ESPEN Expert Group. *Clin. Nutr*. 33, 929–936.
7. Phillips, S.M.; Chevalier, S.; Leidy, H.J. (2016). Protein requirements beyond the RDA: Implications for optimizing health. *Appl. Physiol. Nutr. Metab*., 41, 565–572.
8. Bollwein, J.; Diekmann, R.; Kaiser, M.J.; Bauer, J.M.; Uter, W.; Sieber, C.C.; Volkert, D. (2014). Distribution but not amount of protein intake is associated with frailty: A cross-sectional investigation in the region of Nürnberg. *Nutr. J.,* 12, 109.
9. Dideriksen, K.J.; Reitelseder, S.; Petersen, S.G.; Hjort, M.; Helmark, I.C.; Kjaer, M.; Holm, L. (2011). Stimulation of muscle protein synthesis by whey and caseinate ingestion after resistance exercise in elderly individuals. Scand. *J. Med. Sci. Sports*, 21, e372–e383.
10. Cermak, N.M.; Res, P.T.; de Groot, L.C.; Saris, W.H.; van Loon, L.J. (2012). Protein supplementation augments the adaptive response of skeletal muscle to resistance-type exercise training: A meta-analysis. *Am. J. Clin. Nutr*., 96, 1454–1464.
11. Woojeong Kim; Yong Wang; Cordelia Selomulya; (2020). Dairy and plant proteins as natural food emulsifiers: Trends in Food Science & Technology,105, 261-272.

12. Marta Lonnie; Emma Hooker; Jeffrey M. Brunstrom; Bernard M. Corfe; Mark A. Green; Anthony W. Watson; Elizabeth A. Williams; Emma J. Stevenson; Simon Penson; Alexandra M. Johnstone; (2018). Protein for Life: Review of Optimal Protein Intake, Sustainable Dietary Sources and the Effect on Appetite in Ageing Adults: Nutrients, 10, 360.
13. Ioannis Delimaris; (2013). Adverse Effects Associated with Protein Intake above the Recommended Dietary Allowance for Adults: ISRN Nutrition, Article ID 126929

A STUDY ON GEN Z DIET CULTURE OF STUDENTS IN COLLEGE, TIRUCHIRAPPALLI

Dhaneshwari Alamelu.M,[1] Booma Devi.S[2]

[1]Assistant Professor/Seln, [2]Assistant Professor, PG & Research Department of Economics, Seethalakshmi Ramaswami College, Tiruchirappalli, Tamil Nadu, India.

Abstract

Health is an important means of leading meaningful life filled with happiness and inner harmony. With rapid economic development and increasing westernization of lifestyle in past few decades, there is a change in the diet pattern of human being. This paper focused on the pattern of food habitat among Gen Z students of College, Tiruchirappalli. Consumption of nutrition rich food is one of the solutions for the many psychological and lifestyle disorders of the modern life. It was detected that all the respondent's opinion that skipping junk food is beneficial to have healthy life. It also helps them to attain a strong immunity and balanced work life. Thus, it can be concluded that, having a balanced diet makes life healthy and increase their productivity.

Keywords: *Nutrition, women health, diet, Gen Z, lifestyle*

Introduction

In a competitive world, every human wants to succeed in their respective field. While attaining the success or in the headway of success majority of the people ignore the importance of health. It is imperious to uphold a finest balance between body and mind. With rapid economic development and increasing westernization of lifestyle in past few decades, the prevalence of obesity and other lifestyle-related diseases has increased at an alarming rate across globe including India. Obesity is an important risk factor in many lifestyle-related diseases like diabetes, hypertension, coronary artery diseases, stroke, etc.

This study focused on the diet culture of Gen Z. The Zoomers or Generation Z are those people who born between 1997 and 2012. This generation face a complex mix of challenges due to mental health tasks in adulthood starting during or before adolescence, combined with financial and social pressures. As a result, Gen Z is at most in risk of poverty and vulnerable to food insecurity. To overcome this, lifestyle modification advices like calorie restricted balanced diets and regular physical exercises are the cornerstones in the management of all lifestyle-related diseases.

According to the study by Aramark, 79% of members of the Gen Z would go meatless one to two times in a week. This generation is the most interested in plant-based and vegan food

choices, which they see as equal to other food types. The amount of vegan and vegetarian food they eat, their purchasing power grows. Gen Z sees dining out with friends and sharing small plates of food as exciting and interesting.

Gen Z is the generation born between 1997 and 2012. In 1991, India opened its economy to the world through liberalisation, privatisation and globalisation which permitted Western companies to launch themselves in our country. When India liberalised its economy, this Gen Z were the consumption of fast-food chains which increased and popularised in the 2000, likewise it was popular in the United States in the 1950s and the United Kingdom in the 1970s. To address this issue globally, it is important to know the timelines and developments of Gen Z. In developed countries, fast food became popular in the 1950s and 1970s itself. Gen Z in these countries has been exposed to fast food from a young age itself where as in developing and underdeveloped countries, the consumption of junk food has also increased significantly, but recently it is still lower than developed countries and has been for a shorter period of time.

Objective

To study the diet pattern of Gen Z students among college students.

Methodology

This study used a pilot survey with volunteer participants. This is an exploratory study. The methodology adopted both quantitative and qualitative techniques. The consumption of food intake and fitness level are evaluated based on a 5-point Likert scale, varying from 'Strongly Disagree' to 'Strongly Agree' and 'always' to 'often'. This study designed based on survey methodology. This survey was conducted by providing questionnaire to the participants. The survey instrument was directed to 50 participants. The participants comprise of students from both Undergraduate and Postgraduate with the age group of 17 – 27 years. For data analysis, MS Excel and percentage analysis were used.

Results and Discussion

Based on the analysis, it is found that 82 per cent of the respondents having 3 meals in a day and only 6 per cent of the respondents are having less than 3 times in a day. This shows that the Gen Z students know the importance of intake of food, instead of skipping their meals. From the analysis, it is perceived that 53 per cent of the respondents include more of veggies in their daily diet and 47 per cent of the respondents consume fruits on a daily basis.

It is found that among the youngest adult generation, 48 per cent of the respondents described their consumption of fast food on daily basis. The respondents consume white sugar

in their food in day today consumption of food. It is detected that 61 per cent of the respondents consume fried foods 3 to 6 times in a week. Among these respondents, 57 per cent of the respondents consume sweetened beverages once in a week. It is found that 64 per cent of the respondents consume high salted snacks once in a week and also 49 per cent of the respondents consume refined food twice a week. WHO recommends less than 2000 mg/day of sodium for healthy lifestyle. Too much sodium in the diet can lead to high blood pressure, heart disease, and stroke. It can also cause calcium losses and pull from bone.

Snacking pattern of Gen Z draws prominent attention. It is detected that 87 per cent of the respondents of Gen Z reported that snacking at least once in a day. Among these, 64 per cent of the respondents snack due hungry which is common reason, 17 per cent of the respondents consume thirsty out of boredom, and 19 per cent of them consume snack to acquire more energy. The appeal of snacking for responding to hunger cues and for energy may be particularly aligned with the life stage of this generation, which balances school, work, extracurricular, maintaining a social life, and moreover while navigating the entry into adulthood.

Among those who pursued to improve their nutrition or diet to manage or reduce their stress, 48 per cent of the respondents specifically quoted that practicing intuitive eating to accomplish stress management. It is observed that 73 per cent of the respondents were more likely to say they “always” eat when they’re feeling stressed and they also feel guilty about what they have consumed. While intuitive eating is one way in which some Gen Z can manage their stress, other segments of this generation may still be exploring what and how much support they need to come up with other healthier options.

The interesting fact that Gen Z is the generation who born during the rise of the internet and now with social media, the way in which the information shared and consume, not only alters our thinking process but also our eating habits. About 73 per cent of the respondents try to impose in their diet plan what they surf in the internet. This generation is trying to incline towards adopting healthier lifestyles, in hunt of the ideal physique propagated by the influencers. While only 38 per cent of the respondents have passionately incorporated healthier diets and conscious eating, others haven’t completely abandoned junk food but they are exploring healthier alternatives.

Conclusion

This study observed that Gen Z prioritizes both their physical and mental health. The Gen Z pilots their way of consumption through peer influence and social media pressure, they learn to strike a balance in their food choices and embrace a more thoughtful approach to

eating. From the analysis, it can be concluded that the preferences and consumption habits are slightly different from the Millennial. Gen Z should intake nutritional rich food and it must be part of their daily diet for sustainability, health and wellness of modern lifestyle.

References

1. Constantinos-Vasilios Priporas, Durga Vellore-Nagarajan, Irene and Kamenidou, 2021, Stressful eating indulgence by generation Z: a cognitive conceptual framework of new age consumers' obesity, *European Journal of Marketing,* 56(11).
2. Sogari, G., Vélez-Argumedo, C., Gómez, M.I., Mora, C., (2018), College students and eating habits: a study using an ecological model for healthy behavior. Nutrients 10(12), 1823
3. Blair, O. & O'Malley, K. Jameela Jamil, 2019, on Instagram's new Diet Products Policy: 'This is an issue at its peak'.

A STUDY ON EDUCATION AND FOOD PRACTICES OF ADOLESCENT GIRLS IN SELECTED COLLEGE IN TIRUCHIRAPPALLI DISTRICT

Sundari. P[1], Vaishnavi. B[2]
[1]Associate Professor, [2] Assistant Professor, PG & Research Department of Economics,
Seethalakshmi Ramaswami College, Tiruchirappalli, Tamil Nadu

Abstract

Adolescent is the period in human growth and development. During this phase it is important to monitor their health to understand the future needs of the upcoming generation. In India among adolescent girls bear the burden of heath conditions due to improper food practices. It is believed that the girls who have on the path of education would be more conscious about their health and well being. Many low-and middle income countries suffer with high level malnutrition in their adolescent female population. The food choice decisions become challengeable now due to availability of wide range of food which makes the adolescent population especially girls towards unhealthy and improper food habits. This should be addressed for bringing up balanced and nutritious food intake practices among them. This study aims to find out the relationship between education and food practices of adolescent girls in the study area.

Key Words: *Adolescence, Education, Food, Nutrition, Health*

Introduction

Consumption pattern of adolescent population has become the burning topic of the research as they are the builders of the future world. It is important to know the food practices and health awareness of the adolescents especially girls to ensure their reproductive phase healthier. The statistics says around 56 percent of the adolescent girls are anemic in the world level (WHO). They also fight with under-nutrition, overweight and obesity due to increased attraction towards lifestyle change and also increase their risk factors for communicable diseases.

The fast-food intake has been changes among adolescent girls even they are known to impacts (Nitin Joseph, 2015). Overweight and obesity are the common unhealthy signs among the adolescents. The diet culture of adolescents has been changed the food habit among them. Food like sugary snacks, salty snacks, processed meals are taking the place in their meal plate (Anusha Pappala, 2023). The research in India also says that one in four Indians are obese, diabetic due to junk food consumption.

Objectives

This study aims to find out the food practices of the adolescent girls in the study area and also tries to relate their education and their food practices.

Methodology

This study has taken 45 samples on the basis of mutually exclusive stratified sampling method from the study area as Primary data. They were given questionnaires and asked to reveal their food intake practices on various timings. Collected samples were drawn and analysed with statistical tools like Classification and Percentage to derive the conclusion.

Result and Discussion

The growing attractions towards junk food and increasing habit of improper intake among the respondents have been given consideration to know their food practices and frequency they take to refill their energy process.

Education and Age

The respondents taken for the study are pursuing their Undergraduate degree courses and they are belonging to the age group between 17 to 19 Years, the age group of adolescents declared by WHO. The respondents also revealed that they are instructed by their parents and teachers follow proper food intake and nutritious food on time.

Clock to Eat

Having right food at right time at right amount will keep the human energetic, healthy and productive. 45 of the respondents revealed that they take food 3 times a day and 25 percent

of the respondents 4 times a day including having food after returning home from the college instead having tea time. Remaining 30 percent of the respondents do not sure about their regular food times. It apparently shows that more than one fourth of the respondents do not have proper food intake and do not follow proper food timings. It would affect their concentration in listening and illness.

Breaking the fast

This study reveals that 62 percent of the respondents do not take their breakfast regularly due to lack of time, in a hurry, poor time management practices and do not aware of the impact of skipping it. The remaining respondents (38) take their breakfast as their daily habit. About 30 percent of the respondents take Idlis and Dosas followed by 14 percent take Poori or Pongal and 18 percent take mixed food. 2 percent of the respondents skip their breakfast daily. It is also revealed that breakfast time of the respondents falls between 7.30am to 9am.

Filling up the (hot)meal

It is revealed that 27 percent of the respondents take their noon meal from outside the home up to 3 times a week as they are “hot chiliphiles”(One who loves to taste spicy food) while 56 percent take their food prepared at their home. 17 percent of the respondents take food form noon meal scheme provided by the institution. It is appreciable that all the respondents do not miss their lunch. Among home food 36 percent of the respondents’ food does not consist of vegetables. It would be reason that having working parents with less awareness about vegetables intake. All the respondents revealed that they take lunch between 12.30pm to 1.30pm(Lunch Break of the Institution).

Dining at night

It is also found that 41 percent of the respondents take dinner between 8pm to 10.30pm which is completely beyond the ideal time for dinner as Dietician Vanessa Risseto says about the ideal time for dinner (5pm to 7pm). In India it is between 6pm to 8pm (The Indian Express, 2024). The 23 percent of the respondents also revealed that they take sugary food like biscuits and coffee before bed which may slower down their sleep time (Vanessa Risseto, 2023). 43 percent of the respondents revealed that they take oily food like Parota, Fried Rice, Chappathi,

Briyani in their dinner often. This reveals that the respondents are not conscious about their digestive system during the nights which may lead to related weaknesses.

Snack Time

Taking salty and spicy snacks, processed food, junk food and Chat food items are found common among the respondents. But they differ in the frequencies of taking them. It is revealed that panipoori is the most preferred chat items among the respondents (81 percent) followed by Mushroom rice. 85 percent of them prefer for Lays, Potato chips, chocolates, samosas in their snacks.

Holidays

During holidays 48 percent of the respondents revealed that they do not take food in timings and may take food 2 or 3 times a day. Among 97 percent of non-vegetarian 48 percent take chicken, 42 percent take both chicken and mutton, 28 percent take chicken, mutton and fish in their food. 9 percent take mixed non-veg items in their food. 41 percent revealed that they take non-veg food every week. It is found that maximum percentage of the respondents prefer chicken as their favourite non-veg food.

Fruit in food

From this study it is revealed that only 34 percent of the respondents take fruits regularly and apple, pomegranate and grapes are the major fruits intake by the respondents. It is also revealed that 53 percent of the respondents do not care about the nutritious value present in their food.

Exercise, Yoga and Meditation

From this study it is revealed that only 12 percent of the respondents do exercise followed by 5 percent do Yoga and meditation. Unfortunately the majority of the respondents do not practicing any physical exercise except those who are participating in sports. It is also revealed that they are lacking in regular physical activities like cycling, weight lifting, walking etc.

