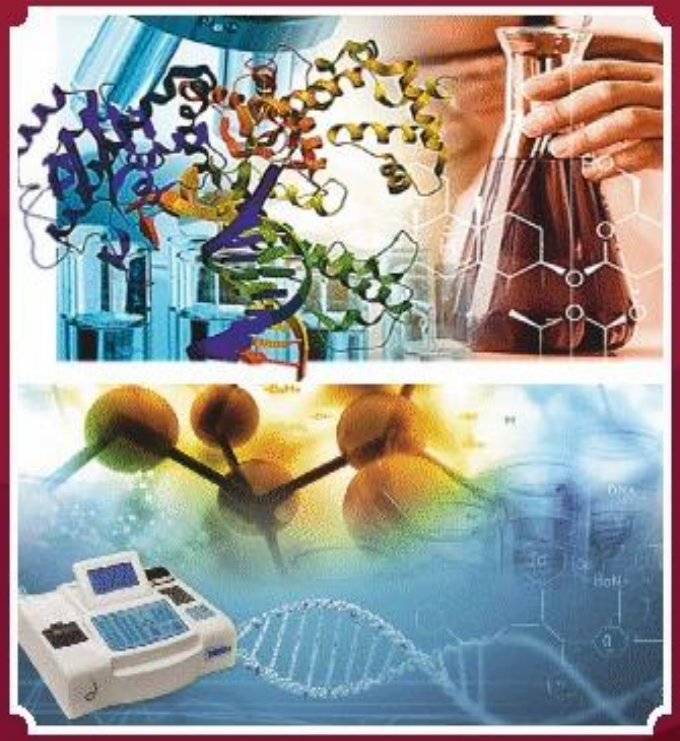


Publishers:
Darshan Publishers,
8/173, Vengayapalayam, Rasipuram,
Namakkal, Tamil Nadu, India – 637406.
www.darshanpublishers.com
E-mail: darshanpublishers12@gmail.com

Printers:
Dhazh Computers (Graphic Designer)
No: 442- A, 10th East Cross Street,
Munthirithoppu, Annanagar,
Madurai – 20, Tamil Nadu, India.
E-mail: naveennarayanasamy@gmail.com

ISBN: 978-93-93942-61-6

Basic and Clinical Biochemistry - Dr. G. Durai Muthu Mani

BASIC AND CLINICAL BIOCHEMISTRY

First Edition

Dr. G. Durai Muthu Mani

Darshan Publishers, Tamil Nadu, India

ISBN: 978-93-93942-61-6

BASIC AND CLINICAL BIOCHEMISTRY

First Edition

Dr. G. Durai Muthu Mani
Assistant Professor, Department of Biochemistry,
SRM Arts and Science College,
Kattankulathur,
Tamil Nadu, India

Editor

Dr. K. Thiruppathi M.L.I.Sc., M.Phil., M.A., B.Ed., Ph.D.
Librarian, SRM Arts and Science College, Kattankulathur- 603202.

Darshan Publishers, Tamil Nadu, India

First published in India in 2024

This edition published by Darshan publishers

http://www.darshanpublishers.com

ISBN: 978-93-93942-61-6

Price: Rs: 450.00

Published by:

Darshan Publishers,
8/173, Vengayapalayam, Kakkaveri, Rasipuram,
Namakkal, Tamil Nadu,
India – 637406.
www.darshanpublishers.com
E-mail: darshanpublishers12@gmail.com

Printed by:

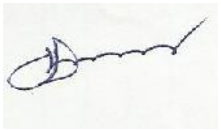
Dhazh Computers (Graphic Designer)
No: 442- A, 10th East Cross Street,
Munthirithoppu, Annanagar,
Madurai – 20, Tamil Nadu, India.
E-mail: narennarayanasamy@gmail.com

Dr. D. Tamilvendan, M.Sc., M.Phil., Ph.D.,
Laboratory-In-Charge.,
Salem Smart Laboratory,
NABL, DGCA & DGAQA Accredited Lab.
INDIAN OIL CORPORATION LIMITED[M.D.],
Sankari Durg.R.S.- 637 302
Salem District, Tamil Nadu.

29.07.2024
Salem

"Basic and Clinical Biochemistry" by **Dr. G. Durai Muthu Mani** is a valuable educational resource for students of biochemistry, particularly those interested in the intersection of biochemical theory and clinical practice. Its structured approach and focus on examination preparation make it a practical choice for undergraduate students.

"Basic and Clinical Biochemistry" is a comprehensive textbook designed to provide a deep understanding of the fundamental principles of biochemistry with a focus on clinical applications. The book is primarily targeted at undergraduate students pursuing a B.Sc. degree in microbiology, as indicated by its alignment with the syllabus prescribed by the University of Madras for the academic years 2023-2024. The book is structured into several key sections, each dedicated to different biochemical concepts and their clinical relevance like Biomolecules, Disorders of Metabolism, Clinical Biochemistry, Question Papers and Analysis. The Key strength of the book is Comprehensive Coverage, Educational Tools and Focus on Clinical Application. I hope this book is highly fruitful to the undergraduate students.



Dr. D. Tamilvendan

Preface

The ultimate goal of biochemistry is to explain all life processes in molecular detail. It powers scientific and medical discovery in fields such as pharmaceuticals, forensics and nutrition. Therefore, it is necessary to have a thorough understanding of life science.

So I believe that this book will fulfill the needs of the Nature.

Dr. G. Durai Muthu Mani
Assistant Professor, Department of Biochemistry,
SRM Arts and Science College,
Kattankulathur
Tamil Nadu, India

About Author

Dr. G. Durai Muthu Mani is Assistant Professor in Biochemistry working at SRM College of Arts and Science Kattankulathur, Chengalpet District, Tamil Nadu, India, affiliated to University of Madras Chennai. He has completed his under graduation in Biochemistry in S. Chattanatha Karayalar College of Arts and Science Tenkasi. He did his Master degree at Biochemistry in MIET Arts & Science College, Trichy and M.Phil, Biochemistry Bharathidasan University Trichy. He completed his Ph.D degree from Biochemistry in Manonmaniam Sundaranar University. Tirunelveli. He has 18 years working experience as a Assistant Professor for research students. He had published research papers in national & international journals, also attended seminar, national and International conferences at the various institutes.

Acknowledgement

First and foremost I thank the **Almighty God** for his blessings and knowledge to write and complete the book successfully.

I am thankful to Founder chairman **Dr. T.R. Paarivendhar, Chairman, Dr. Ravi Pachamuthu, Vice-Chairman Dr. P. Sathyanarayanan, Correspondent, Ms. Harini Ravi, Principal, Dr. R. Vasudevaraj, Vice-Principal Prof. K. Mathiyazhagan, Our Biochemistry department HOD, Dr. S. Jayakumar, Assistant Professors, Mrs. Hemalatha. M, Dr. Arirudran. B, Dr. Aruna. R, Dr. Yuvaraj.M, Dr. Ravilla Leelarani Chandrababu and Dr.V.Chitra**, SRM Arts and Science College, Kattankulathur. 603202., and **Editor Dr. K. Thiruppathi M.L.I.Sc., M.Phil.,. M.A. B.Ed. Ph.D.,** the book who completed the given task on time.

I am grateful to **Mrs. D. Sudha, and Selvi. P. Jaanupriya** for continuous support.

My sincere and heartfelt thanks to all my teaching and non teaching staff **Mr. M. Samidurai, Mr. G. Elandan. and Mrs. S. Indumathi**, my brothers, sisters, students, friends and relatives who has always supported, encouraged and stood beside me during all times and helped me from the start till the completion of the book.

THANKS

TO

Parents and Family...

புத்தகச்சிறகுகள்

எண்ணப்பறவை

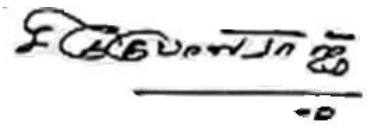
சிறகடித்து

இதயவானத்தை

எட்டிப்பிடிக்க

நாளும் முயலும்

வண்ணப்புத்தகச் சிறகுகள்!



CONTENT

UNIVERSITY OF MADRAS

B.SC. DEGREE COURSE IN MICROBIOLOGY

SYLLABUS WITH EFFECT FROM 2023-2024

ALLIED-I: BASIC AND CLINICAL BIOCHEMISTRY

(Theory)

(For Microbiology branch Students)

Instr. Hrs:4 **SUB.CODE:136E1A**

Year: I **Credits: 3**

Semester: I

Learning outcomes:

1. Explain the structure, classification, functions, and significance of carbohydrates and lipids.

2. Differentiate essential and non-essential amino acids, biologically important modified amino acids and their functions, illustrate the role, classification of proteins and recognize the structure level organisation of proteins, its function and denaturation.

3. Assess defective enzymes and Inborn error. Recognise diseases related to carbohydrate and lipid metabolism.

4. Discuss and evaluate the pathology of amino acid metabolic disorders.

5. Appraise the imbalances of enzymes in organ function and relate the role of Clinical Biochemistry in screening and diagnosis.

Course content:

UNIT I - Course outcome 1(CO 1): Attain thorough knowledge on carbohydrates and lipids, their characteristic properties and organisation in carrying out all the living functions which constitute the life

Biomolecules - Carbohydrates- General properties, functions, structure, classification - Monosaccharides (Glucose, Fructose, Galactose), Oligosaccharides (Sucrose, Maltose, Lactose) and Polysaccharides (Starch, Glycogen) and biological significance. Lipids - General properties, functions, structure, classification (Simple, Derived and complex), Cholesterol- LDL, HDL - biological significance.

UNIT II - Course outcome 2(CO 2): Explain the biological activity of amino acids and proteins

Biomolecules - Amino acids - General properties, functions, structure, classification and biological significance. Proteins - General structure, properties, functions, structure, classification and biological significance.

UNIT III - Course outcome 3(CO 3): Identify the metabolic errors in enzymes of carbohydrates and lipids

Disorders of metabolism : Disorders of carbohydrate metabolism: Diabetes mellitus, Ketoacidosis, Hypoglycemia, Glycogen storage diseases, Galactosemia and lactose intolerance. Disorders of lipid metabolism: Hyperlipidemia, Hyperlipiproteinemia, Hypercholesterolemia, Hypertriglyceridemia, Sphingolipidosis.

UNIT IV - Course outcome 4(CO 4): Describe the disorders in amino acid metabolism

Disorders of metabolism: Disorders of amino acid metabolism: Alkaptonuria, Phenylketonuria, Phenylalaninemia, Homocysteineuria, Tyrosinemia, Aminoacidurias.

UNIT V - Course outcome 5(CO 5): Interpret the consequences, biochemical, clinical features, diagnosis and treatment of metabolic diseases of day to day life.

Evaluation of organ function tests: Assessment and clinical manifestations of renal, hepatic, panreactic, gastric and intestinal functions.Diagnostic enzymes: Principle of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase.

Text books:

1. Satyanarayana,U. and Chakrapani,U (2014).Biochemistry, 4th Edition, Made Simple Publisher.

2. Jain J L, Sunjay Jain and Nitin Jain (2016). Fundamentals of Biochemistry, 7th Edition, SChand Company.

3. Ambika Shanmugam's(2016). Fundamentals of Biochemistry for Medical Students,8th Edition.Wolters Kluwer India Pvt Ltd.

4. Vasudevan.D.M.Sreekumari.S, Kannan Vaidyanathan (2019). Textbook of Biochemistry For Medical Students. Kindle edition, Jaypee Brothers Medical Publishers

5. Jeremy M. Berg, Lubert Stryer, JohnL. Tymoczko, GregoryJ. Gatto(2015). Biochemistry, 8th edition.WH Freeman publisher.

References :

1. Amit Kessel& Nir Ben-Tal(2018). Introduction to Proteins: structure, function and motion.2nd Edition, Chapmanand Hall.

2. David L. Nelson and Michael M.Cox(2017). Lehninger Principles of Biochemistry,7th Edition W.H. Freeman and Co., NY.

3. Lupert Styrer, Jeremy M.Berg, John L.Tymaczko, GattoJr., GregoryJ(2019). Biochemistry.9th Edition, W.H. Freeman & Co. New York.

4. Donald Voet, Charlotte Pratt (2016). Fundamentals of Biochemistry: Life at the Molecular Level, 5th Edition, Wiley.

Joy PP, Surya S. and Aswathy C (2015). Laboratory Manual of Biochemistry, Edition 1., Publisher: Kerala agricultural university.