Health issues

The major health issues among the respondents are revealed that back pain (40 percent), headache, giddiness (12 percent), Low Blood Pressure (3 percent), Underweight(22 percent/ Low BMI), stomach ache(23 percent), bone problems(6 percent)and irregular periods(21) and periods with pain(5 Percent). These may occur due to improper food intake and lack of nutrition in their food. It is revealed that 85 percent of the respondents take tea as their energy booster 2 to 3 times a day followed by the respondents (22 Percent) consuming coffee in their daily schedule.

Conclusion

Proper and nutritious intake is important for the adolescent girls as they are in the reproductive stage. They also should take care of their health and start to take nutritious food for their well-being and increase their productivity in academic and un-academic activities. Avoiding breakfast should be addressed. Despite having education the importance given to their health is found little lacking. It is needed to be addressed to revive their health with proper nutritious food and regular physical exercises.

References

1. Emily C. Keats, Avaniv I. Rappaport, Shailja Shah, Christina Oh, Reena Jain and Zulfiqr and A.Bhutt, The Dietary Intake and Practices of Adolescent Girls in Low- and Middle-Income Countries: A Systematic Review, Emily C.Keats, , *Nutrients 2018*, 14 December, 2018.
2. Madeline Monaco, Adolescents' Perspectives and Food Choice Behaviors in Terms of the Environmental Impacts of Food Production Practices: Application of a Psychosocial Model, *Journal of Nutrition Education,* Volume 33, Issue 2, March – April 2001, pg. 72-82.
3. Nitin Joseph and Maria Nelliyanil, Fast Food Consumption Pattern and Its Association with Overweight Among High School Boys in Mangalore City of Southern India, Journal of Clinical & Diagnostic Research, 9(5), May 2015, Pg.13-17.
4. Ayush Mehrotran and Shagun Chaudhary, Revamp your health in 2024, *Business Insider,* December 2023

5. Deepak Malik and Neeru S Juneja, Food habits among adolescent girls: A qualitative study in urban and peri-urban communities, Delhi, India, Agroalimentaria28(55), November 2022, Pg. 39-52
6. Harika Yadhav, Sneha naidu, Sulakshana S. Baliga and Maheshwari D.Mallapur, Dietary pattern of college going adolescents (17-19 Years) in urban area of Belagavi, International Journal of Recnt Scientific Research, Volume 6. Issue 5, May 2015, Pg.3774-3777

EFFECT OF ENCAPSULATING CARRIER AGENT ON PHYSICO-CHEMICAL AND FUNCTIONAL PROPERTIES OF MICROENCAPSULATED *SOLANUM ANGUIVI* L. SPRAY-DRIED POWDER

P. Karthika [1], T. Poongodi Vijayakumar [2]

[1]Assistant Professor, [2]Professor, Department of Food Science and Nutrition,

Periyar University, Salem, Tamil Nadu, India

karthikafsn@gmail.com

Abstract

Anemia is a major public health problem worldwide and is often ignored in both developed and developing countries. Preschool children, pregnant women, and adolescents constitute a vulnerable group of anemia. Dietary diversification and fortification appear as the most sustainable approaches to increasing a population's iron and other micronutrient status. The present study aims to investigate the impact of encapsulating carrier agents on the nutritional and functional properties of microencapsulated spray-dried Solanum anguivi L. and Emblica Officinalis juice powder. The spray drying was conducted at 130°C with 15% carrier agent (maltodextrin, gum acacia and β-cyclodextrin) used in the mixtures with the Solanum anguivi L. and Emblica Officinalis juice. The quality of feed emulsions such as total soluble solids and light microscopic images were determined. In addition, nutritional components (protein, fat, crude fibre, sodium, potassium, calcium, zinc, iron, copper, manganese, phosphorus, vitamin C) and functional properties (water and oil absorption capacity; swelling properties) and powder encapsulate efficiency were analyzed. Nutritional properties reveal that GA produced a higher amount of nutrient value than the other powders. There was not shown much significant difference in nutritional properties between the powdered samples but a slight difference was noted by carbohydrate, zinc, and iron. The maximum amount of vitamin C was procured by GA which showed better encapsulation efficiency. The functional properties (WAC, OAC, swelling capacity, swelling index and swelling powder showed that MD and GA powders had higher and lower water holding capacity respectively and GA and GA: β-CD powders had higher oil holding capacity than other powders.

Keywords:*Anemia, Carrier agents, Soluble solids, Swelling properties, Proximate composition*

Introduction

Spray drying involves complex interactions of process, apparatus and feed parameters (inlet temperature, air flow rate, feed flow rate, atomizer speed, types of carrier agent and their concentration) which all influence the final product which produces a good quality product with less weight and moisture content, resulting in easy storage and transportation[1].

Microencapsulation can be defined as a process in which tiny particles or droplets are surrounded by a coating, or embedded in a homogeneous or heterogeneous matrix, to give small capsules with many useful properties. It can provide a physical barrier between the core compound and the other components of the product. In the food field, microencapsulation is a technique by which liquid droplets, solid particles, or gas compounds are entrapped into thin films of a food-grade microencapsulating agent [2].

The primary reason for the food industry to use microencapsulation is because it protects the core material from reacting with environmental factors that would cause the degradation of the product. Such factors can range from photo-oxidation of oils to deliquesce of sweeteners due to heat and humidity (protection of hygroscopic materials from moisture) [3]. Additionally, the dehydration of fruit juices makes it easier to handle the core material, both in shipping and storage, by converting liquids into a solid form and promoting an easy mixing of the core material [4]. Spray drying is successfully employed in the manufacture of fruit juice powder using the following materials as encapsulating carrier agents due to its high capacity to withhold volatile compounds by developing a matrix phase. The present study aims to investigate the impact of encapsulating carrier agents on the nutritional and functional properties of microencapsulated spray-dried *Solanum anguivi* L. and *Emblica Officinalis* juice powder.

Methodology

Preparation of Juice Extract

A 1:3 ratio of *Solanum anguivi* L. and *Emblica Officinalis* (S1:E3) fruits were weighed and extracted the juice using a domestic mixer grinder and filter through a double-folded muslin cloth.

Preparation of Feed Emulsion

The feed emulsions were prepared according to the percentage mentioned in Table 1 for microencapsulation through the spray drying process.

Spray Drying Process

The spray drying was conducted at 130°C with 15% carrier agent (maltodextrin, gum acacia and β-cyclodextrin) used in the mixtures with the *Solanum anguivi* L. and *Emblica Officinalis* juice.

Table 1: Preparation of Feed Emulsion

Samples	Carrier Agent	Juice Extract
Sample A	GA (15%)	15%
Sample B	β-CD (15%)	15%
Sample C	GA (7%):β-CD (7%)	15%
Sample D	MD (15%)	15%

GA-Gum Acacia, β-CD- Beta-cyclodextrin, MD - Maltodextrin

Characterization of Feed Emulsions and Developed Powder

The quality of feed emulsions such as total soluble solids and light microscopic images were determined. The macronutrients such as protein, fat, and crude fibre were estimated and the minerals (sodium, potassium, calcium, zinc, iron, copper, manganese, phosphorus, and vitamin C) were analyzed using Atomic Absorption Spectrophotometry. The functional properties (water and oil absorption capacity; swelling properties) and powder encapsulate efficiency were also determined in the developed different spray-dried powders.

Statistica Analysis

All the data were analyzed statistically and interpreted using the SPSS package 14.0 and Origin Software 7.1. Statistical analysis like mean, standard deviation, one-way analysis of variance (ANOVA) with LSD as post hoc comparison test, paired sample "t" test, and correlation were used.

Results and Discussion

The result of light microscope images (Fig.1) revealed that samples coded as A (GA) and D (MD) were round in shape and similar in size, which could provide a protective layer against any depletion to the inner particle as revealed in red raspberry powder [5]. On the other hand sample B (β-CD) and sample C (GA:β-CD) had crystal-like structures and uneven shapes along with rough surfaces that could be due to low concentration of encapsulating agents.

The encapsulation efficiency (Fig 2) indicated that greater efficacy was observed in GA powder followed by GA:β-CD; MD and β-CD powders. Total solids of feed emulsions (Fig 2)

noticed that β-CD (42.46%) and MD (43.56%) procured higher solids and leads rapid crust formation, dry surface layer, sticking nature; GA (35.4%) and GA:β-CD (38.46%) was moderate.

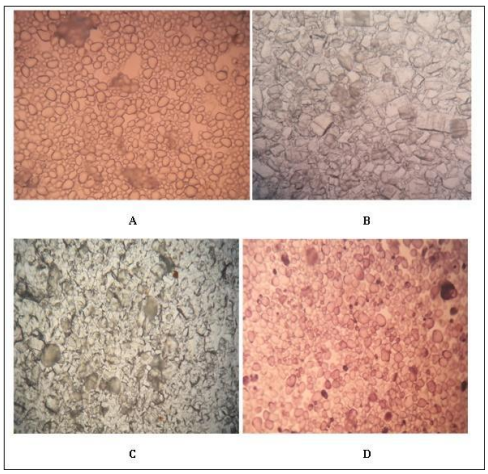


Fig.1. Light microscopic image of feed emulsions (A-GA; B-β-CD; C-GA:β-CD; D-MD)

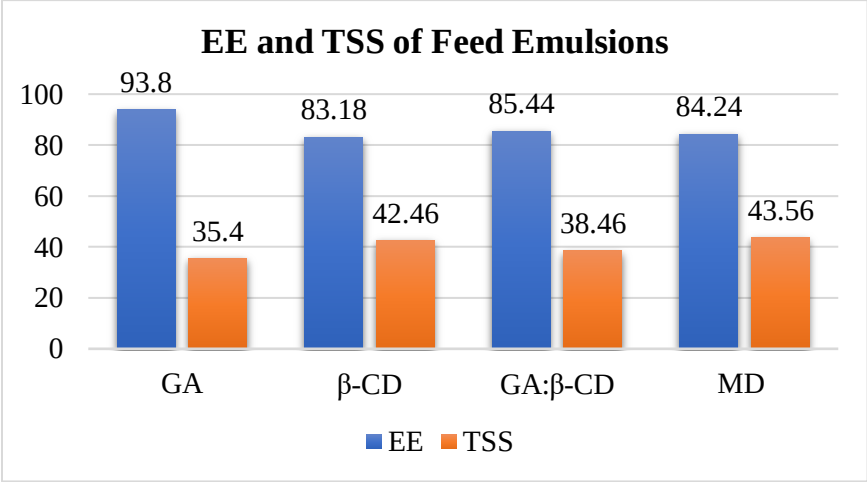


Fig. 2: Encapsulation Efficiency (EE) and Total Soluble Solids (TSS) of Feed Emulsions.

The nutritional properties (Fig.3) reveal that GA produced a higher amount of nutrient value than the other samples. There was not shown much significant difference between the powdered samples such as TSS, protein, sodium, potassium, calcium, copper, manganese and phosphorus are the only nutrients that showed much significant difference; a slightly significant difference was noted by carbohydrate, zinc, and iron. However, there was no significant difference was observed in ash, pH, acidity, and crude fiber. Fat content was not detected in all the powdered samples. The Vitamin C content also revealed that GA produced the maximum amount which showed better encapsulation efficiency. Compared to the fresh samples there was a minimum loss of nutrients after spray drying in all the samples.

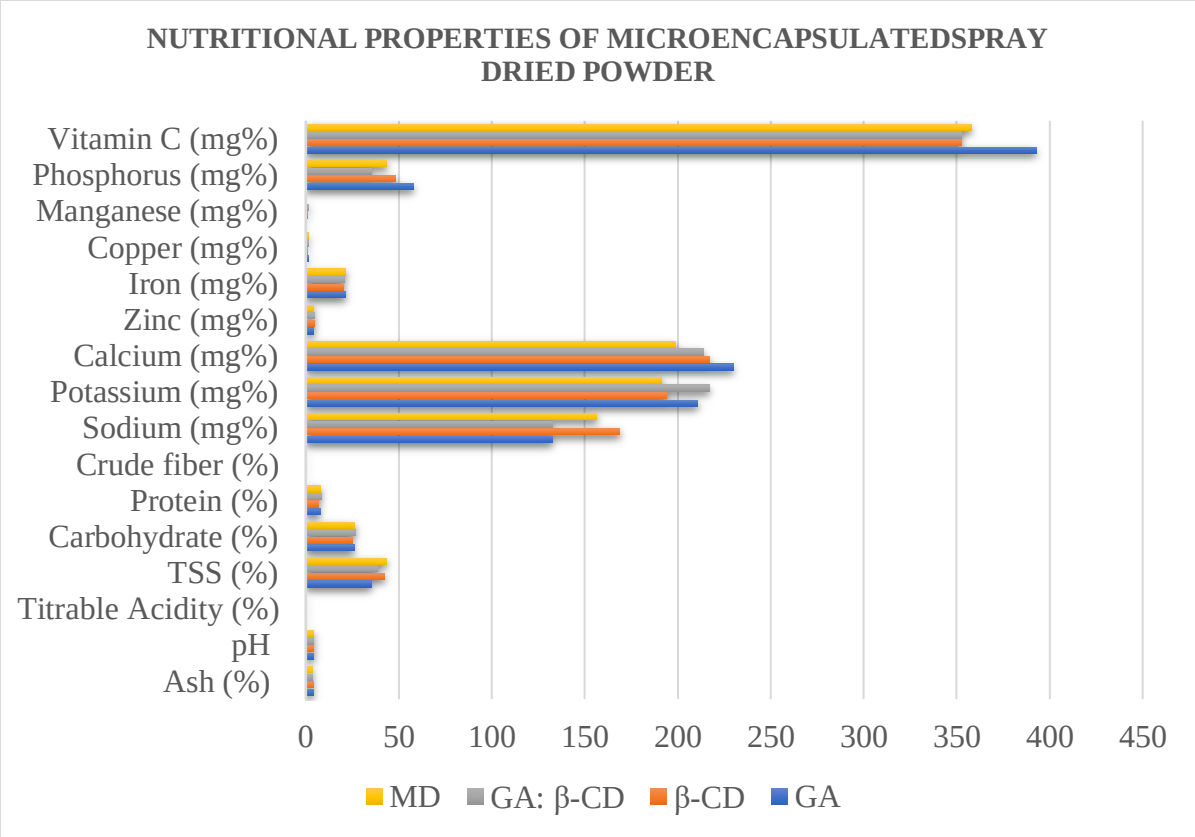


Fig. 3: Nutritional Properties of Microencapsulated Spray-Dried Powder

The functional properties (Table 4) of microencapsulated spray-dried powders such as WAC, OAC, swelling capacity, swelling index, and swelling powder at different temperatures (40-90 degrees) showed that MD and GA powders had higher and lower water holding capacities respectively and GA and GA: β-CD powders had higher oil holding capacity than other powders. β-CD; GA:β-CD powders obtained lower and GA and MD powders observed higher values in both swelling capacity and swelling index. Swelling power revealed that all four microencapsulated spray-dried powders were increased significantly ($p<0.05$) while increasing the temperature.