UNIVERSITY OF MADRAS

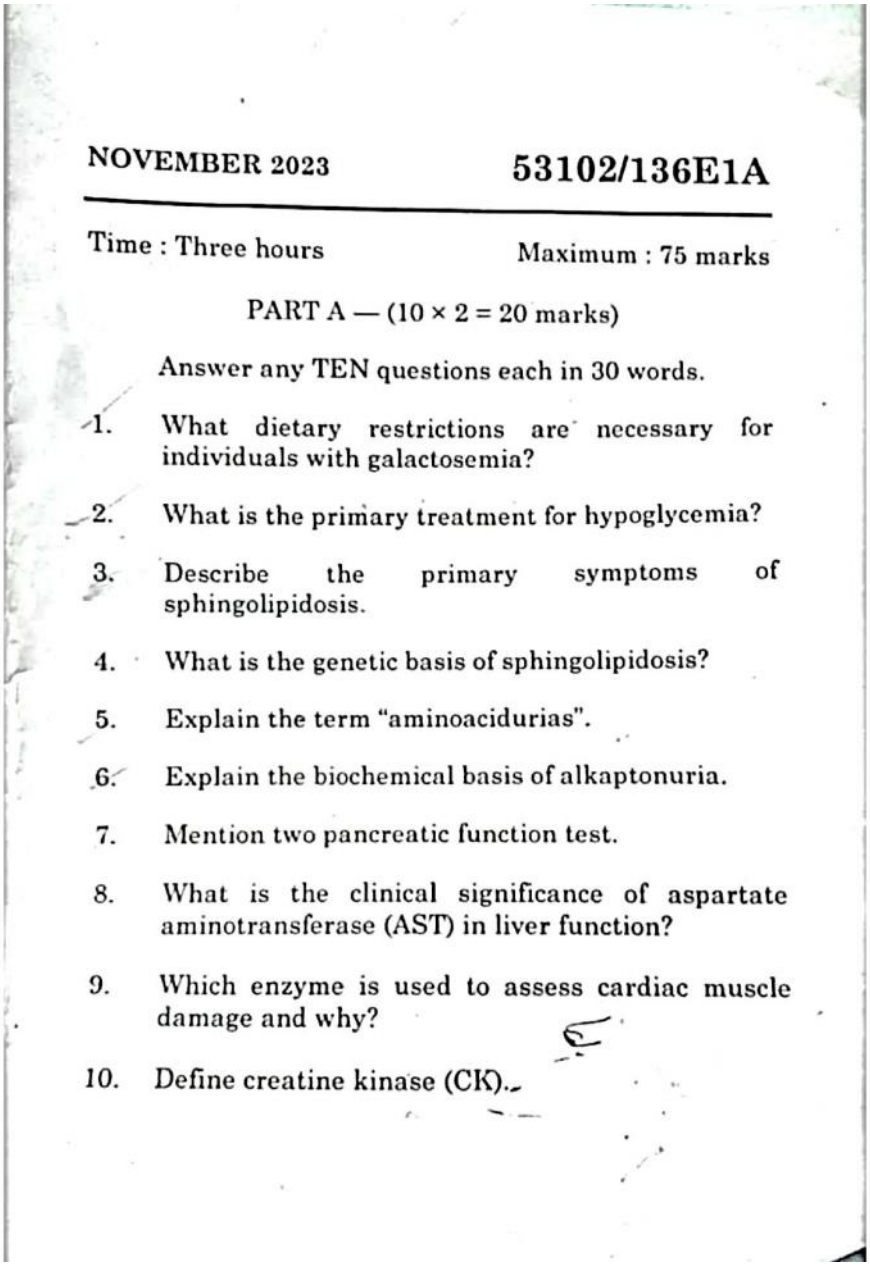
B.Sc. DEGREE COURSE IN MICROBIOLOGY

SYLLABUS WITH EFFECT FROM 2023-2024

SUB.CODE: 136E1A

ALLIED-I: BASIC AND CLINICAL BIOCHEMISTRY(Theory)

(For Microbiology branch Students)



NOVEMBER 2023 **53102/136E1A**

Time : Three hours Maximum : 75 marks

PART A — (10 × 2 = 20 marks)

Answer any TEN questions each in 30 words.

1. What dietary restrictions are necessary for individuals with galactosemia?
2. What is the primary treatment for hypoglycemia?
3. Describe the primary symptoms of sphingolipidosis.
4. What is the genetic basis of sphingolipidosis?
5. Explain the term "aminoacidurias".
6. Explain the biochemical basis of alkaptonuria.
7. Mention two pancreatic function test.
8. What is the clinical significance of aspartate aminotransferase (AST) in liver function?
9. Which enzyme is used to assess cardiac muscle damage and why?
10. Define creatine kinase (CK).

UNIVERSITY OF MADRAS

B.Sc. DEGREE COURSE IN MICROBIOLOGY

SYLLABUS WITH EFFECT FROM 2023-2024

SUB.CODE :136E1A

ALLIED-I: BASIC AND CLINICAL BIOCHEMISTRY(Theory)

(For Microbiology branch Students)

Page -2

11. How is the isoenzyme profile of LDH used to determine the source of tissue damage?

12. Explain the clinical significance of aspartate aminotransferase (AST) in liver function tests.

PART B — (5 × 5 = 25 marks)

Answer any FIVE questions each in 200 words.

13. Describe the process of gluconeogenesis and its significance in glucose homeostasis.

14. Discuss the genetic and dietary factors contributing to hypercholesterolemia and its association with atherosclerosis.

15. Discuss the clinical manifestations and treatment strategies for tyrosinemia.

16. Compare the metabolic pathways affected in alkaptonuria and phenylketonuria.

17. Discuss the clinical manifestations of renal dysfunction and the key tests used to evaluate kidney function.

18. Elaborate on the significance of creatine kinase (CK) and aldolase in the diagnosis of muscle-related disorders.

19. Explain the significance of aldolase levels in assessing muscle and liver function.

UNIVERSITY OF MADRAS

B.Sc. DEGREE COURSE IN MICROBIOLOGY

SYLLABUS WITH EFFECT FROM 2023-2024

SUB .CODE :136E1A

ALLIED-I: BASIC AND CLINICAL BIOCHEMISTRY(Theory)

(For Microbiology branch Students)

Page -3

PART C — (3 × 10 = 30 marks)

Answer any THREE questions each in 500 words.

20. Describe the biochemical basis of ketoacidosis in diabetes and the clinical manifestations.

21. Explain the biological significance of Lipid transport system.

22. Describe the pathophysiology of phenylketonuria.

23. Discuss in detail about the various test to assess the Gastric and intestinal functions.

24. Describe the diagnostic implications of measuring LDH and its isoenzymes in various clinical scenarios.

UNIVERSITY OF MADRAS

B.SC.DEGREE COURSE IN MICROBIOLOGY SYLLABUS WITH EFFECT FROM 2020-2021 SUB. CODE : SB31A

ALLIED-I:BIOCHEMISTRY(Theory)

(For Microbiology branch Students)

NOVEMBER 2020 **50152/SB31A**

Time : Three hours **Maximum : 75 marks**

PART A — (10 × 2 = 20 marks)

Answer any TEN questions, each in 30 words.

1. Write the structure of glucose and galactose.
2. Write any two properties of lactose.
3. Define an amino acid.
4. Define isoelectric point.
5. What are essential amino acids?
6. Name any two unsaturated fatty acids.
7. What is glycolipid? Give examples.
8. Define phospholipid.
9. What is salting in?
10. What is a dipeptide?
11. What are water soluble vitamins?
12. What are the diseases caused by the deficiency of vitamin C?

PART B — (5 × 5 = 25 marks)

Answer any FIVE questions, each in 200 words.

13. Write down the properties of monosaccharides.
14. Comment on the classification of amino acids based on side chain (R group)
15. Explain the biological importances of cholesterol.
16. Describe the various forces involved in the maintenance of the protein structures.
17. What are vitamins? Explain the classification of vitamins.
18. Explain how glucose is represented using Haworth projection formula.
19. Write the various biological roles of proteins.

PART C — (3 × 10 = 30 marks)

Answer any THREE questions, each in 500 words.

20. Describe in detail about the classification of carbohydrates.
21. Write a note on the classification of amino acids.

22. What are phospholipids? Explain its classification.
23. Explain the various levels of organization of proteins.
24. Comment on fat soluble vitamins and its deficiency diseases.

UNIVERSITY OF MADRAS

B.SC.DEGREE COURSE IN MICROBIOLOGY SYLLABUS WITH EFFECT FROM 2020-2021 SUB. CODE :SB31A

ALLIED-I: BIOCHEMISTRY(Theory)

(For Microbiology branch Students)

APRIL 2021 **50152/SB31A**

Time : Three hours Maximum : 75 marks

PART A — (10 × 2 = 20 marks)

Answer any TEN questions each in 30 words.

1. Draw the structure of sucrose and write any two properties.
2. What is heteropolysaccharides? Give two examples.
3. Define zwitterion.
4. Draw the structure of sulphur containing amino acids.
5. What are essential fatty acids? Give examples.
6. Name any two saturated fatty acid.
7. Draw the structure of cholesterol.
8. Write any two biological roles of proteins.
9. Define peptide bond.
10. What is salting out?
11. What are fat soluble vitamins?
12. What are the diseases caused by deficiency of vitamin D?

PART B — (5 × 5 = 25 marks)

Answer any FIVE questions each in 200 words

13. Write the physical and chemistry properties of disaccharide sucrose and lactose.
14. Explain homopolysaccharides with two examples.
15. What are the classification of proteins based on the source and biological function?
16. Comment on the classification of fatty acids.
17. Write a note on glycolipids.
18. Describe the secondary structure of proteins.
19. What are water soluble vitamins? Explain with examples.

PART C — (3 × 10 = 30 marks)

Answer any THREE questions each in 500 words.

20. Comment on the properties of monosaccharides.
21. Write down the properties of amino acids.
22. Describe compound lipids with examples.
23. Define and explain the following terms:
    (a) Disulfide linkages, (b) Van der waals force.
    (c) Hydrogen bond. (d) Salt linkages
24. Explain the classifications of vitamins with examples.

UNIVERSITY OF MADRAS

B.SC.DEGREE COURSE IN MICROBIOLOGY SYLLABUS WITH EFFECT FROM 2020-2021 SUB.CODE :SB31A

ALLIED-I: BIOCHEMISTRY(Theory)

(For Microbiology branch Students)

NOVEMBER 2022 **50152/SB31A**

Time : Three hours Maximum : 75marks

PART A — (10 × 2 = 20 marks)

Answer any TEN questions each in 30 words.

1. Define carbohydrates.
2. What are homopolysaccharides and heteroplysaccharides?
3. What are sulphur containing amino acids? Give examples.
4. What is Zwitterion?
5. What is bad cholesterol? Write the reason.
6. What are saturated fatty acids? Give examples.
7. What is isoionic point?
8. What is peptide bond?
9. What is scurvy?
10. Write the structure of vitamin A.
11. Mention the symptoms and causes of Beriberi.
12. Write the physical properties of amino acids.

PART B — (5 × 5 = 25 marks)

Answer any FIVE questions each in 200 words.

13. Describe the sources, chemistry and functions of disaccharide.
14. Explain the chemical properties of monosaccharides.
15. Compare and contrast saturated and unsaturated fatty acids.
16. Exemplify salting in and salting out process.
17. Demonstrate tertiary structure of proteins with example.
18. Write a note on vitamin B6 with its sources and functions.
19. Discuss the sources and biological functions of vitamin D

PART C — (3× 10 = 30 marks)

Answer any THREE questions each in 500 words.

20. Explain the occurrence, chemistry and biological functions of starch.
21. Give an account on chemical properties of amino acids with examples.
22. Discuss in detail about lipoproteins.
23. Illustrate the classification of proteins.
24. Illustrate the sources, chemistry, biological functions and deficiency of vitamin C

UNIVERSITY OF MADRAS

B.Sc. DEGREE COURSE IN MICROBIOLOGY

SYLLABUS WITH EFFECT FROM 2023-2024

SUB. CODE :136E1A, SB31A

ALLIED-I: BASIC AND CLINICAL BIOCHEMISTRY(Theory)

(For Microbiology branch Students)

	NOVEMBER2023					
UNIT	U-1	U-2	U-3	U-4	U-5	TOTAL
PART-1	-	-	4	3	5	12
PART-2	1	-	1	2	3	7
PART-3	-	--	2	1	2	5
TOTAL	1	-	7	5	10	24

	NOVEMBER2022					
UNIT	U-1	U-2	U-3	U- 4	U-5	TOTAL
PART–A	2	3	2	2	3	12
PART–B	2	-	1	2	2	7
PART–C	1	1	1	1	1	5
TOT	5	4	4	5	6	24

	APRIL2021					
UNIT	U-1	U-2	U-3	U-4	U-5	TOTAL
PART-1	2	2	3	3	2	12
PART-2	2	0	2	2	1	7
PART-3	1	1	1	1	1	5
TOTAL	5	3	6	6	4	24

UNIVERSITY OF MADRAS

B.SC.DEGREE COURSE IN MICROBIOLOGY SYLLABUS WITH EFFECT FROM 2020-2021 SUB. CODE :SB31A

ALLIED-I: BIOCHEMISTRY(Theory)

(For Microbiology branch Students)

	NOVEMBER2020					
UNIT	U-1	U-2	U-3	U-4	U-5	TOTAL
PART-1	2	3	3	2	2	12
PART-2	2	1	1	2	1	7
PART-3	1	1	1	1	1	5
TOTAL	5	5	5	5	4	24

IMPORTANT BLOOMS TAXONOMY VERBS				
	1(0R)2 MARKS →		5MARKS	10 MARKS
B1	Define	வரையறு		
	State	சுட்டிக்காட்டுக		
	Select	தேர்ந்தேடு		
	Quote	தேற்தகாள்		
	Name	பெயர்		
	Tell	சொல்லுங்கள்		
	Enumerate	எண்ணுக	←	
B2		விளக்குக	Explain	
		விவரிக்கவும்	Describe	
		சுருக்கவும்	Summarize	
		வகைப்படுத்து	Classify	
		விவாதிக்கவும்	Discuss	
		வேறுபடுத்து	Differentiate	
		வேறுபடுத்தி	Distinguish	
		விளக்குவது	Interpret	
B3		விளக்கவும்	Illustrate	
		நிரூபிக்க	Demonstrate	
		வரைக	Sketch	
B4		விளக்குக	Explain	
		வகைப்படுத்து	Classify	
		வேறுபடுத்து	Differentiate	
		முடிவு செய்	Conclude	
B5		முடிவு செய்	Conclude	
B6		தோகு	Compose	
		எழுதுக	Write	
		தோகுக்கவும்	Compile	

UNIVERSITY OF MADRAS

B.SC.DEGREE COURSE IN MICROBIOLOGY SYLLABUS WITH EFFECT FROM 2023-2024 SUB.CODE :136E1A

ALLIED-I: BASIC AND CLINICAL BIOCHEMISTRY(Theory)

(For Microbiology branch Students)

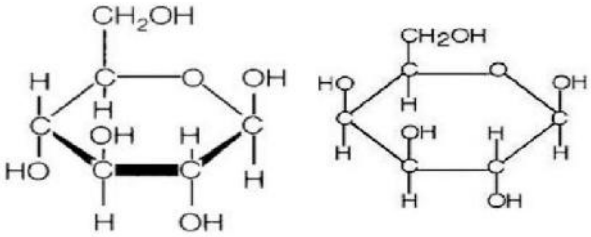
(UPTO NOVEMBER2023 QUESTIONS WERE ANALYSED)

UNIT - I

Biomolecules - Carbohydrates- General properties, functions, structure, classification - Monosaccharides (Glucose, Fructose, Galactose), Oligosaccharides (Sucrose, Maltose, Lactose) and Polysaccharides (Starch, Glycogen) and biological significance. Lipids - General properties, functions, structure, classification (Simple, Derived and complex), Cholesterol- LDL, HDL - biological significance.