Table 4: Functional Properties of Microencapsulated Spray-Dried Powder

Parameters	GA	β-CD	GA:β-CD	MD
Water absorbing capacity (g/g)	1.04 ± 0.01^{a}	1.23 ± 0.03^{c}	1.12 ± 0.02^{b}	1.61 ± 0.02^{d}
Oil absorbing capacity (g/g)	0.50 ± 0.01^{c}	0.08 ± 0.02^{a}	0.50 ± 0.01^{c}	0.44 ± 0.01^{b}
Swelling capacity (%)	0.41 ± 0.01^{c}	0.24 ± 0.01^{a}	0.38 ± 0.01^{b}	0.54 ± 0.005^{d}
Swelling Index (%)	0.82 ± 0.02^{b}	0.48 ± 0.02^{a}	0.77 ± 0.02^{d}	1.08 ± 0.01^{c}

Swelling Power (g/ml)				
40°C	1.05±0.04[a]	2.2±0.02[c]	1.18±0.02[a]	1.69±0.08[b]
50°C	1.03±0.01[a]	2.47±0.06[c]	1.19±0.02[b]	2.45±0.04[c]
60°C	1.13±0.04[a]	2.66±0.02[c]	1.27±0.06[a]	2.49±0.08[b]
70°C	1.24±0.03[a]	2.78±0.01[b]	1.31±0.06[a]	2.87±0.06[b]
80°C	1.28±0.01[a]	3.02±0.02[b]	1.33±0.05[a]	2.91±0.09[b]
90°C	1.29±0.01[a]	3.14±0.03[d]	1.41±0.04[b]	3.01±0.02[c]

Values are the average of three determinants. The a,b,c,d alphabets indicate the significant mean difference suggested by LSD.

Conclusion:

The physicochemical properties of the microcapsule powder and the encapsulation efficiency of the core material are significantly influenced by the drying temperature. The use of spray-drying and gum arabic, along with other carriers, to obtain powders from *Solanum anguivi* L. and *Emblica* extract resulted in a product with functional properties, according to this study. The powders showed a dilution effect due to the use of the carrier; however, the stability of bioactive compounds present in the extracts can be improved, compared to the other dried samples.

References:

1. Chegini, G.R., Khazaei, J., Ghobadian, B. and Goudarzi, A.M. Prediction of process and product parameters in an orange juice spray dryer using artificial neural networks. *Journal of Food Engineering*, 2008, 84(4), 534-543.
2. Gharsallaoui, A., Roudaut, G., Chambin, O., Voilley, A., and Saurel, R. Applications of spray-drying in microencapsulation of food ingredients: An overview. *Food Research International*, 2007, 40(9), 1107-1121.
3. Augustin, M.A., and Hemar, Y. Nano-and micro-structured assemblies for encapsulation of food ingredients. *Chemical Society Reviews*, 2009, 38(4), 902-912.
4. Anal, A.K., and Singh, H. Recent advances in microencapsulation of probiotics for industrial applications and targeted delivery. *Trends in Food Science & Technology*, 2007, 18(5), 240-251.
5. Syamaladevi, R.M., Insan, S.K., Dhawan, S., Andrews, P., and Sablani, S.S. Physicochemical properties of encapsulated red raspberry (Rubus idaeus) powder: Influence of high-pressure homogenization. *Drying Technology,* 2012, 30(5), 484-493.

IMPORTANCE OF NUTRIENTS IN IMMUNE HEALTH

Hemavathi. B[1], and Suvarna Latha. A[2]

Faculty, Department of Biosciences and Sericulture,

Sri Padmavati Mahila Visvavidyalayam (Women's University),

Tirupati, Andhra Pradesh, India.

hemavathisvutpt@gmail.com, suvarnalatha.2009@gmail.com

Abstract

The immune system protects the host against pathogenic organisms and acts to ensure tolerance to self, to food and environmental components. Bovine milk, micronutrients and many nutrients beneficially affect the host immunity. The immune system must be constantly alert, monitoring for signs of invasion or danger. Cells of the immune system must be able to distinguish self from non-self and furthermore discriminate between non-self-molecules which are harmful (e.g., those from pathogens) and innocuous non-self-molecules (e.g., from food) Nutrition has a direct impact on the immune system's function as it influences the microbiome, gut barrier function, inflammatory reactions, and white blood cell function. There are links between dietary habits and specific foods that elevate illness risk and weaken immunological response. The relationship between nutrition and immunological health is extremely complex, even though it is obvious that dietary choices have an impact on overall health, including immune function. Vitamins and minerals boost immunity In. this article how nutrients play an important role to develop immune health was discussed.

Key words: *Nutrients, immune system, nutrients, immunological response, vitamins and minerals.*

Introduction

The immune system is made up of a vast and highly complex network of cells, tissues and organs that all work in union all of the time to protect the body from harm. If an individual has impaired immunity, the body's natural defenses could quickly be overwhelmed, resulting in serious infection, illness, and even death (Fritsche, 2006). Immunity may be innate (nonspecific) or acquired (specific). Innate immunity is conferred by all elements with which an individual is born and which are available at a very short notice to protect the individual from challenges by foreign invaders. Acquired immunity is more specialized than innate immunity and it supplements and augments the protection provided by innate immunity.

Immune function protects healthy tissue from disease promoting factors. Nutrient availability has the potential to affect all aspects of the immune system. In general, deficiency of several nutrients will lead to impaired immune responses, and replenishment of those specific components will typically restore the affected responses (Fernandes *et al*., 2006). In human beings, nutrient deficiencies impaired the immune response. Besides, conditions associated with over nutrition such as cardiovascular disease (Kang *et al*., 2001), diabetes and obesity significantly modulate immune function (Chandra, 2002).

Different factors depress immune system

Older age: As we age, our internal organs may become less efficient; immune-related organs like the thymus or bone marrow produce less immune cells needed to fight off infections. Aging is sometimes associated with micronutrient deficiencies, which may worsen a declining immune function.

Environmental toxins (smoke and other particles contributing to air pollution, excessive alcohol): These substances can impair or suppress the normal activity of immune cells.

Excess weight: Obesity is associated with low-grade chronic inflammation. Fat tissue produces adipocytokines that can promote inflammatory processes. Research is early, but obesity has also been identified as an independent risk factor for the influenza virus, possibly due to the impaired function of T-cells, a type of white blood cell.

Poor diet: Malnutrition or a diet lacking in one or more nutrients can impair the production and activity of immune cells and antibodies.

Chronic diseases: Autoimmune and immunodeficiency disorders attack and potentially disable immune cells.

Chronic mental stress: Stress releases hormones like cortisol that suppresses inflammation (inflammation is initially needed to activate immune cells) and the action of white blood cells.

Lack of sleep and rest: Sleep is a time of restoration for the body, during which a type of cytokine is released that fights infection; too little sleep lowers the amount of these cytokines and other immune cells. (ttps://www.hsph.harvard.edu/nutritionsource/nutrition-and-immunity/)

Immune strengthening micronutrients and their various food sources

Micronutrients are a group of nutrients, usually in smaller amounts, that are vital for the human body to perform various physiological functions properly. This includes vitamins, minerals, phytochemicals, and antioxidants.

Vitamin C

Vitamin C is a water-soluble vitamin that supports the immune response and has been shown to limit the development of bacteria. Sources of vitamin C include citrus fruits, berries, melons, tomatoes, bell pepper, and broccoli.

Vitamin D

Vitamin D is a hormone made by the body in response to sunlight. It is a fat-soluble vitamin that can assist with controlling infection and inflammation in the body. In Minnesota, the sun is not strong enough to help our bodies make adequate vitamin D. Vitamin D can be found naturally in very few foods; some sources include fatty fish, egg yolk, and a select group of fortified foods (soy beverage, breakfast cereal, and orange juice). For most people, the best way to meet their vitamin D needs is through a dietary supplement.

B Vitamins

There are eight B vitamins that are collectively called B complex vitamins: B1 (thiamine), B2 (riboflavin), B3 (niacin), B5 (pantothenic acid), B6 (pyridoxine), B7 (biotin), B9 (folate [folic acid]), and B12 (cobalamin). The B vitamins play a role in immune health by supporting multiple body functions including cell growth, energy production, and oxygen transportation. Some good sources of B vitamins are salmon, leafy greens (spinach, collard or turnip greens, and romaine), liver and other organ meats, beef, legumes, and fortified breakfast cereal.

Minerals include phosphorus, calcium, magnesium, sodium, potassium, chloride, and sulphur. There are also trace minerals needed in smaller amounts, which include iron, manganese, copper, iodine, zinc, cobalt, fluoride, and selenium. (https://medlineplus.gov/minerals.html)

Phytochemicals

Phytochemicals are chemical compounds found in plants. These phytochemicals are present in things like fruits, vegetables, whole grains, seeds, nuts, and legumes. They provide a multitude of health benefits ranging from small improvements such as, lowering blood pressure, reducing inflammation, and lowering LDL cholesterol levels in the blood to the major benefits of fighting against the growth of tumors, cancer, cardiovascular disease, along with being able to boost the immune system. (https://www.health.harvard.edu/staying-healthy/fill-up-on-phytochemicals)

Antioxidants

Antioxidants are compounds that block unpaired electrons in a molecule or atom and keep it from becoming a free radical. Free radicals are molecules that are either naturally made

in the human body after exercise or can be from exposure to environmental factors such as, cigarette smoke, pollution, and sunlight. These free radicals are destabilized and are highly reactive, which produces oxidative stress. This oxidative stress is what causes reactions that can damage cells in the body and can cause the cells to lose their function and become pathogenic. (https://www.nccih.nih.gov/health/antioxidants-in-depth)

Polyphenols

Polyphenols are organic substances that naturally occur in plants. They are important antioxidants with anti-inflammatory properties. It was demonstrated that curcumin can modulate immunity in many ways, mainly via regulation and inhibition of transcription factors such as nuclear factor NF-kB and activator protein 1 (AP-1). (Abdollah, et.al. 2018). Another polyphenol, resveratrol, also modulates and promotes immune response. (Leischner, et.al 2015)

Macronutrients

Macronutrients, including carbohydrates, proteins, and fats, are the main sources of energy for our bodies. Carbohydrates are our primary energy source and can be found in foods like grains, fruits, and vegetables. Proteins are essential for the growth and repair of tissues and can be obtained from sources like meat, dairy, and plant-based options like beans and tofu. Healthy fats, such as those found in avocados, nuts, and olive oil, support brain function and provide long lasting energy. Balancing these macronutrients is vital for maintaining a healthy weight and sustaining optimal energy levels.

Hydration is often overlooked, but it is a critical aspect of a healthy diet. Water is involved in numerous bodily functions, including digestion, nutrient absorption, and temperature regulation. Proper hydration supports healthy skin, boosts energy levels, and aids in weight management. (McNulty)

Vitamins and immunity

Vitamins are essential constituents of our diet that have long been known to influence the immune system (Mora et al., 2008). There are nine water soluble vitamins including the eight in the vitamin B complex and vitamin C. The B complex vitamins include thiamine, riboflavin, niacin, B6 (pyridoxine), B12, folic acid, biotin and pantothenic acid.

Humoral and cell mediated immunity are affected by vitamin B6 deficiency and supradietary intakes. Vitamin B6 is involved in lipid metabolism, nucleic acid and protein biosynthesis. It also helps to maintain normal nerve function and the formation of red blood cells (Heinz *et al*., 2010). Vitamin B6 deficiency impairs lymphocyte maturation, growth and proliferation, and antibody production; it suppresses the production of Th1 cytokines and, thus,

promotesTh2 responses (Maggini *et al*., 2007).Vitamin B12 enhanced T cell proliferative responses to concanavalin A (Con A) and immunoglobulin synthesis of B cells by pokeweed mitogen (PWM) (Sakane *et al*., 1982).

A variety of nutrients are affected: zinc, iron, beta-carotene, Vitamins B6, B12, C, D and E and Folic acid. The causal interaction between nutritional deficiencies and impaired immunity has been known in children; a similar relationship has been postulated in the elderly. Biotin is a coenzyme for several enzymes that catalyze carboxylation reaction.

Vitamin C deficiencies are found to be associated with decreases in the bactericidal activity and locomotion of neutrophils and macrophages and decreases in resistance to microbial infection (Chandra, 2004). Several mechanisms of ascorbate mediated immunostimulation have been proposed including : (a) modulation of intracellular cyclic nucleotide levels, (b) modulation of prostaglandin (PG) synthesis, (c) protection of 5'-lipoxygenase, (d) enhancement of cytokine production. (e) antagonism of the immunosuppressive interactions of histamine and leukocytes and, (f) neutralization of phagocyte derived autoreactive and immunosuppressive oxidants (Anderson *et al.*, 1990; Sorice *et al*., 2014).

The four fat soluble vitamins are A, D, E and K. normally act interactively together. β-Carotene (provitamin A) can protect phagocytic cells from auto oxidative damage, enhance T and B lymphocyte proliferative responses, stimulate effector T cell functions, promote the production of cytokines and increase macrophage, cytotoxic T cell and natural killer cell tumoricidal capacity (Bendich, 1991). The role of vitamin A in resistance to infection is well established (Field *et al*., 2002). The mechanism by which vitamin A reduces infection may be through modification of epithelial integrity and function, lymphoid mass, and specific and non specific immunity of host. Vitamin D plays an important role in pulmonary resistance and its deficiency has been linked to various respiratory infections (de Tena *et al*.,2014). It affects both cytokine and immunoglobulin production. Besides it has a beneficial effects in autoimmune thyroiditis, multiple sclerosis and rheumatoid arthritis. Supplementation with antioxidant vitamins especially with vitamin E has been associated with an enhancement of immune function (Meydani *et al*., 2004; Maslovea *et al.*, 2014). Mega dose of vitamin E has a stimulatory effect on humoral and cell mediated immunity (Bauersachs *et al*., 1993).

The Role of Nutrition on the Prevention and Management of Diseases

A healthy diet contains a multitude of micronutrients that have anti-inflammatory and immune boosting effects that can help prevent or treat autoimmune diseases.

Allergies

Nutrition can help prevent or promote the development of food allergies. The hygiene hypothesis states that a child's early introduction to certain microorganisms can avert the onset of allergies. Breast feeding is considered to be the main method of preventing food allergies. This is because breast milk contains oligosaccharides, secretory IgA, vitamins, antioxidants and possible transfer of micro biota. (Heine, Ralf G. 2018)."). Conversely, a child's lack of exposure to specific microorganisms can establish a vulnerability to food allergies.

Diabetes

Diabetes mellitus is a disease in which one's blood sugar levels are elevated. (https://www.mayoclinic.org/diseases-conditions/diabetes/sympt oms-causes/syc-20371444). There are two forms of diabetes: Type 1 diabetes and Type 2 diabetes. Type 1 is caused by the immune system attacking insulin-producing cells in the pancreas. Type 2 is caused by the underproduction of insulin and the cells in your body becoming resistant to insulin. (https://www.mayoclinic.org/diseases-conditions/diabetes/sympt oms-causes/syc-20371444). A low-glycemic diet that is high in fiber is recommended for diabetics because low-glycemic foods digest slower in the body. Slower digestion helps stabilize blood glucose levels and prevents spikes in blood sugar. (Fuhrman, Joel. (2011))

Cancer

Cancer is a disease with multifactorial causes. Cigarette smoking, physical activity, viruses, and diet play a role in the development of cancer. (https://www.cancer.org/cancer/cancer-causes.html). Poor diet has been linked to the development of cancer, while a healthy diet has been shown to have positive effects on preventing and treating cancer. Cruciferous vegetables contain chemicals called Isothiocyanates (ITC's). ITC's have immune-boosting effects, as well as anti-cancer activity such as the prevention of angiogenesis. Angiogenesis is a process where tumor shave their own blood supply in order to feed growing cancer cells. The alliinase containing food group, allium, has anti-cancer and anti-inflammatory properties. Alliinase is an enzyme, which acts as anangiogenisis-inhibitor and a carcinogen detoxifier. Mushrooms reduce cancer cell and tumor growth and prevent DNA damage. Mushrooms have aromatase inhibitors that decrease the levels of estrogen released in the bloodstream, slowing the production of breast tissue. Fruits and vegetables contain flavonoids, which are anti-carcinogens. (Fuhrman, Joel. (2011).)