PARTA—(10×2=20marks)
Answer any TEN questions, each in 30 words.

CO.1 BL: 61.Write the structure of glucose and

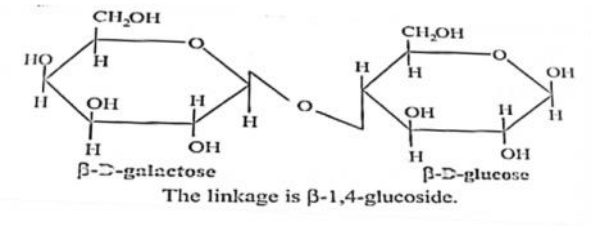


Galactose.(Nov.2020)

- Glucose and galactose are stereoisomers of each other. The main structural difference is between glucose and galactose is the orientation of the hydroxyl group (OH) at carbon 4

CO.1BL:62.Write any two properties of lactose. (Nov.2020)

- It is a Disaccharide purely of ***animal origin***
- It is commonly called ***milk sugar***. It is present in milk of mammals.
- It is present in the ***mammary gland***. However it is also found in urine during pregnancy.
- It is formed by the combination of ***Galactose*** and ***Glucose.*** The two sugars are linked by a ***Glycosidic bond***

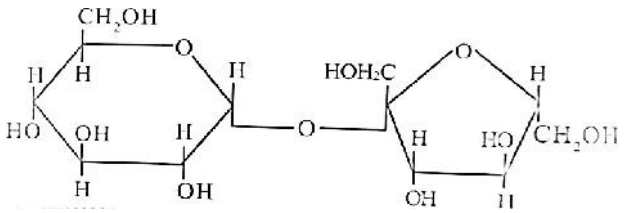


1. **Draw the structure of sucrose and write any two properties. (Apr 2021)**

CO.1 BL:3. Sketch the structure of sucrose and write any two properties.

Sucrose

- Sucrose is a disaccharide. It i s commonly called ***cane-sugar***.
- It is the ***table sugar***. It is formed of an***α-D glucose and B- D-fructose***.



- Sucrose on hydrolysis by dilute acids or the enzyme ***invertase (sucrase)*** gives invert sugar. It is a mixture of glucose and fructose. Glucose is dextrorotatory. Fructose is ***levorotatory.***
- There is inversion of the sign of rotation. This process is called inversion and the mixture is called ***invert sugar***.

2. What is heteropolysaccharides? Give two examples.(Apr2021)

Heteropolysaccharides

- Heteropolysaccharides are composed of a mixture of ***monosaccharides***. On hydrolysis, they yield a mixture of ***monosaccharides***.
- Heteropolysaccharides are further classified into two types, namely 1.***Neutral sugars and 2. Mucopolysaccharides***
  1. ***Neutral sugars*** such as ***hemicellulose,gums,etc***.,
  2. ***Mucopolysaccharides*** such as ***hyaluronic acid, chondroitin, chondroitin sulfate A,B and C, keratosulfate, heparin,*** etc.

1. Define Carbohydrates.(Nov.2022)

- Carbohydrates are known as one of the basic components of food, including sugars, starch, and fibre which are abundantly found in grains, fruits and milk products.
- Carbohydrates are also known as starch, simple sugars, complex carbohydrates and so on.
- It is also involved in fat metabolism and prevents ketosis.

2. What are Homopolysaccharides and Heteropolysaccharides? (Nov.2022)

Homopolysaccharides:

- A polysaccharidethat contains the same type of monosaccharides is known as a homopolysaccharide.
- Some of the important homopolysaccharides are:
  - **Glycogen**
  - **Cellulose**
  - **Starch**
  - **Inulin**

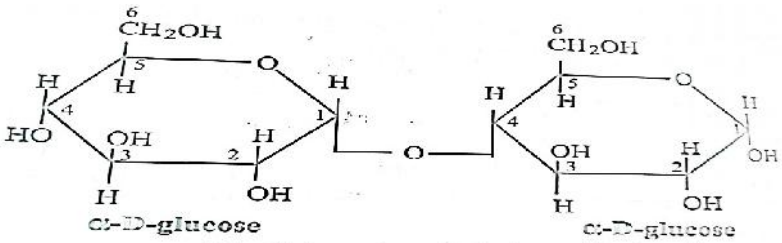
Heteropolysaccharides:

- A polysaccharide that contains different types of monosaccharides is known as a heteropolysaccharide.
- Some of the important heteropolysaccharidesare:
  - **HyaluronicAcid**
  - **Heparin**
  - **Chondroitin-4-sulfate**
  - **Gammaglobulin**

CO.1BL:1.Label the Glycosidic linkage of Maltose.(Expected) Maltose

1. It is a disaccharide. It is commonly called ***malt sugar***. Malt from sprouting ***barley*** is the major source of maltose.
2. It is produced during the digestion of starch by the enzyme ***a- amylase***.
3. Maltose is formed of two molecules of ***D-glucose***.

4. Maltose is formed by the removal of a molecule of water from the ***glycosidic OH group of a-D-glucose and the alcoholic OH group on carbon atom 4 of another D-glucose.***



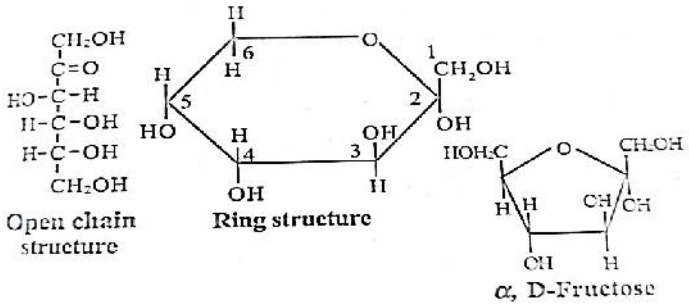
The linkage is α–1,4-glycosidic bond.

CO.1BL:3 Sketch any one Keto sugar.

(Expected) Fructose

1. It is a monosaccharide and a ***ketohexose***.
2. It is a sugar with ***crystalline state and sweet taste***. It is highly soluble in water.
3. It is a ***reducing sugar***.
4. It reduces Tollen's reagent and Fehling's solution.

5. It is an optically active compound. It is ***levorotatory***. So it is called as ***levo sugar***. It's specific rotation is ***-92º***



PARTB— (5×5 =25marks)

Answer any FIVE questions, each in 200 words.

CO.1BL:67.Write down the properties of monosaccharides. (Nov.2020)

Monosaccharides

- Monosaccharides are simple sugars.
- They are sweet in taste.
- They are soluble in water.
- They are crystalline in nature.
- They are represented by the general formula $(CH_2O)n$.