Conclusion

A balanced diet and proper nutrition are vital for maintaining good health and well-being. By understanding the importance of macronutrients, micronutrients, hydration, and the mind body connection, we can make informed choices that support our overall vitality. With a focus on whole, nutrient-dense foods and healthy eating habits, we can nourish our bodies and minds, paving the way for a vibrant and fulfilling life.

References

1. Anderson, R., Smit, M.J. and Joone, G.K. (1990). Vitamin C and cellular immune functions. Protection against hypochlorous acid-mediated inactivation of glyceraldehyde-3-phosphate dehydrogenase and ATP generation in human leukocytes as a possible mechanism of ascorbate-mediated immunostimulation. *Annals of the New York Academy of Sciences* 587:34-48.
2. ."Antioxidants: In Depth" (https://www.nccih.nih.gov/health/antioxidants-in-depth) *NCCIH* Retrieved 2020-10-18
3. Abdollahi, Elham; Momtazi, Amir Abbas, Johnston, Thomas P., Sahebkar, Amirhossein (2018). Therapeutic effects of curcumin in inflammatory and immune-mediated diseases: A nature-made jack-of-all-trades? Immunomodulatory and anti-inflammatory effects of curcumin. *Journal of Cellular Physiology* 233(2): 830–848.
4. Bauersachs, S., Kircbgessener, M. and Paulicks, B.R.(1993). Effect of different levels of dietary selenium and vitamin E on the humoral immunity of rats. *Journal of Trace Elements and Electrolytes in Health and Disease* 7: 145-152.
5. Bendich, A. (1991). Carotenoids and immunity. *Clinical Applied Nutrition* 1:45-51
6. Chandra, R.K. (2002). Nutrition and the immune system from birth to old age. *European Journal of Clinical Nutrition* 56: S73-76.
7. Chandra, R.K. (2004). Impact of nutritional status and nutrient supplements on immune responses and incidence of infection in older individuals. *Aging Research Reviews* 3(1): 91-104.
8. "Diabetes - Symptoms and causes"(https://www.mayoclinic.org/diseases conditions /diabetes/symptoms-causes/syc-20371444) Mayo Clinic. Retrieved 2020-11-16
9. de Tena, J.G., Debekc, A. E., Gutiérreza, C. H. and Alonso, J. L. I. (2014). The Role of Vitamin D in Chronic Obstructive Pulmonary Disease, Asthma and Other Respiratory Diseases. Archivos Bronconeumolo 50: 179-84

10. Fritsche, K. (2006). Fatty acids as modulators of the immune response. *Annuals Review of Nutrition* 26: 45-73.
11. Fernandes, G., Jolly, C.A. and Lawrence, R.A. (2006). Nutrition and the immune system. 10. In: Shils M.E., Shike M., Ross, A.C., Caballero, B. and Cousins, R.J. eds. Modern Nutrition in Health and Disease. Pp.670-684 10th ed. Philadelphia: Lippincott Williams &Wilkins. YEAR
12. Field, C. J., Johnson, l.R. and Schley, P.D. (2002). Nutrient and their role in host resistance to infection. *Journal of Leukocyte Biology* 71(1): 16-32.
13. Fuhrman, Joel. (2011). Super immunity: the essential nutrition guide for boosting your body's defenses to live longer, stronger, and disease free New York.
14. Heinz, J., Kropf, S., Domrs̨e, U., Westphal, S., Borucki, K., Luley, C., Neumann, K.H. and Dierkes, J. (2010). B vitamins and the risk of total mortality and cardiovascular disease in end-stage renal disease: results of a randomized controlled trial. Circulation 121(12): 1432-1438.
15. Heine, Ralf G. (2018). Food Allergy Prevention and Treatment by Targeted Nutrition Annals of Nutrition and Metabolism.72 (3): 33– 45
16. Kang, B.P., Metha, U. and Bansal, M.P. (2001). Selenium supplementation protects from high fat diet induced atherogenesis in rats: role of mitogen stimulated lymphocytes and macrophage NO production. *Indian Journal of Experimental Biology* 39(8): 793-797.
17. McNulty BA. (2021). Risk of Iron Overload in Obesity and Implications in Metabolic Health. Nutrients. ; 13:1539.
18. Mora, J.R., Iwata, M. and von Andrian, U.H. (2008). Vitamin effects on the immune system: vitamins A and D take centre stage. *Nature Reviews Immunology* 8(9): 685-698
19. Maggini, S., Wintergerst, E.S., Beveridge, S. and Hornig, D.H. (2007). Selected vitamins and trace elements support immune function by strengthening epithelial barriers and cellular and humoral immune responses. *The British Journal of Nutrition* 98: S29-S35.
20. Meydani, S.N., Leka, L.S., Fine, B.C. Dallal, G.E., Keusch, G.T., Singh, M.F. and Hamer, D.H (2004). Vitamin E and respiratory tract infections in elderly nursing home residents. *The Journal of the American Medical Association* 292(7): 828-836
21. Maslova, E., Hansen, S., Storm, M., Halldorsson, T.I. and Olsen, S.F. (2014). Maternal intake of vitamins A, E and K in pregnancy and child allergic disease: a longitudinal

study from the Danish National Birth Cohort. *British Journal of Nutrition* 111(6): 1096-1108.

22. "Minerals" (https://medlineplus.gov/minerals.html)*medlineplus.gov*. Retrieved 2020-10-21
23. Leischner, Christian; Burkard, Markus; Pfeiffer, Matthias M.; Lauer, Ulrich M.; Busch, Christian;Venturelli, Sascha (December 2015). Nutritional immunology: function of natural killer cells and their modulation by resveratrol for cancer prevention and treatment. *Nutrition Journal* 15(1):
24. Publishing, Harvard Health (February 2019). "Fill up on phytochemicals" (https://www.health.harvard.edu/staying-healthy/fill-up-on-phytochemicals)*Harvard Health*. Retrieved 2020-10-18
25. Sakane, T., Takeda, S., Kotani, H. and Tsunematsu, T. (1982). Effects of methyl-B12 on the in vitro immune functions of human T lymphocytes. *Journal of Clinical Immunolology* 2(2): 101-109
26. Sorice, A., Guerriero, E., Capone, F., Colonna, G., Castello, G. and Costantini, S. (2014). Ascorbic acid: Its role in immune system and chronic inflammation diseases. *Mini Reviews in Medicinal Chemistry* 14(5): 444-452
27. What Causes Cancer? American Cancer Society (https://www.cancer.org/cancer/cancer- causes.html) www.cancer.org Retrieved 2020-11-16

.

.

EFFICACY OF DIETARY SUPPLEMENTS FOR THE MANAGEMENT OF DIABETES: A REVIEW

Viji. J

Assistant Professor, Research Department of Zoology

Seethalakshmi Ramaswami College, Tiruchirappalli, Tamil Nadu, India

vijikannan.j@gmail.com

Abstract

Diabetes is the seventh leading cause of death in the World. Although oral hypoglycemic medications are effective in maintaining glycemic control in diabetic patients, these medications still cause problems in manypatients. Recently, some dietary supplements and biological substances have been found to improve diabetes and are commercially available. Patients who want to find nutritional supplements to manage their diabetes often have questions about which supplements to choose and/or problems with their current medication schedule. This review will assist the patients i) to identify the potential dietary supplements that may improve diabetes management and ii) to understand what potential harm may occur

Keywords: *Diabetes mellitus, hypoglycaemia, nutrients, dietary supplements*

Introduction

Diabetes mellitus is characterized by chronic hyperglycemia. Diabetes is caused either by disrupted insulin secretion or function or both. This is due to Dietary supplements are defined as a product taken by mouth that contains a dietary ingredient intended to supplement the diet. These can contain vitamins, herbs, minerals, amino acids, and other substances, such as enzymes, metabolites, and organ tissues. Dietary supplements are commonly available as tablets, soft gels, capsules, liquids, powders, and bars. According to Afolayan and Sunmonu (2010), diabetes is a metabolic illness characterized by elevated blood glucose levels due to deficiencies in insulin synthesis, action, or both. If left untreated, diabetes can result in severe complications and early mortality. The name diabetes is derived from a Greek word meaning siphon. On the other hand, individuals with the illness can take action to manage the illness and reduce the chance of complications by collaborating with their medical professionals, support system, and other relevant parties.

Diabetes mellitus is a dangerous condition that adversely affects a patient's quality of life, health, and life expectancy in addition to the health care system (Dey *et al.,* 2002).

According to Rang *et al.* (1991), it is a condition that affects how the body metabolizes proteins, lipids, carbohydrates, and electrolytes, which can result in acute, subacute, and chronic problems. Acute diabetes consequences include hyperglycemia, ketoacidosis, and non-ketotic syndromes (Knentz and Nattras, 1991); sub-acute diabetes incidence is characterized by thirst, polyuria, blurred vision, weight loss, and low energy (Kumar and Clark, 2002). Glycation, a consequence of chronic hyperglycemia, is the bonding of a protein or lipid molecule with a sugar molecule. This bonding might eventually damage the kidney, nerves, arteries, and eye.

Dietary supplements for the management of DM

Numerous dietary supplements have been used to treat diabetes and its complications (Table 1). The most common reasons for using supplements are to lower blood sugar, lower blood pressure, prevent cholesterol, insulin resistance, neuropathy, and other diabetes-related complications (Papaspurou *et al.,*2015) It was found that in the subgroup of patients with diabetes, the use of nutritional supplements is relatively common, consumption was reported by a little more than half (Zablocka-Slowinska *et al.,*2014).

Table 1: Common dietary supplement used in the management of Diabetes

S. No.	Dietary Supplement	Nutrients/Food Source	Health benefits	Limitations	References
1	Alpha-lipoic acid	Liver, spinach, broccoli and potato.	Prevents cell damage, improves the body's ability to use insulin.	May lower blood sugar too much.	Jacob *et al.,* 1995; 1996 and Konrad *et al.,* 1999.
2	Chromium	Trace Element, Meat, whole grain products, some fruits, vegetables and spices	Keeps pancreas working well and lowers blood sugar levels.	Lower doses are safer as high doses can cause kidney problem.	McCarty,1999; Althuis *et al.,*2002; Cefalu and He, 2004; Balk *et al.,* 2007 and Jellin and Gregory, 2007
3	Omega-3fatty acids	Poly unsaturated fatty acids. Oil, vegetable oil (canola and soybean),	Maintains blood glucose levels.	Safer at low to moderate doses, may interfere with certain medications.	Hartweg *et al.,* 2007 and 2008

		walnuts, and wheat germ			
4	Polyphenols	Tea and dark chocolate.	Lowers blood glucose levels by enhancing insulin action.	Contains caffeine, which can cause, in some people, insomnia, anxiety, or irritability. Green tea also has small amounts of vitamin K, which can make anticoagulant drugs, such as warfarin, less effective.	Ryu *et al.,* 2006; Collins *et al.,* 2007; Kim *et al.,* 2007; Mackenzie *et al.,* 2007 and Potenza *et al.,* 2007
5	Garlic	Allium sativum	Reduces fasting blood glucose and lower serum cholesterol levels.	Inhibits platelet Aggregation and may prolong bleeding time	Sheela and Augusti, 1992; Kaczmar, 1998; Banerjee and Maulik, 2002
6	Magnesium	Fat or fibre from fruits, vegetables, cereals and grain	Improves insulin response and glucose handling in the elderly and in type 2 diabetics	Causes loose stool in sensitive individuals	Begon *et al.,* 2000; Larsson and Wolk, 2007; Schulze *et al.,* 2007
7	Coenzyme Q10	Oil	Improves long-term glycemic control in type 2 diabetics.	Body stores of Co-Q10 can be reduced when used alongside prescribed diabetic medications such as glyburide.	Anderson *et al.,* 2001; Hodgson *et al.,* 2002; Bonadkdar and Guarneri, 2005
8	Vanadium	Black pepper, mushroom,	Helps cells of both the liver	Adverse reactions of	Cusi *et al.,* 2001

		shell fish parsley, fresh fruits and vegetables.	and muscles use insulin more effectively, controls glucose and insulin sensitizers.	diarrhea, green Tongue, nausea, vomiting and cramps are reported.	
9	Folic Acid	Vitamin B9, spinach broccoli, avocado, oranges, tomatoes, banana.	Along with B12, folic acid prevents strokes and loss of limbs due to diabetic complications.	High dosages cause neural damage.	Salardi *et al.,*2000
10	Selenium	Broccoli, radish, cabbage, onion, garlic, cereals, meat, mushroom, fish, nuts and egg.	Helps take blood sugar into cells, protects against blood vessel and nerve damage from elevated blood sugars.	Low blood selenium predisposes to cancer, coronary heart disease and diabetes.	Mukherjee *et al.,* 1998 and Stapleton, 2000
11	Vitamin B6	All bran, brown rice, oats, molasses, wheat germ, banana, plum, fish and salmon.	Pyridoxine with folic acid, B12 and B6 helps prevent diabetic blindness and vision loss.	Excessive vitamin B6 produces painful, disfiguring dermatological lesions.	Bendich and Cohen, 1990; Ellis *et al.,* 1991 and McCormick, 2006.
12	Vitamin C	Fruit and vegetables	Improves insulin stimulated glucose metabolism.	May raise blood sugar level.	Paolisso *et al.,* 1994 and 1995
13	Vitamin E	Vegetable oil, sunflower, nuts, whole grain, green leafy avocado, carrot, peanuts,	Produces a significant improvement in insulin mediated glucose utilization in healthy people	Large doses of α-tocopherol are known to deplete plasma and tissue γ-tocopherol.	Paolisso *et al.,* 1993; Barbagallo *et al.,* 1999 and Jiang *et al.,* 2001

		almond, hazelnuts.	and type-2 diabetics.		
14	Zinc	Minerals	Assists normal production, storage and secretion of insulin, necessary for the conformational integrity of insulin, helps blood sugar get into cells.	Significantly higher doses may cause nausea, vomiting, headache and drowsiness.	Paolisso *et al.,* 1993; Barbagallo *et al.,* 1999 and Jiang *et al.,* 2001
15	Copper	Oat, bran, apple, almond.	Protects pancreatic cells, prevents diabetes-related damage to blood vessels and nerves and lowers blood sugar levels.	Health benefits impaired by high intake of zinc.	Johnson *et al.,*1998 and Sitasawad *et al.,* 2001