Properties of Monosaccharides

1. **Colour-**Monosaccharides are colourless.
2. **Shape-**They are crystalline compounds.
3. **Solubility-**They are readily soluble in water
4. **Taste-**They have sweet taste.

- **Optical Activity-**They are optically active.
- They rotate the plane polarized light.
- When a monosaccharide rotates the plane polarized light in the clockwise direction or to the right (dextrorotatory) the monosaccharide is called 'd' form.
- When a monosaccharides rotates the light in the anticlockwise direction or to the left (levorotatory) the monosaccharides is called 'l' form.

5. **Mutarotation**

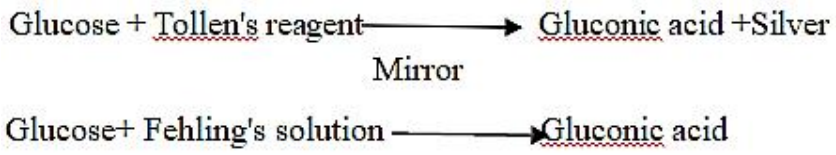
- Monosaccharides exhibit mutarotation. The change in specific rotation of an optically active compound is called mutarotation.

- When a monosaccharideis dissolved in water, the optical rotatory power of the solution gradually changes until it reaches a constant value.
- A freshly prepared aqueous solution of Alpha-D-glucose has a specific rotation of +112.20°.
- A freshly prepared solution of Beta-D-glucose has a rotation value of +18.7°.

+112°Alpha-D-glucose+52.5°Beta-D-glucose+19°

6. Reducing Agents (Oxidation)

- Glucose and other sugars capable of reducing oxidizing agents are called reducing sugars.
- This property is useful in the analysis of sugars. By measuring the amount of an oxidizing agent that is reduced by a solution of a sugar, it is possible to estimate the concentration of the sugar.
- In this way blood and urine can be analyzed for content of glucose in the diagnosis of diabetes mellitus.
- Glucose reduces Tollen's reagent, Fehling's solution, Benedict's reagents, etc. At the same time glucose is oxidized to gluconic acid.



7. Formation of Osazone

- Aldoses and ketoses react with phenylhydrazine Glucose consumes 3 molecules of phenylhydrazine and produces osazones, aniline and ammonia.
- Reaction with phenylhydrazine involves only 2 carbon atoms, namely the carbonyl carbon atom (the aldehyde or ketone group) and the adjacent one.
- Only reducing sugar forms an osazone derivatives. Non- reducing ones are not able to form it because they don't have an OH group attached to the anomeric carbon and hence are not able to reduce other compounds.

8. Fermentation

- Is the conversion of carbohydrates to alcohol and carbon dioxide, or organic acids using yeasts, bacteria or a combination of that under anaerobic (no oxygen) conditions.
- Fermentation results in the production of energy in the form of ATP molecules and produces less energy than aerobic process of cellular respiration.

- Glucose gives ethylalcohol and CO_2 during fermentation by Zymase.

Glucose $\xrightarrow{\text{Zymase}}$ Ethylalcohol+ CO2

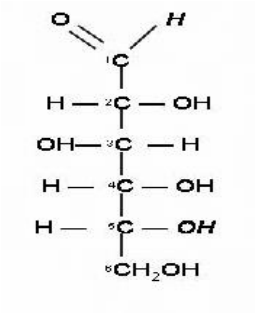
9. Explain how glucoseis represented using Haworth projection formula.(Nov.2020)

Structure of Monosaccharides

The monosaccharides may be represented by two structures. They are:

1. Straight chain structure or open chain structure
2. Cyclic structure or ring structure

1. Straight chain structure or open chain structure



2. Cyclic Structure or Ring Structure

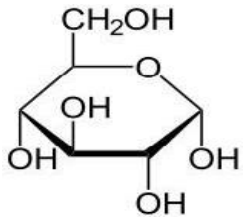
- In cyclic structure, the atoms are arranged in the form of ring. Haworth (1929) an English Chemist, devised the ring structure Hence the ring structure is referred to as Haworth's projection formula. The sugar molecules exist in two types of rings.
- They are furanose ring and pyranose ring.

Furanose Ring

- Furanoseisa5-memberedring.
- It is a pentagonal ring.
- It resembles the ring of a compound called furan and hence it is called furanose ring.

PYTANOSERING

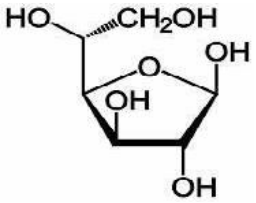
- Pyranoseisa6-memberedring.
- It is a hexagonal ring.
- This ring resembles the ring of a compound called and hence the ring is called pyranose ring.
- The sugars containing pyranose ring are called pyranose sugars.

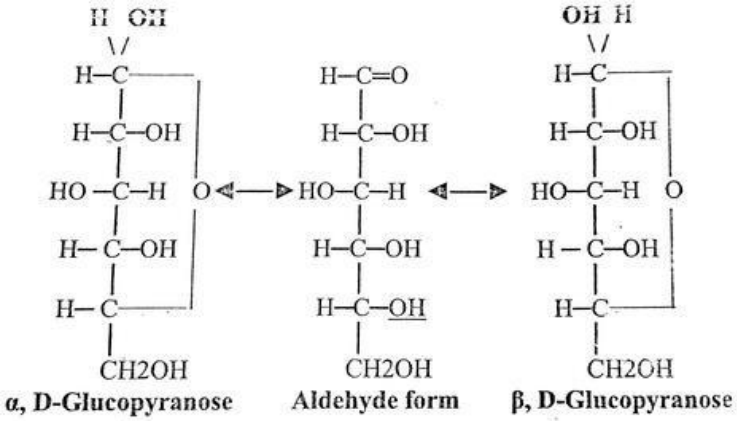


Fischer's Projection formula

Derivation of Ring Structure From Straight Chain Structure:

- The ring structure of glucose can be derived from the straight chain by folding.
- Because of the folding, the ends of the molecule tend to approach each other.
- When the carbon atom of the aldehyde group is linked to the 5^{th}carbon atom of the chain through an oxygen atom, a ring- form would result.

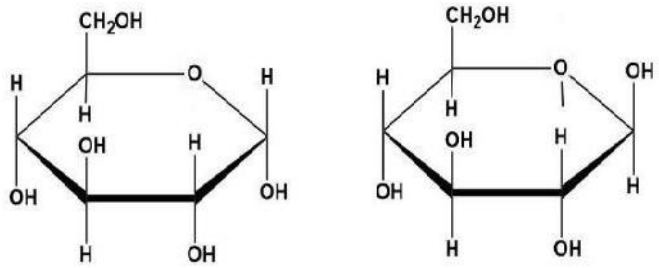




Anomer

- The1stcarbonatomnexttothering-oxygenisasymmetricand it is called anomeric carbon atom.
- This asymmetric carbon atom produces two forms of glucose, namely a and B-forms. They are called anomers. x-form is called a-anomer and B-form is called B-anomer.
- The a and B-glucopyranoses differ only in the configuration H and OH of the carbon atoni number 1. So the two forms of glucose are called anomers and the first carbon atom is called anomeric carbon atom.
- When the hydroxyl group of the carbon atom number 1 is attached below the plane of the ring, the pyranose glucose is called a-glucopyranose.
- When the hydroxyl group is above the plane of the ring in the C-1, the pyranose glucose is called B-glucopyranose

Haworth's structure



Haworth projection of Glucose

- The ***a-glucose*** is formed when the H atom of the OH of C-5 catches the carbonyl O of the aldehyde group on the same side of the chain.The new OH group at C-1 will extend tothe right.
- The ***B-glucose*** is formed when the H atom of the OH at C-5 catches the carbonyl Oof the aldehyde group on the left side of the chain. The new OH group at C-1 will extend to the left.
- The same nomenclature applies to the ring form of fructose, except that a and ß refer to the hydroxyl groups attached to C- 2.

10. Write the physical and chemistry properties of disaccharide sucrose, Maltose and lactose. (Apr 2021)

Disaccharide Definition

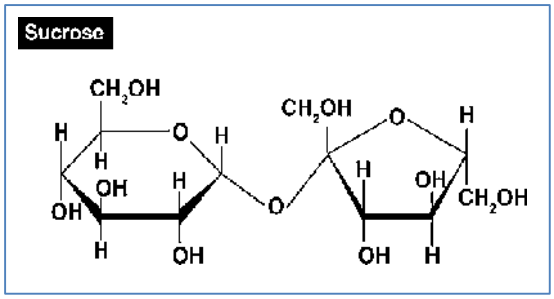
- The term *disaccharide* tymologically means *two saccharides*. A saccharide refers to the unit structure of carbohydrates.
- Thus, a disaccharide is a carbohydrate comprised of two saccharides (or two monosaccharide units). The term sugar can refer to both monosaccharides and disaccharides.

Structure of Disaccharides(Sucrose)

- The most common disaccharide is sucrose which gives D -(+)- glucose and D-(-)- fructose on hydrolysis.
- Both the monosaccharides i.e. glucose and fructose are connected through the glycosidic linkage between alpha glucose and second carbon beta fructose. Sucrose is a non-reducing sugar as both the reducing groups of glucose and fructose are involved in the glycosidic bond formation.

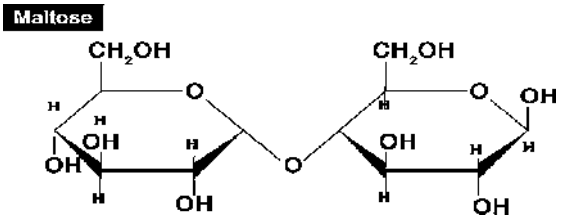
Examples of Disaccharides

1. **Sucrose**



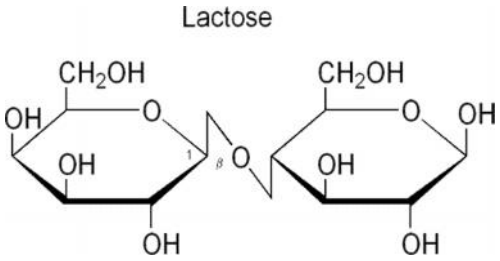
- Sucrose being dextrorotatory in nature gives dextrorotatory glucose as well as laevorotatory fructose on hydrolysis.
- The overall mixture is laevorotatory and this is because the laevorotation of fructose (-92.4) is more than the dextrorotation of glucose (+52.5).

2. **Maltose**



- Maltose is also one of the disaccharides, which have two α -D-glucose units that are connected by the first carbon of the glucose and linked to the fourth carbon of another glucose unit.
- In the solution, a free aldehyde can be produced at the first carbon of the second glucose of the solution and it is a reducing sugar as it shows reducing properties

3. **Lactose**



- Commonly it is called milk sugar as this disaccharide is found in milk. It is made up of Beta-D-galactose and β-D-glucose.
- The bond is between the first carbon of galactose and thefourth carbon of glucose. This is also a reducing sugar.

11. Explain Homopolysaccharides with two examples. (Apr2021)

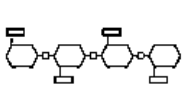
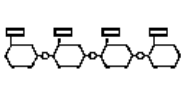
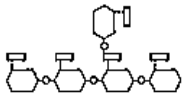
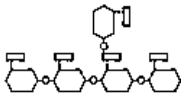
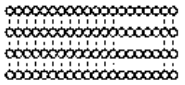
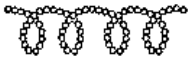
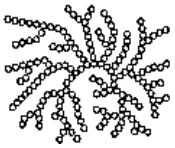
Homopolysaccharides

- A polysaccharide that contains the same type of monosaccharides is known as a homopolysaccharide. Some of the important homopolysaccharides are:

1. **Glycogen**: It is made up of a large chain of molecules. It is found in animals and fungi.
2. **Cellulose**: The cell wall of the plants is made up of cellulose.

It comprises long chains of β-glycosides.

3. **Starch**: It is formed by the condensation of amylose and amylopectin. It is found largely in plants, fruits, seeds, etc.
4. **Inulin:** It is made up of a number of fructofuranose molecules linked together in chains. It is found in the tubers of dahlia, artichoke, etc.

	Cellulose	Starch		Glycogen
		Amylose	Amylopectin	
Source	Plant	Plant	Plant	Animal
Subunit	β-glucose	α-glucose	α-glucose	α-glucose
Bonds	1-4	1-4	1-4 and 1-6	1-4 and 1-6
Branches	No	No	Yes (~per 20 subunits)	Yes (~per 10 subunits)
Diagram				
Shape				

CO.1 BL: 6. Summerize the classification Polysaccharides (Expected)

- Polysaccharides are major classes of bio molecules. They are long chains of carbohydrate molecules, composed of several smaller monosaccharides.
- These complex bio-macro molecules functions as an important source of energy in **animal cell** and form a structural component of a plant cell.

Types of Polysaccharides

Polysaccharides are categorized into two types:

- Homopolysaccharides.
- Heteropolysaccharides.

Characteristics of Polysaccharides

Polysaccharides have the following properties:

1. They are not sweet in taste.
2. Many are in soluble in water.
3. They are hydrophobic in nature.
4. They do not form crystals on desiccation.
5. Can be extracted to form a white powder.
6. They are high molecular weight carbohydrates.