Table 2: Food Supplements and their effects

Food Supplement	**Dose**	**Effects**	**Ref.**
Moringa oleifera	Dry leaf powder (50 mg/day, gavage) 8 week	Regulation of microflora	Nova *et al.,* 2020 and Villarruel *et al.,* 2018
Liriope spicata var. *prolifera*	100, 200 mg/kg	Improvement in insulin function	Chen *et al.,* 2009
Psacalium decompositum	50, 100, 200, 400 mg/kg	Improvement in insulin function	Alarcon *et al.,* 2000
Murraya koenigii	5%, 10% and 15%	Improvement in insulin function	Yadav *et al.,* 2002
Aporosa lindleyana	100 mg/kg aqueous extract, 100 mg/kg alcohol extract	Improvement in insulin function	Jayakumar and Suresh, 2003
Ceratonia siliqua L.	50, 100, 200 mg/kg	Inhibition of glucose absorption	Rtibi *et al.,* 2017

Momordica charantia	20 mg/kg	Inhibition of glucose absorption	Viridi *et al.,* 2003
Terminalia pallida	0.25, 0.5, 0.75, 1.0 g/kg	Improvement in insulin function	Kameswara Rao *et al.,* 2003
Ganoderma lucidum	1 mL/kg/day	Improvement in insulin function	Bach *et al.,* 2008
Punica granatum	250, 500, 1000 mg/kg	Inhibition of glucose absorption	Li *et al.,* 2005
Paullinia cupana	(65.16 ± 0.19) mg and (3.97 ± 0.02) mg	Inhibition of glucose absorption	Pinaffi *et al.,* 2020
Viburnum opulus	ethanol-acetone extract, acetone extract and phenolic rich fraction with water/dimethyl sulfoxide 100 mg/mL	Inhibition of glucose absorption	Zaklos-Szyda *et al.,* 2019
Astilbe thunbergii	100, 300 mg/kg	Inhibition of glucose absorption	Kato *et al.,* 2017
Sambucus nigra L.	0.040 g/kg	Inhibition of glucose absorption	Ferreira *et al.,* 2020 and Badescu *et al.,* 2012
Annona squamosa	15 mg/kg	Improvement in insulin function.	Panda and Kar, 2010
Cinnamoni cassiae	120 and 360 mg/day	Improvement in insulin function.	Anderson *et al.,* 2004
Tribulus terrestris	2 g/kg	R educe systemic oxidative stress	Amin *et al.,* 2006
Hibiscus sabdariffa	89.03, 147.22, 163.75, 21.35, 29.11, 38.57 mg/kg	Inhibition of glucose absorption Reduce systemic oxidative stress Improvement in insulin function	Alegbe *et al.,* 2009
Daucus carota	1 g of fiber sample was mixed in 100 mL of glucose solution (100 mmol/L)	Inhibition of glucose absorption	Ou *et al.,* 2000 and Chau *et al.,* 2004
Psacalium decompositum	50, 100, 200, 400 mg/kg	Improvement in insulin function.	Alarcon *et al.,* 2000
Trigonella foenum graecum	0.5 g/kg	Inhibition of glucose absorption	Hannan *et al.,* 2003

Maydis stigma	400, 600 and 800 mg/kg	Regulation of microflora	Wang *et al.,* 2016
Passiflora edulis	1 g of fibre-rich fractions in 100 mL of glucose solution (100 mmol/L)	Inhibition of glucose absorption	Chau and Huang, 2003
Cocos nucifera	50, 100, 150, 200, 250 g	Inhibition of glucose absorption	Trinidad *et al.,* 2003
Cicer aretinum	300 mg/kg	Inhibition of glucose absorption	Aisa *et al.,* 2019 and Zulet *et al.,* 1999
Centella asiatica	250, 500, 1 000 mg/kg	Inhibition of glucose absorption	Kabir *et al.,* 2014
Cornus officinalis	20 mg/kg	Improvement in insulin function	Hsu *et al.,* 2006
Trigonella foenum-graecum	18, 36, 50 mg/kg	Improvement in insulin function	Broca *et al.,* 1999
Andrographis paniculata Nees	100 µg/mL	Reduce systemic oxidative stress	Lee *et al.,* 2010
Salacia oblonga	100 mg/kg	Inhibition of glucose absorption	Li *et al.,* 2004
Trigonella foenum-graecum	high fat diet supplemented with 0.5 or 2.0% fenugreek	Improvement in insulin function	Uemura *et al.,* 2010
Costus igneus	5 or 10 mg/kg	Improvement in insulin function	Kalailingam *et al.,* 2014
Momordica charantia L.	300, 150, 75 mg/kg	Improvement in insulin function	Chai *et al.,* 2008
Morus alba	1 g of mulberry tea	Inhibition of glucose absorption	Hansawasdi *et al.,* 2006
Morus alba	0.25, 0.5 and 1.0 g/kg	Improvement in insulin function	Naowaboot *et al.,* 2009
Euodia rutaecarpa (Juss.) Benth.	3 mg/kg	Improvement in insulin function	Wang *et al.,* 2013
Ojamin	0.28 mL/kg	Improvement in insulin function	Choudhari *et al.,* 2017
Punica granatum L	1.25, 2.5, 5, 10 µmol/L	Reduce systemic oxidative stress	Hontecillas *et al.* (2009)
Moringa oleifera	5, 10 mg/kg	Reduce systemic oxidative stress	Kalailingam *et al.* (2014)

Food Supplements and their role on the management of DM

The food supplements play the following roles on the management of DM

i). Inhibiting ∞ glucosidase and ∞ amylase

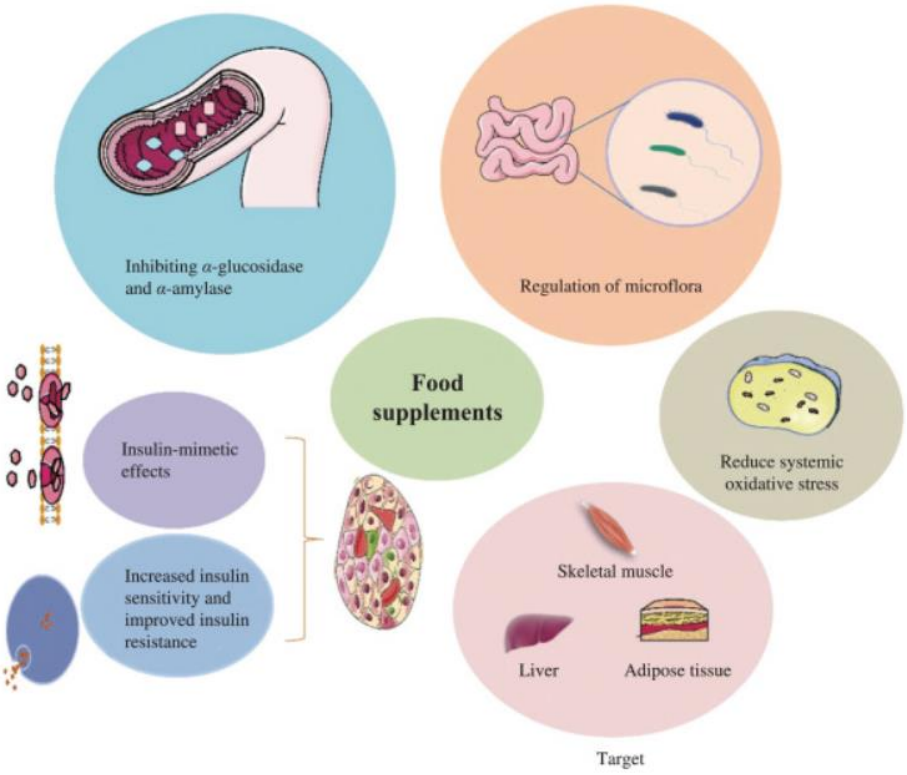
ii) Regulation of microflora

iii) Reduce systemic oxidative stress

iv) Insulin mimetic effects

v) Increased insulin sensitivity and improved insulin resistance

Fig. 1: Food supplements and their role on the management of DM (Xiangxi Meng *et al.*, 2021)



Conclusion

Diabetes mellitus (DM) is a serious chronic metabolic disease characterized by hyperglycemia due to lack of insulin secretion, insulin action, or both (Schmidt *et al.,* 2018 and Duran-Lopez *et al.,* 2021). Insulin plays a central role in maintaining average blood sugar levels. In patients with diabetes, insulin production is absent or reduced, leading to hyperglycemia (Verma *et al,* 2018 and Hasanpour *et al.,* 2020). Uncontrolled DM can lead to serious chronic complications such as blindness, heart failure, eye problems, stroke, nerve damage, dental disease and kidney failure (Policardo *et al.,* 2015, Bragg *et al.,* 2017 and Yang *et al.,* 2019). The treatment strategies for DM have improved over the last few decades. Despite

the improvement of patients with DM over the few decades, anti-diabetic drugs have serious side effects such as hypoglycemic coma, and liver and kidney disorders (Chaudhury *et al.,* 2017). This review paper highlights the potential efficacy of FS in preventing or controlling DM. In a modern society striving for a healthy life, overcoming DM is seen as an inevitable challenge for people. It is clear that much energy must be invested in basic research and clinical trials to identify and validate new drug targets. The diabetic component of FS is a renewable natural resource with the characteristics of sustainable and healthy development. According to the current concept of health and the development of FS, the development of anti-hyperglycaemic health products will have a far-reaching impact in the future.

References

1. Afolayan, A.J. and Sunmonu, T.O. (2010). In vivo studies on Antidiabetic plants used in South Africa Herbal medicine. *J Clin Biochem Nutri.* 47:98–106.
2. Aisa, H.A., Gao, Y. and Yili, A. (2019). Beneficial role of chickpea (*Cicer arietinum L.*) functional factors in the intervention of metabolic syndrome and diabetes mellitus, *Bioact Food Diet Interventions Diabetes.* 615-627.
3. Alarcon Aguilar, J., Jimenez Estrada, M. and Reyes Chilpa, *R*. (2009). Hypoglycemic effect of extracts and fractions from Psacalium decompositum in healthy and alloxan-diabetic mice *J. Ethnopharmacol*., 72: 21-27.
4. Alarcon Aguilar, F.J., Jimenez Estrada, M. and Reyes Chilpa, R. (2000). Hypoglycemic effect of extracts and fractions from Psacalium decompositum in healthy and alloxan-diabetic mice *J. Ethnopharmacol*., 72: 21-27.
5. Alegbe, E.O., Teralı, K. and Olofinsan, K.A. (2019). Antidiabetic activity-guided isolation of gallic and protocatechuic acids from Hibiscus sabdariffa calyxes. *J. Food Biochem*., 43 (7): 12927.
6. Anderson, R.A., Broadhurst, C.L. and Polansky, M.M. (2004). Isolation and characterization of polyphenol type-A polymers from cinnamon with insulin-like biological activity. *J. Agric. Food Chem*., 52 (1): 65-70.
7. Bach, E.E., Hi, E.M.B. and Martins, A.M.C. (2018). Hypoglycemic and hypolipedimic effects of Ganoderma lucidum in streptozotocin-induced diabetic rats Medicines (Basel), 5 (3): 78

8. Badescu, L., Badulescu, O. and Badescu, M. (2012). Mechanism by Sambucus nigra extract improves bone mineral density in experimental diabetes Evid. *Based Complement Alternat. Med.*
9. Bragg F., Holmes M.V., Iona A., Guo Y., Du H., Chen Y., Bian Z., Yang L., Herrington W. and Bennett D. (2017). Association Between Diabetes and Cause-Specific Mortality in Rural and Urban Areas of China. *JAMA.* 317:280–289.
10. Broca, C., Gross, R. and Petit, P. (1999). 4-Hydroxyisoleucine: experimental evidence of its insulinotropic and antidiabetic properties. *Am. J. Physiol.,* 277 (4): 617-623
11. Chai, R.H., Xiao, C.Y. and Guan, J. (2008). Hypoglycemic mechanism of total saponins of Momordica Charantia Chin. Tradit. Herb. Drugs, 39 (5): 746-747 751.
12. Chau, C.F. and Huang. Y.L. (2004). Characterization of passion fruit seed fibres-a potential fibre source. *Food Chem*., 85 (2): 189-194.
13. Chau, C.F., Chen, C.H., and Lee, M.H. (2004). Comparison of the characteristics, functional properties, and in vitro hypoglycemic effects of various carrot insoluble fiber-rich fractions. *LWT-Food Sci. Technol*., 37 (2): 155-160.
14. Chaudhury, A., Duvoor, C., Reddy Dendi, V.S., Kraleti, S., Chada, A., Ravilla, R., Marco, A., Shekhawat N.S., Montales M.T. and Kuriakose K. Clinical Review of Antidiabetic Drugs: Implications for Type 2 Diabetes Mellitus Management. Front. Endocrinol. 8:6.
15. Chen, X., Bai, X. and Liu, Y. (2009). Anti-diabetic effects of water extract and crude polysaccharides from tuberous root of Liriope spicata var. prolifera in mice. *J. Ethno pharmacol.* 122 (2): 205-209.
16. Choudhari, V.P., Gore, K.P. and Pawar, A.T. (2017). Antidiabetic antihyperlipidemic activities and herb-drug interaction of a polyherbal formulation in streptozotocin induced diabetic rats. *J. Ayurveda Integr. Med.,* 8 (4): 218-225.
17. Dey, L., Attele, A.S. and SuYuan, C. (2002): Alternative therapies for type 2 diabetes. *Alt Med Rev.* 7(1):45–48.
18. Duran-Lopez L., Dominguez-Morales J.P., Rios-Navarro A., Gutierrez-Galan D., Jimenez-Fernandez A., Vicente-Diaz S. and Linares-Barranco A. (2021). Performance Evaluation of Deep Learning-Based Prostate Cancer Screening Methods in Histopathological Images: Measuring the Impact of the Model's Complexity on Its Processing Speed. Sensors. 21:1122.
19. Ferreira, S.S., Silva, A.M. (2020). Nunes Sambucus nigra L. fruits and flowers: chemical composition and related bioactivities. *Food Rev. Int*. pp. 1-29.

20. Hannan, J.M.A., Rokeya, B. and Faruque, O. (2003). Effect of soluble dietary fibre fraction of Trigonella foenum graecum on glycemic, insulinemic, lipidemic and platelet aggregation status of type 2 diabetic model rats. *J. Ethnopharmacol*., 88 (1): 73-77.
21. Hansawasdi, C. and Kawabata, J. (2006). Alpha-glucosidase inhibitory effect of mulberry (Morus alba) leaves on Caco-2 Fitoterapia. 77 (7/8): 568-573
22. Hasanpour, M., Iranshahy M. and Iranshahi M. (2020). The application of metabolomics in investigating anti-diabetic activity of medicinal plants. Biomed. Pharmacother. 128:110263.
23. Hontecillas, R., O'Shea, M. and Einerhand, A. (2009). Activation of PPAR gamma and alpha by punicic acid ameliorates glucose tolerance and suppresses obesity-related inflammation. *J. Am. Coll. Nutr.,* 28 (2): 184-195
24. Hsu, J.H., Wu, Y.C. and Liu, I.M. (2006). Release of acetylcholine to raise insulin secretion in wistar rats by oleanolic acid, one of the active principles contained in *Cornus officinalis* Neurosci. Lett. 404: 112-116.
25. Jayakar, B. and Suresh, B. (2003). Antihyperglycemic and hypoglycemic effect of Aporosa lindleyana in normal and alloxan induced diabetic rats. *J. Ethnopharmacol*., 84 (2/3) (2003), pp. 247-249
26. Kabir, A.U., Samad, M.B. and Costa, N.M.D. (2014). Anti-hyperglycemic activity of Centella asiatica is partly mediated by carbohydrase inhibition and glucose-fiber binding BMC Complement Altern. *Med*., 14 (1): 31.
27. Kalailingam, P., Kannaian, B. and Tamilmani, E. (2014). Efficacy of natural diosgenin on cardiovascular risk, insulin secretion, and beta cells in streptozotocin (STZ)-induced diabetic rats Phytomedicine, 21 (10): 1154-1161
28. Kameswara Rao, B., Renuka, P., Sudarshan, M.D. and Rajasekhar. R. (2003). Antidiabetic activity of Terminalia pallida fruit in alloxan induced diabetic rats. *J. Ethnopharmacol*., 85 (1):169-172.
29. Kato, E., Kushibiki, N. and Inagaki, Y. (2017). Astilbe thunbergii reduces postprandial hyperglycemia in a type 2 diabetes rat model via pancreatic alpha-amylase inhibition by highly condensed procyanidins Biosci. Biotechnol. Biochem, 81 (9): 1699-1705
30. Knentz, A.J. and Nattras, M. (1991). Diabetic ketoacidosis, non ketotic hyperosmolar coma and lactic Acidosis. In: Pickup JC, Williams G, editors. *Handbook of diabetes.* 2nd edition. Blackwell Science. 479–494.
31. Kumar, P.J. and Clark, M. (2002). *Textbook of clinical medicine.* London: Saunders; 2002. pp. 1099–1121.

32. Lee, M.J., Rao, Y.K. and Chen, K. (2010). Andrographolide and 14-deoxy-11, 12-didehydroandrogr-apholide from *Andrographis paniculata* attenuate high glucose-induced fibrosis and apoptosis in murine renal mesangeal cell lines J. Ethnopharmacol., 132 (2): 497-505.
33. Li, Y., Wen, S. and Kota, B.P. (2005). *Punica granatum* flower extract, a potent alpha-glucosidase inhibitor, improves postprandial hyperglycemia in Zucker diabetic fatty rats J. Ethnopharmacol., 99 (2):239-244.
34. Li, Y., Peng, G. and Li, Q. (2004). *Salacia oblonga* improves cardiac fibrosis and inhibits postprandial hyperglycemia in obese Zucker rats Life Sci., 75 (14): 1735-1746
35. Naowaboot, J., Pannangpetch, P. and Kukongviriyapan, V. (2009). Antihyperglycemic, antioxidant and antiglycation activities of mulberry leaf extract in streptozotocin-induced chronic diabetic rats Plant. Foods Hum. Nutr. 64 (2): 116-121.
36. Nova, E., Redondo-Useros, N. and Martinez-Garcia, R.M. (2020). Potential of Moringa oleifera to improve glucose control for the prevention of diabetes and related metabolic alterations: a systematic review of animal and human studies Nutrients, 12: 7.
37. Ou, S., Kwok, K.C. and Li, Y. (2001). In vitro study of possible role of dietary fiber in lowering postprandial serum glucose. *J. Agric. Food Chem*., 49 (2): 1026-1029
38. Panda, S. and Kar, A. (2010). Antidiabetic and antioxidative effects of Annona squamosa leaves are possibly mediated through quercetin-3-O-glucoside Bio factors, 31: 201-210.
39. Papaspurou, M., Laschou, V.C. and Partsiopoulou, P. (2015). Fears and health needs of patients with diabetes: a qualitative research in rural population. *Med Arch.* 69(3): 190-195.
40. Pinaffi, A., Sampaio, G.R. and Soares, M.J. (2020). Insoluble-bound polyphenols released from guarana powder: inhibition of alpha-glucosidase and proanthocyanidin profile Molecules, 25 (3): 679.
41. Policardo, L., Seghieri, G., Anichini, R., De Bellis, A., Franconi, F., Francesconi , P. and Mannucci, E. (2015). Effect of diabetes on hospitalization for ischemic stroke and related in-hospital mortality: A study in Tuscany, Italy, over years 2004–2011. *Diabetes/Metab. Res. Rev.* 31:280–286.
42. Rang, H.P., Dale, M.M. and Ritters, J.M. (1991). In: The endocrine pancreas and the control of blood glucose, in pharmacology. Simmons B, Beasley S, editors. UK: Longman Group Ltd. Pp. 403–410.

43. Rtibi, K., Selmi, S. and Grami, D. (2017). *Ceratonia siliqua* L. (immature carob bean) inhibits intestinal glucose absorption, improves glucose tolerance and protects against alloxan-induced diabetes in rat. *J. Sci. Food. Agric*., 97 (8): 2664-2670.
44. Schmidt A.M., Maahs D.M., Daniels S.R., de Ferranti S.D., Dichek H.L., Flynn J., Goldstein B.I., Kelly A.S., Nadeau K.J., Martyn-Nemeth P. (2018). Highlighting Diabetes Mellitus. Arter. Thromb. Vasc. Biol. 8.
45. Sharma, A.K. (1993). In: *Diabetes mellitus and its complications: An update.* Galadari EO, Behara I, Manchandra M, Abdulrazzaq SK, Mehra MK, editors. New Delhi: Macmillian; pp. 391-401.
46. Trinidad, T.P. Valdez, D.H. and Loyola, A.S. (2003). Glycaemic index of different coconut (*Cocos nucifera*)-flour products in normal and diabetic subjects. *Br. J. Nutr*., 90 (3): 551-556.
47. Uemura, T., Hirai, S. and Mizoguchi, N. (2010). Diosgenin present in fenugreek improves glucose metabolism by promoting adipocyte differentiation and inhibiting inflammation in adipose tissues. *Mol. Nutr. Food Res*., 54 (11): 1596-1608
48. Verma S., Gupta M., Popli H. and Aggarwal, G. (2018). Diabetes mellitus treatment using herbal drugs. *Int. J. Phytomed.*10:1–10.
49. Villarruel-López, A., López-de la Mora, D.A. and Vázquez-Paulino, O.D. (2018) Effect of Moringa oleifera consumption on diabetic rats BMC Complementary Altern. *Med*., 18 (1): 127.
50. Virdi, J., Sivakami, S., and Shahani, S. (2003). Antihyperglycemic effects of three extracts from *Momordica charantia*. J. Ethnopharmacol., 88 (1): 107-111
51. Wang, C., Yin, Y., and Cao, X. (2016). Effects of Maydis stigma polysaccharide on the intestinal microflora in type-2 diabetes. *Pharm. Biol*., 54 (12): 3086-3092
52. Wang, T., Kusudo, T. and Takeuchi, T. (2013). Evodiamine inhibits insulin-stimulated mTOR-S6K activation and IRS1 serine phosphorylation in adipocytes and improves glucose tolerance in obese/diabetic mice. PloS One., 8 (12): 83264.
53. Xiangxi. M., Qinyu, L., Ruyu, S., Jiayin, C., Hong, C. and Minhui, L. (2021). Food supplements could be an effective improvement of diabetes mellitus: a review. *Journal of Future Food*. 1(1): 67-81.
54. Yadav, S., Vats, V. and Dhunnoo, Y. (2002). Hypoglycemic and antihyperglycemic activity of Murraya koenigii leaves in diabetic rats. *J. Ethnopharmacol*., 82: 111-116.

55. Yang J.J., Yu D., Wen W., Saito E., Rahman S., Shu X.O. and Zheng W. (2019). Association of diabetes with all-cause and cause-specific mortality in Asia: A pooled analysis of more than 1 million participants. JAMA Netw. Open. 2:192696.
56. Zablocka-Slowinska, K., Dzielska, E., Gryszkin, I. and Grajeta, H. (2014). Dietary supplements during diabetes therapy and the potential risk of interactions. *Adv Clin Exp Med.*23 (6):939-946.
57. Zaklos-Szyda, M., Pawlik, N. and Polka, D. (2002). Viburnum opulus fruit phenolic compounds as cytoprotective agents able to decrease free fatty acids and glucose uptake by Caco-2 cells. Antioxidants (Basel), 8 (8): 262.
58. Zulet, M.A., Macarulla, M.T. and Portillo, M.P. (1999). Lipid and glucose utilization in hypercholesterolemic rats fed a diet containing heated chickpea (*Cicer aretinum* L.): a potential functional food. *Int. J. Vitam. Nutr. Res*., 69 (6): 403-411.

TRADITIONAL TECHNOLOGY IN PROCESSING OF DESIGNER OIL

Sridevi Sivakami. PL[1] and Siva sankari. A[2]

[1]Associate Professor and [2]Research Scholar, Department of Food Service Management and Dietetics, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu, India.

Abstract

India, contributing 6-7% of global oilseeds production, faces a rising demand for edible oils projected between 22.8 and 29.4 million tonnes. This study addresses the increasing trend of oil blends in the market by innovatively combining underutilized coconut, groundnut, and sesame oils with cumin and turmeric extracts. Incorporating black cumin seed oil offers health benefits with unsaturated fats, while turmeric antioxidants reduce fat oxidation. The aim is to explore the rheological properties of these blends. The oils were extracted through expelling, filtered, and analyzed for rheological properties, including viscosity, wet ability, solubility, saponification value, rancidity, and acid value, with certification from Tamil Nadu Agricultural University. The rheological analysis highlighted distinctive characteristics of the designer oils. Viscosity varied, with groundnut oil exhibiting the highest (41.06 Centistokes) and coconut oil blend the lowest (38.60 Centistokes). Solubility values were comparable (1.8 to 3.0 ml/100ml), and wet ability characteristics were minimal, with coconut oil displaying the least wet ability (below 0.1%). Saponification values indicated stability, with coconut oil leading (191.1 mg KOH/g oil), followed by sesame oil (188.2 mg KOH/g oil), and designer groundnut oil showing the least (137.0 mg KOH/g oil). Rancidity levels were acceptable, with values of 0.28 milli equl/kg in designed sesame oil, 0.31 milli equl/kg in designed coconut oil, and 0.25 milli equl/kg in designed groundnut oil. Acid values mirrored the free fatty acids present, with higher values in designer coconut oil (4.0 milliequl/kg), followed by designed sesame oil (3.5 milliequl/kg), and the least in designed groundnut oil (3 milliequl/kg), underscoring their potential for extended shelf life and culinary use. In conclusion, this rheological exploration of designer oils accentuates their culinary versatility, enriched by regional preferences and health-conscious formulations.

Keywords: *Oil blends, Healthy formulations, Oxidative stress, Stability, Rancidity.*

Introduction

In the agricultural economy of India, oilseeds are important next to food grains in terms of average, production and value. India is the world's fifth largest oil-seed producing nation accounts for about 13 percent of world oilseeds area, eight per cent of world oilseeds output and six per cent of world vegetable oil production. (Hegde, 2013).

For processing of oilseeds and oil bearing materials, India has a large network of oil millIs employing more than 10 million people. Oil milling industries at present, consist of about 0.25 million village ghanies, 50,000 power driven ghanies, 50,000 mechanical expellers, 360 solvent extraction plants and 90 vanaspati units. The installed capacity of oil mills is estimated as 35 million tonnes per annum besides there is solvent extraction plants of about 6.8 million tonnes per annum capacity in the country.

Traditionally, Indians consume substantial quantity of edible oils mainly as a cooking medium, oil extraction is an age old activity in the country and with the advent of new techniques, and the extraction process is now convenient as well as hygienic. Oil extracted from sesame seeds is not as popular as other edible oils like groundnut, cottonseed, mustard or rapeseed but it is used as a cooking medium in some parts of the country it is also used in preparation of certain medicines (Veendeep Oil Tech Processes Pvt. Ltd., 2013).

In ancient times, ghani crushers in India were recorded as being a separate caste and this distinction still persists. Since the start of the twentieth century, as the demand for ghani oil has dropped, turning away from ghani crushing as they have from many other artisanal activities in a rapidly changing social, technological and economic environment (Bose, 1975).

Use of ghani crushing in India has probably stabilized at the current level of subsidized operations. In the future, power driven devices are certain to displace traditional ghanis worked by animal traction. Still powered ghanis in India are in prevalence and perhaps even in other developing countries with limited local supplies of raw materials for oilseed extraction, and there may be a place for batteries of power ghanis to multiply oil output from a common shaft in factory operations (Achaya, 1993).

The traditional method of oil processing was by hydraulic press by which the virgin oil is extracted as the evolution occurs expeller machine are used and the oil obtained is purely organic. The recent trends in oil extraction is solvent extraction. In this method the solvent is separated from the oils and is universally used by the big commercial oil processors because it gets more oils out quicker and cheaper about 98 percent of the oil is solvent extracted globally. Ghanis originated in India where they are primarily used to express oil from mustard and sesame seeds, although in some cases they can be used for coconut and groundnut processing. Expeller pressing

extraction is common, though the screw press, ram press and ghani (powered mortar and pestle) are also used. Oilseed presses are commonly used in developing countries, among people for whom other extraction methods would be prohibitively expensive

In many countries, traditional processes for processing oil are very important, especially among communities which have easy access to raw oleaginous materials. Traditional processing trends to do environmental and skill in a changing industrial atmosphere, these positive features have been out weighted by the negative aspects of traditional processing (Agriculture and Consumer Protection, 2010).

Traditionally ghanis are operated by animals and can be manufactured locally. They consist of a wooden mortar and wood or stone pestle. Mechanized versions of the traditional animal-powered ghanis are replaced. Power ghanis have a greater capacity than the traditional ghanis and can process about 1000 kg of seed per day, power ghanis yield an oil with a lower pungency (Damodaram, and Hegde, 2007).

Methodology

Selection of oil seeds

The inhabitants of several regions have developed specific preference for certain oils largely depend upon the availability. People in the south and west prefer to have groundnut oil while those in east and north use mustard or rapeseed oil in their cooking where as in south people prefer to take coconut and sesame oil (Department of Food and Public Distribution, Govt. of India, 2014).

As per the type of soil in Tamil Nadu the groundnut, sesame , sunflower seeds and coconuts are cultivate in the agricultural land. These seeds are locally available at a moderate economic price, they are rich in nutrients and health beneficial too. For the present research groundnut oil, sesame oil and coconut oil were selected to formulate the designer oil.

The designer oil was formulated by adapting traditional expeller pressed method of dried coconuts (*Cocos nucifera*), groundnuts (*Arachis hypogaea*), sesame seeds (*Sesamum indicum*) with black cumin seeds (*Nigella sativa*), curry leaves (*Murraya koenigii*) and turmeric (*Curcuma longa*)

Plant and Machinery

Processing of designer oil requires different machinery to extract oil from the plant sources, the machinery includes expellers complete with long heating kettle, other accessories like electrical filter press with plunger pump, filter cloth, weighing scale, oil storage tanks ,blender and shaker screen with blower.

Findings of the Study

Pre-processing of Oil Seeds and Selected Herb, Spices

Harvesting

The coconuts are harvested at fully ripen stage to obtain its good quality. The maturity of groundnut pods is examined by its color, the groundnuts are harvested by either pulling or digging up the plants manually or mechanically. The sesame seeds are protected by the capsules on ripening those bursts and kernels are removed.

The maturity of cumin seeds are seen when the color changes and they are harvested by removing the whole plant from the ground. The curry leaves from the tree foliage that are arranged alternately on the stem. The whole turmeric plant is removed from the ground and the rhizomes must not be bruised.

Husking

The most prevalent method of husking coconuts is by manually. It involves the removing the husk by impaling the coconut on an iron or wooden spike which pierces the husk.

Field drying

After the groundnuts has been harvested they are inverted and placed in windows in field. They are left to dry for two weeks during this period the moisture content of pod reduces to about 10 percent.

Shelling

The shell of the dehusked coconut is cracked into two equal halves with a hatchet, the coconut water was drained out and the drying process is under taken to avoid bacterial action and spoilage. Removing the groundnut kernels from pod is referred as “decorticating” or shelling. On small holdings, the groundnuts are shelled manually or a simple hand operated decorticators are available.

Sweating

The turmeric roots washed in water and the lateral branches of the rhizomes are cut off, the rhizomes are heaped and covered in leaves to sweat for a day.

Drying

Sun drying process is very common and simple method which is most prevalent. The process involves placing drained coconut on the ground with open side turned to sun depending on the climatic condition the drying process is done for five to seven days. On the first day the moisture content reduces from 55 percent to 35 percent, on the second day 20 percent of moisture was noted and in the next day further reduced to five to six percent. The groundnuts are sun dried for three days till it reaches moister content less than 15 percent. The sesame seeds are removed

from the capsules and drying process is carried out for three days till moisture retains up to 15 percent. The cumin seeds are dried in the sun or in the partial sun for two days.

The curry leaves are sun dried or shadow dried till the moisture reaches less than 20 percent. The turmeric rhizomes are removed and dried in the sun immediately, finally moisture content should be between 8 and 10 percent.

Threshing and Winnowing

The cumin seeds are beaten out by threshing the dried plants with sticks. The seeds are dried to reduce the moisture content up to 10 percent. The dried seeds are winnowed using a traditional winnowing basket to remove the dirt, dust, leaves and twigs.

Bagging and Storage

The dried coconut copra's are stuffed in jute bags and stored, the relative humidity in storage area should not exceed 85 percent at room temperature or nine percent at 40°c. The groundnut kernels are collected in sacks and stored at room temperature in rigid humidity of 85 percent. The sesame seeds are bagged and dry stored in jute bags at rigid humidity of 85 percent. In case of cumin seeds, turmeric and curry leaves must be stored in moisture proof thick gunny bags.

Processing of Edible Oils

Processing can remove the components of edible oils which may have negative effects on taste, stability, appearance and nutritive value. Oil seeds are rich source of bioactive components however a major portion of these components is not present in refined oils because they are lost during refining process to extent the oil on processing should preserve tocopherols and prevent chemical changes in the triacylglycerol's. Before attempts are made to introduce improved methods of oil extraction an effort had taken to understand the traditional methods employed on oil extraction. The rural oil extraction usually occurs near the areas of raw material production to get its access, this helps to ensure that the perishable oil crops are processed quickly and hence these oils are purely organic and natural.

Extraction Process of Oils

The pre-processed copra's (dried coconuts), groundnuts and sesame oil seeds are extracted in separate oil blends as they are mixed with the fixing agent palm jaggery. The role of fixing agent is the one that encourages in fine extraction of oil from oil seeds. The addition of oil seeds and fixing agent during extraction process was done at the ratio of seeds (coconuts : palm jaggery :: 10 : 1 ; groundnut : palm jaggery : 10 : 1 and sesame : palm jaggery : 10 : 2).

Expelling

As the raw materials passes through the expeller the oil is squeezed out, exits through the perforated cage and is collected in a trough under the machine. The solid residue, oil cake, exits from the end of the expeller shaft when it is bagged.

Filtration

The crude expelled oil contains solid and other foreign particles which can be removed by allowing the oil to stand and then filtering the clear oil by gravity through fine cloth. A better method is pumping the crude oil through a filter press.

Production capacity of oils seeds

Expeller pressed oils are economical hence the oil is mechanically expressed without the use of solvents or chemicals. It has an excellent quality of food grade oil that is not hydrogenated and contains no trans fatty acids. Expeller pressed oils has a neutral flavor and contains the same medium chain fatty acids as virgin oil. The yield of the oil from oil seeds will also be maximum from the oil bearing seeds, the separation of the deoiled cake is also easier in expeller method of oil extraction.

Table 1-Production Capacity of Various Oil Seeds

Name of the ingredients	Processing Input Capacity (kg)	Production Capacity		Time taken (Minutes)
		Yield (liters)	Deoiled Cake (kg)	
Coconut meat	10	5.2	6.5	35
Sesame seeds	10	4.5	7	40
Groundnut kernel	10	4	6.2	40
Cumin seeds	5	1.2	5	60
Curry leaves	10	3.5	8.6	45
Turmeric	5	0.8	4.4	60

Above table reveals that the production of oil from the oil seeds are extracted to a maximum of oil from the seeds and the deoiled cake and the residue obtained after the extraction are bagged and supplied as cattle feeds.

Blending of oils

Blending of oil combines the potency of three edible oils to offer a balance of fatty acid. Various cooking preparations existing across different ethnicities and regions subject oil to different cooking temperature thereby damaging oil to various level of oxidative stress. With the view to tackle the oxidative damage of unsaturated fatty acid, a blending of oil with spices &herbs. Taking into consideration the regional preferences of the local population, the present

study focuses on the three different oil blends using coconut oil, groundnut oil and sesame oil as control with the selected herb (curry leaves) and spices (turmeric and cumin seed), these oil blends were used for cooking purposes.

Table II-The Ratio of Designer oil blends

Types of oil(ml)		Phases	Cumin seedextract (ml)	Turmeric extract (g)	Curry leavesextract (ml)
Coconut oil	90	I	5	0.5	5
	85	II	5	0.5	10
	80	III	5	0.5	15
Sesame oil	90	I	5	0.5	5
	85	II	5	0.5	10
	80	III	5	0.5	15
Groundnutoil	90	I	5	0.5	5
	85	II	5	0.5	10
	80	III	5	0.5	15

Conclusion

However, the study needs to focus on the synergisticeffect blending of oil combines the potency of edible oils to offer a balance of fatty acids, various cooking oil preparations existing across different ethnicities and regions subject oil to different cooking temperature thereby damaging oils to different oxidative stress. With the view to tacklethe diets low in saturated and trans-unsaturated fat for the health and the oxidative damage of unsaturated fatty acid the blend of edible oil with selected herb and spices extract with a patented anti-oxidant technology was designed.

References

1. Achaya K.T., (1993). Oilseeds and Oil milling in India: A Cultural and historical Survey, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Bureau of Indian Standards, Blended Edible vegetable oils-Specification, (1995), Oils and Oilseeds Sectional Committee, FAD
3. Damodaram, T., Hegde, D.M., (2007). Oilseeds situation in India: A Statistical Compendium.Directorate of Oilseeds Research, Hyderabad, India.

4. Hegde, D.M., (2007). Vegetable Oils Scenario in India: Past, Present and Future. Renewable Energy Science Series. 12, 1 - 17.
5. Veendeep oil tech processes Pvt. Ltd., (2013), Oil expellers and ancillary equipment, Medium- tolarge-scale expellers and solvent extraction.

மானிடவியலாரின் உணவுக்கோட்பாடும் சங்ககாலப் பண்பாடும்

ரா. சரஸ்வதி,

உதவிப் பேராசிரியர்,
சீதாலட்சுமி இராமசுவாமி கல்லூரி, திருச்சி.

முன்னுரை

பசி என்பது எல்லா உயிர்களுக்கும் பொதுவானதாகும். எல்லா உயிரினங்களும் தங்களது இயக்கத்திற்கு ஏற்ப உணவினை உட்கொள்கின்றன. இந்த உலகில் ஐம்புலன்களை அடக்கியாளும் ஞயானியானாளும் பசிக்கு புசித்தல் ஒன்றே மருந்தாகும். எனவேதான் அடிப்படைத் தேவையான உணவு, உடை, உறைவிடத்தில், உணவு முதலிடம் பெறுகிறது. இத்தகு உணவினைச் சங்ககால மக்கள் இயற்கையாகவே பெற்றனர். மானிடவியலார் உணவியல் சார்ந்து குறிப்பிடும் கோட்பாடுகளும் சங்ககால மக்கள் பின்பற்றிய உணவு முறைகளும் ஒன்றுபடுவதை இவ் ஆய்வுக்கட்டுரை எடுத்துரைக்கிறது.

ஆய்வுச்சுருக்கம்:

சங்ககால உணவு முறைகள் இன்றைய கால மக்களுக்கு நல்ல உணவுப் பழக்கத்தைப் போதிக்கின்றன. உணவுச் சங்கிலியால் பிணைக்கப்பட்ட சமுதாயத்தில் இன்றைய பழக்கங்களே நாளைய வழக்கங்களாகின்றன. விஞ்ஞானம் மற்றும் விரைவு உலகத்தில் நல்ல உணவுப் பழக்கங்களால் மட்டுமே, நல்ல எதிர்காலத்தை உருவாக்க இயலும் என்பது இவ்ஆய்வின் சுருக்கமாகும்.

உணவியல்சார் மானிடவியல்:

மக்கள் விரும்பி உண்ணும் உணவானது, அவர்களது விருப்பத்திற்குத் தக்கவும், தேவையைப் பொறுத்தும் மாறுபடுகிறது. அவை சிறப்பு உணவுகள் என்றும், சாதாரண உணவுகள் என்றும் அமைகின்றன. விருந்தினர்கள் வரும் பொழுதும், சிறப்பான

தருணங்களிலும், சங்க காலத்தில் 'மாமிச உணவு' சிறந்த உணவாக அமைந்ததை நற்றிணைவழி (பா.35:1-4) அறியமுடிகிறது. அதுபோல மற்ற நேரங்களில் அந்நிலம் சார்ந்து அதிகப்படியாகக் கிடைக்கும் உணவுகள் உண்ணப்படுகின்றன. மானிடவியலாரின் கருத்துப்படி உணவானது,

"மக்கள் அவரவர் உண்ணும் சாதாரண உணவிற்கும், தேர்ந்தெடுத்து உண்ணும் சிறப்பு உணவிற்கும், பிற ஊட்ட உணவிற்கும் பல்வேறு காரணங்களைக் கொண்டுள்ளனர். ஒவ்வொரு பண்பாட்டிலும் அதற்கான காரணங்கள் ஆயிரக்கணக்கிலுள்ளன. அவையனைத்தையும் உயிரியல்சார் நோக்கில் ஆராய்வதே உணவியல்சார் மானிடவியலாளரின் பணியாகும்"1

என்கிறார் பக்தவத்சல பாரதி. இவ்வாறு நிலம் சார்ந்து அமைந்த உணவுகளும், அவை உற்பத்தி செய்யப்பட்ட தன்மைகளும் முல்லை, குறிஞ்சி, மருதம், நெய்தல் நில இனக்குழுக்களின் பண்பாடாக அமைகின்றன.

முல்லை நில உணவுகள்:

முல்லை நிலத்தில் சிறுசிறு தானியங்கள் பயிரிடப்படுகின்றன. முரல் உணவும், வரகுத்தினை உணவுகளும் இதற்கு உதாரணங்களாகும். வரகரிசியை வேகவைத்துத் துவரை விதையின் பருப்பை (துவரம்பருப்பு) அதிகமாக விட்டு ஒன்றாகச் சமைத்த உணவினை 'மூரல்" என்பர். இதனை,

"நெடுங்குரற் பூளைப் பூவினன்ன
குறுந்தாள் வரகின் குறளவிழச்
.....
தீன்சுவை முரற் பெறுகுவீர்" 2

என்ற அடிகள் வெளிப்படுத்துகின்றன. தினைச்சோற்றினைப் பாலுடனும்(பெரும்பாண் 168) உண்டுள்ளனர்.

குறிஞ்சி நில உணவுகள்:

மலை சார்ந்த குறிஞ்சி நிலத்தில் கிடைக்கும் அனைத்து இயற்கை உணவுகளும் குறிஞ்சி இனக்குழு மக்களின் அன்றாட உணவுகளாக அமைகின்றன. அவர்கள் மிக வலிமையுடன் காணப்படுவதற்கு மலை உணவுகள் முக்கிய காரணமாகிறது. இயற்கையான தேன், கிழங்கு. மா, பலா, வாழைக்கனிகள், மற்றும் வேட்டையாடிய உணவுகள் முதலிய அனைத்தும், அதிக புரதச்சத்து நிறைந்த உணவுகளாக அமைத்துள்ளன. தினை, ஐவனம், வரகு, வெண்ணெல் முதலியவற்றையும் விளைவித்து உண்ணுகின்றனர். குறவர்கள் இயற்கை மற்றும் உற்பத்தி மூலம் கிடைக்கும் உணவுகளைவிட வேட்டையாடிய உணவுகளையே விரும்பி உண்டுள்ளனர். இதனை

"மாடாக்கின் இனக்குழுவியல் வரைபடத் தரவுகளின்படி உலகில் மொத்த நிலப்பரப்பில் 15 **விழுக்காடு, இன்றும் வேட்டையாடி உணவு சேகரிக்கும் மக்கள் வசம் உள்ளது"**3

என்கிறார் பக்தவச்சல பாரதி. இதிலிருந்து குறிஞ்சில மக்கள் மட்டுமல்லாது, பிற நிலமக்களும் இறைச்சி உணவினை விரும்பியுள்ளதை அறியமுடிகிறது. குறவர்கள் கொழுப்பு நிறைந்த மாமிச உணவினை விரும்பி உண்டதை அகநானூறும்(132:5) எடுத்துரைக்கிறது. குறிஞ்சி நிலத் தலைவி, முள்ளம்பன்றியின் கொழுப்புள்ள தசையினை மகிழ்ந்து சுற்றத்தார்க்கு உணவாகக் கொடுக்கிறாள். இதனை,

"கானவன் எய்த முளவுமான் கொழுங்குறை

தேம்கமழ் கதுப்பின் கொடிச்சி மகிழ்ந்து கொடு" 4

என்று நல்விளக்கனாரும் குறிப்பிடுகிறார். இவ்வாறாக வேட்டையாடிய கொழுப்பு நிறைந்த மாமிசம், குறிஞ்சி நில மக்களின் விருப்ப உணவாக அமைகிறது.

நிலத்தில் பயிரிடப்படும் விளைப்பொருட்களை வேளாண் உணவு என்பர். முல்லை நிலம் போல, குறிஞ்சிநில மக்களும் பருவ மழையை எதிர்பார்த்துப் பயிரிடும் இயல்பினர் ஆவர். பயிரிடப்படும் தானியங்கள், அவர்கள் பயன்படுத்தியது போக எஞ்சியவை பரிமாற்றம் செய்யப்படுகின்றன. குறிஞ்சி நில மக்கள் 'ஐவனம்' எனும் நெல்லினை விதைத்து உண்டனர். தினை மற்றும் நெல்லினைப் போல கிழங்குகளும் மக்களால் விரும்பி உண்ணப்படுவதால், அவை விதைக்கப்பட்டுத் தக்கப் பருவம் வந்ததும் அகழ்ந்து எடுத்துப் பயன்படுத்தப்படுகின்றன. இதனை,

"பழங்குழி அகழ்ந்த கானவன் கிழங்கினொடு
கண் அகள் தூமணி பெறூஉம் நாடன்" 5

என்ற அடிகள் வெளிப்படுத்துகின்றன. தினை அரிசியில் செய்யப்பட்ட பொங்கலினை நெய்யூற்றி, ஆட்டுக்கறியுடன் உண்டுள்ளனர். இதனை 'தினைப் பொங்கல்' (மலைபடு 168-169) என்று வழங்குவர். கம்பு, வரகு, தினை, சாமை, சோளம், குதிரைவாலி, கேழ்வரகு போன்ற சிறுதானியங்களில், அதிகளவு ஊட்டச்சத்து, இரும்புச்சத்து, புரதச்சத்து, நார்ச்சத்து, கண்ணாம்புச்சத்து, நிறைந்து காணப்படுகின்றன. இவை இரத்தச் சோகையை குணப்படுத்துகின்றன. இதில் உள்ள வைட்டமின் 'பி' சத்தானது, இரத்தத்தில் கொழுப்பு கலப்பதைத் தடுத்து இதயத்தைப் பாதுகாக்கிறது என்று மருத்துவ அறிஞர்கள் குறிப்பிடுகின்றனர்.

கடினமான பாதுகாப்பு உறைகளைக் கொண்ட இச்சிறுதானியங்களின் அமைப்பினைக் கொண்டு, அவற்றின் ஆற்றலை உணரமுடிகிறது. இவற்றை உண்டதால்தான் மலைவாழ் மக்கள் இன்றளவும் நோயெதிர்ப்பு ஆற்றலுடன் வலிமை கொண்டு காணப்படுகின்றனர். ஆனால், இன்றைய காலக்கட்ட மக்கள் வெறும் 10 செ.மீ. நீளமுள்ள நாக்கின் உணர்வைப் பெரிதென எண்ணி துரித உணவுகளுக்கு அடிமையாகி வாழ்நாளைக் குறைத்துக் கொள்கின்றனர்.

மருதநில உணவுகள்:

மருதநில மக்கள் எளிய வேளாண்மையை விட பண்பட்ட வேளாண்மையால் விளைவிக்கப்பட்ட வெண்நெல், செந்நெல், கரும்பு முதலிய பணப்பயிர்களை உணவாக உண்டுள்ளனர். விருந்தினர்களுக்குச் சிறந்த விருந்தாக வெண்நெல் அரிசியால் செய்த உணவினை, பெடைக்கோழிக்கறியுடன் செய்த பொரியலுடன் சேர்த்து உணவாகத் தந்தனர். இதனை,

வினைஞர் தந்த வெண்ணெல் வல்சி
மனைவா ழளகின் வாட்டொடும் பெறுகுவீர்”6

என்ற அடிகளால் அறியமுடிகிறது. வெண்நெல்லினை உலக்கையிலிட்டு இடித்து அவலாகவும் (பெரும்பாண்.223-224) உண்டுள்ளனர். மருத நிலத்தில் கரும்பு காய்ச்சும் ஆலைகள் வழியாகச் சென்றால், இனிய கரும்புச் சாற்றினை வேண்டுமளவு பருகலாம்.

“விசய மடூஉம் புகைசூழ் ஆலைதொறும்
கரும்பின் தீஞ்சாறு விரும்பினீர் மிசைமின்”7

என்ற அடிகள் கரும்புச்சாறு, மருத நிலத்தில் களைப்பினைத் தீர்க்கும் பானமாக அமைந்ததைப் புலப்படுத்துகஉணவுகள்

நெய்தல்நில உணவுகள்:

நெய்தல் நில மக்களின் அன்றாட உணவுகளில் மீன் சார்ந்த உணவுகள் முதன்மை பெறுகின்றன. வளமையான நிலத்தில் கொழுத்த மீனினை உணக்கும் மணமானது ஊரெங்கும் வீசியது. உண்ணும் ஆர்வத்தையும் தூண்டியது என்பதை,

"கொழுமீன் சுடுபுகை மறுகினுள் மயங்கி"8

என்ற உலோச்சனாரின் அடி வெளிப்படுத்துகிறது. மீன் உணவு மற்ற உணவுகளைக் காட்டிலும், உடலிற்கு நன்மை பயக்கும் உணவாகும். மீன்கள் நீரில் வாழ்வதால், நீர் சார்ந்த உடல் உபாதைகளுக்குச் சிறந்த தீர்வாக (சளி, இருமல், நுரையீரல்) அமைகின்றன.

தொகுப்புரை:

இவ்வாறு சங்க கால மக்களின் உணவு முறைகளில் தானியங்களான வரகு, தினை பாரம்பரிய உணவாக அமைகின்றன. ஆயினும் 'அரிசியே மிகுதியாக விளைவிக்கப்படுகின்றன. மக்களால் அதிகம் உண்ணப்படுபவையே அதிகமாக உற்பத்தி செய்யப்படுகிறது. அரிசியைவிட சிறுதானியங்களின் விலை இரண்டு மடங்காக உள்ளது. இவற்றின் பயன்பாடு அதிகமாகும் பட்சத்தில், உற்பத்தியும் அதிகமாகும். விலையும் குறையும். தவறான உணவுப்பழக்க வழக்கங்களால் உண்டாகும் நோய்களும் கட்டுப்படுத்தப்படும்.

அடிக்குறிப்பு:

- பக்தவத்சல பாரதி பண்பாட்டு மானிடவியல், ப.98.
- பெரும்பாணாற்றுப்படை வரிகள் 192-196
- பக்தவத்சல பாரதி பண்பாட்டு மானிடவியல், ப.462
- நற்றிணை பாடல் 85:8-9

- குறுந்தொகை பாடல் 379:2-3
- பெரும்பாணாற்றுப்படை வரிகள் 255-256
- பெரும்பாணாற்றுப்படை வரிகள் 261-262
- நற்றிணை பாடல் 311:6

OPTIMIZING ATHLETIC PERFORMANCE: THE ERGOGENIC EFFECTS OF MILLET-BASED SUPPLEMENTS

Divya. L[1], Raajeswari.Pa[2]

[1]I PG Student, [2]Associate Professor, Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, India.

divyalakshmanan65@gmail.com

Abstract

Every student aspires to participate in a sport when young. It starts by playing out door games which includes running, kho – Kho, throw ball, shuttle, cricket, football. As time passes some will excel in a particular sport. The sports person have to take nutritious and complete meal to support and improve their performance. Finding the right high-performance diet can be challenging for an athlete. Not only do their meals need to be healthy and filled with the proper mix of nutrients, but they also need a few snacks they can munch on before, after, and occasionally during competition. In case of nutritional composition of various types of Millets serve as decent source of protein, micronutrients and phytochemicals. It encompasses 65-75% carbohydrates, 2-5% fat, 15-20% dietary fibre and 7-12% protein. The essential amino acid profile of the millet protein is healthier than various cereals such as maize. Millets contain fewer cross-linked prolamins, which may be an additional factor contributing to higher digestibility of the millet proteins. Similar to cereal proteins, the millet proteins are poor sources of lysine, but they complement well with lysine rich vegetables (leguminous) and animal proteins which form nutritionally balanced composites of high biological value.

Keywords: *Millets, athletic performance, ergo*

Introduction

Millets are more nutritious compared to fine cereals. Small millets are good source of phosphorous and iron. Millets contributes to antioxidant activity with phytates, polyphenols, tannins, anthocyanins, phytosterols and pinacosanols present in it having important role in aging and metabolic diseases. All millets possess high antioxidant activities.

Millets are a whole grain that's packed with protein, antioxidants, and nutrients. They may have numerous health benefits, such as helping lower your blood sugar and cholesterol levels. Plus, they're gluten-free, making them an excellent choice for people who have celiac disease or follow a gluten-free diet. Athletes must fuel their bodies with the appropriate nutritional foods to meet their energy requirements in competition, training and recovery. If these nutritional needs are not met, there is an increased risk of poor performance and health issues. Millets are rich in essential nutrients, including iron, magnesium, and B vitamins, which play crucial roles in oxygen transport, muscle function, and energy metabolism—key factors for athletic performance.

The versatile grains also contribute to overall health, supporting immune function and aiding recovery. Vital nutrients assist keep the body's nutritional requirements in check and offer excellent nourishment to athletes both before and after workouts. Sorghum is included in sports nutrition, improving quality and build muscle. Their amino acid profile supports muscle protein synthesis, aiding in recovery after exercise.

Methodology

1.Soak sorghum for about 6 – 8 hours / overnight in water
2.Pat them dry using tissue / sundry
3.Roast them in a medium flame until you observe slight colour changes
4.In a pan roast sunflower seed and almond separately
5.Now mix all the 3 ingredients and grind them using a blender
6.Cardamom can be added as it enhances flavour
7.Blend until it turns to fine powder
8.Seive the millet powder to get a uniform mixture.

Result

Millets can contribute to enhanced stamina due to their nutritional composition, particularly their complex carbohydrates and micronutrient content.

1. Millets are rich in complex carbohydrates, which provide a sustained release of energy. This can help maintain stamina and endurance during physical activities, making them beneficial for athletes and individuals engaged in prolonged exercise.

2. The low glycemic index of millets contributes to stable blood sugar levels. This characteristic is important for sustained energy and can prevent rapid spikes and crashes, supporting stamina during physical exertion.
3. Millets contain essential minerals such as magnesium and iron, which play vital roles in muscle function, oxygen transport, and energy metabolism. Adequate levels of these micronutrients contribute to overall stamina and endurance.
4. Millets provide a range of nutrients, including B vitamins, which are involved in energy production. The diverse nutrient profile of millets supports various physiological functions that contribute to overall stamina.
5. Millets are generally well-tolerated and easy to digest, reducing the risk of gastrointestinal discomfort during physical activity. This can positively impact stamina by ensuring that the body efficiently utilizes the energy provided by millet

Discussion

When powdered form of sorghum, sunflower seeds and almonds are given it will be easily to consume and when taken along water/milk which helps in rehydration. Intake of gluten free diets among sports people favours digestion, says study. Sorghum is rich in antioxidants when compared to berries. It reduces muscle damage, immune dysfunction and fatigue, and will thus improve performance. Antioxidant use has been shown to decrease DNA damage, lipid peroxidation, and protein oxidation following exercise. Iron present in sorghum and Sunflower seeds helps in distributing Oxygen to muscle. Sunflower seeds help maintain muscle tone, strengthen them and avoid muscle cramps because they are a source of magnesium. Vitamin B in seeds will help in keeping energy levels up and prevent fatigue. Almonds Promotes Muscle Recovery and Reduces Fatigue from Exercise. A new study involving people who exercise less than 3 times a week demonstrated that snacking on almonds increased leg and lower back strength, enhanced recovery post-exercise, and reduced fatigue and tension.

Therefore this combination serves as a power pack of macronutrients, antioxidants, vitamins and minerals. Added to this it as helps in rehydration when consumed as a drink. Consuming this ergogenic millet powder in the form of drink, milkshake will improve immunity and performance among sport person.

Conclusion

All athletes are required to consume a healthy diet comprising whole grains, protein, fruits, and vegetables. Pre and post-workout nutrition is one of the essential aspects of athletic training. Light meal at least 1-2 hours before a workout or training session, known as a pre-workout snack. Post-workout nutrition is equally important to replenish the lost energy and refuel your body. It is recommended to avoid heavy meals and high-fat and heavy protein snacks before the training session, as they are heavy to digest and may cause sluggishness during training. It is essential that athletes include a healthy (and complex) source of carbohydrates and a good source of protein in their diet. A healthy source of carbs moderates' insulin levels and preserves liver glycogen.

This millet based supplement will satisfy the nutrient requirement of sports person and helps in improving their performance.

Maintaining a good level of hydration is another important aspect of pre and post-workout nutrition for athletes. Apart from water, you can also consume vegetable juices and buttermilk to maintain good hydration and provide other essential nutrients too. Millet mix along with water, Fruit juices will serve as nutrient enhancers. Though the exact nutrition requirements can be different for different athletes and highly dependent upon various factors like body composition, the type of sport they play, etc.

References

- https://www.researchgate.net/publication/272741086_Noble_Millet_Food_Products_for_Quality_Life_of_All_Walks_of_Life_and_Age_Groups
- https://www.investindia.gov.in/team-india-blogs/nutritional-powerhouse-unlocking-benefits-millets
- https://www.researchgate.net/publication/275653985_THERAPEUTIC_POTENTIAL_OF_SUNFLOWER_SEEDS_AN_OVERVIEW#:~:text=Sunflower%20plant%20(Helianthus%20annuus)%20is,skin%20diseases%20and%20even%20cancers

ABOUT THE INSTITUTION

Seethalakshmi Ramaswami College, an autonomous Institution, affiliated to Bharathidasan University, Tiruchirappalli, accredited by NAAC with A+ grade (4th cycle) is a renowned women's Institution in Tamil Nadu. At the time when women's education was not much favored in the society, our founder Padmabushan Shri. N. Ramaswami Ayyar founded the Institution with the noble purpose of educating women in the year 1951. His ardent desire was to provide modern education to women in the background of the rich Indian culture. This great Institution is now spearheaded by Gnanavaridi, Arappani Chemmal, Magalir Kalvi Penum Gunalar Sri.R. Panchapakesan, Managing Trustee an enlightened educationist, an able administrator who has tirelessly crusaded for the betterment of women through education. Autonomy was conferred in 1987 and it is also one of the first 7 colleges in the country accredited by the National Assessment and Accreditation Council in 1999. The College offers 24 UG, 17 PG and 8 Ph.D programmes. The Institution is marching ahead successfully by empowering women through quality education on the strong foundation of ethical, moral and cultural values. Every year more than 1200 graduates leave this portal of learning and are employed in various reputed national and global organizations. The College is aspiring to scale greater heights as an Institution for higher education, serving with the motto *"Nothing Equals Wisdom".*

ABOUT THE DEPARTMENT

The Department of Nutrition and Dietetics was instituted in the year 1983. Students graduated from this Department are successfully placed in industry and institutions of repute. It was awarded UGC funded B.Voc. Food Processing programme in 2018 under National Skill Qualification Framework (NSQF) a flagship programme of the Honorable Prime Minister and aimed at promoting skill development and entrepreneurship particularly for women. Through this programme the remote, rural women folk of Tiruchirappalli completed their diploma, advanced diploma and degree in Food Processing and became successful entrepreneurs. Since nutrition is cornerstone for good health that is vital for national development, the Department is making concerted efforts to achieve the National goal of "Health for All" through its societal outreach activities. The Department of Nutrition and Dietetics has taken up the challenge of offering updated knowledge through experiential learning. Since its inception, the Department has envisioned community development as a core component and has taken up the responsibility of nurturing successful teachers, administrators, researchers, nutritionists, entrepreneurs and health conscious citizens.

ISBN: 978-93-94638-54-9