Homopolysaccharides

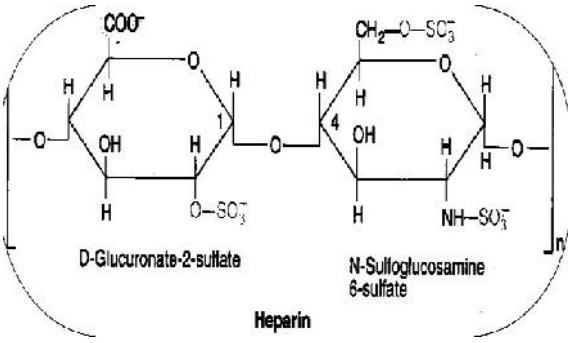
- A polysaccharide that contains the same type of monosaccharides is known as a homopolysaccharide. Some of the important homopolysaccharides are:

1. **Glycogen**: It is made up of a large chain of molecules. It is found in animals and fungi.
2. **Cellulose**: The cell wall of the plants is made up of cellulose. It comprises long chains of β-glycosides.
3. **Starch**: It is formed by the condensation of amylose and amylopectin. It is found largely in plants, fruits, seeds,etc.
4. **Inulin:** It is made up of a number of fructofuranose molecules linked together in chains. It is found in the tubers of dahlia, artichoke, etc.

Heteropolysaccharides

- A polysaccharide that contains different types of monosaccharides is known as a heteropolysaccharide. Some of the important heteropolysaccharides are:

1. **Hyaluronic Acid**: It is made up of D-glucuronic acid and N- acetyl-glucosamine. It is found in connective tissues and skin.
2. **Heparin**: It is made up of D-glucuronic acid, L-iduronic acid, N-sulfo-D-glucosamine and is largely distributed in mast cells and blood.



3.

4. **Chondroitin-4-sulfate**: Its component sugars are D-glucuronic acid and N-acetyl-D-galactosamine-4-O-sulfate. It is present in the cartilages.

5. **Gamma globulin:** N-acetyl-hexosamine, D-mannose, D- galactose are the component sugars of this polysaccharide. It is found in the blood.

12. Describe the Sources, Chemistry and Functions of Disaccharides. (Nov 2022)

Definition:

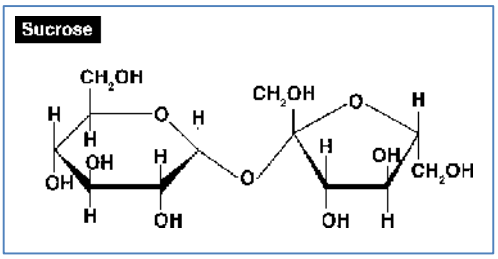
- The term *disaccharide*e tymologically means *two saccharides*. A saccharide refers to the unit structure of carbohydrates.
- Thus, a disaccharide is a carbohydrate comprised of two saccharides (or two monosaccharide units).The term sugar can refer to both monosaccharides and disaccharides.
- The disaccharides differ from one another in their monosaccharide constituents and in the specific type of glycosidic linkage connecting them.
- There are three common disaccharides: **maltose, lactose, and sucrose**.
- All three are white crystalline solids at room temperature and are soluble in water.

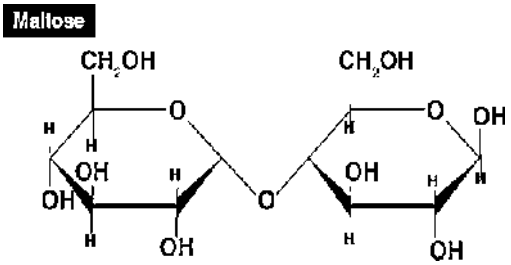
Sources:

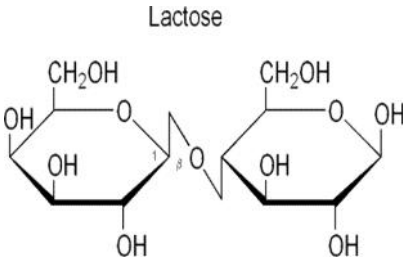
- Disaccharides can be found naturally in **grains, honey, fruits and vegetables**.

- Foods that contain disaccharide include: -Grains: wheat and other starchy grains such as rice, oats, corn and barley contain small amounts of disaccharide molecules.

Chemical structure:







1. Sucrose
2. Maltose
3. Lactose

Functions:

- These are highly soluble in water, this is due to the presence of hydroxyl groups in them which make hydrogen bonds.
- These are polar compounds which are again due to the presence of a large number of hydroxyl groups.

- These are sweet and are used as sweetening agents.
- Due to the large size of disaccharides, these can't cross the cell membrane.

PART C—(3×10=30 marks)
Answer any THREE questions, each in 500 words.

CO.1BL:412.Describe in detail about the classification of carbohydrates. (Nov.2020)

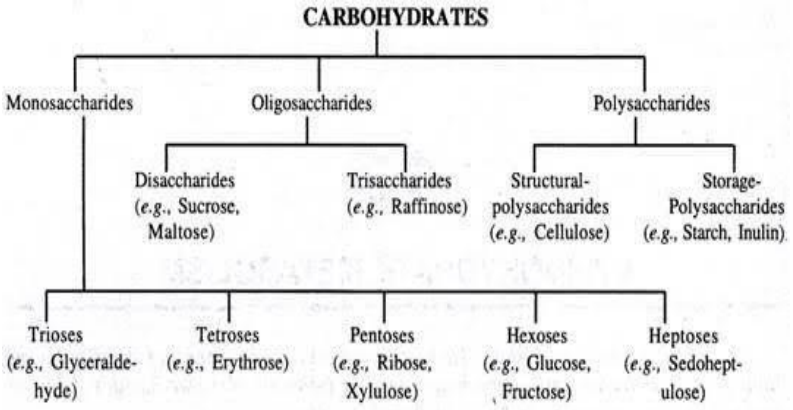


Fig. 13.1. Classification of the Carbohydrates

- Biomolecules with elemental composition of carbon, hydrogen and oxygenarein1:2:1ratio are called Carbohydrates or hydrates of carbon.
- On the basis of number of saccharides in hydrolysis,carbohydrates are classified as monosaccharides, oligosaccharides, and polysaccharides.
- Monosaccharides–They are the simplest sugars which cannot be further hydrolysed.
- Based on the number of carbon atoms, these are of different types. They are trioses, tetroses, pentoses, hexoses, heptoses,etc.
- Trioses–Three carbon atoms are present. E.g. Glyceraldehyde.
- Tetroses–Four carbon atoms are present. E.g. Erythrose.
- Pentoses–Five carbon atoms are present. E.g. Ribose.
- Hexoses–Six carbon atoms are present. E.g.Glucose.
- Heptoses–Seven Carbon atoms are present. E.g. Sedoheptulose.
- Oliosaccharides–carbohydrates which on hydrolysis yield 2 to 10 monosaccharides are called Oligosaccharides. They monosaccharides are held together by glycosidicbonds.
- Based on the number of monosaccharides present, oligosaccharides are of following types.

- Disaccharides–two mono saccharides are present. Eg: Maltose
- Trisaccharides–three mono saccharides are present eg: Raffinose
- Polysaccharides–large number of monosaccharides are present.
- Onstructural basis, these are of two types.
- Homopolysaccharides –composed of same type of monosaccharides. Eg: cellulose
- Heteropolysaccharides–different types of monosaccharides are present. Eg: Hyaluronicacid.

13. Comment on the properties of monosaccharides. (Apr2021)

Monosaccharides

- Monosaccharides are polyhydroxy aldehydes or ketones which cannot be further hydrolysed to simple sugars (In Greek Mono; single, saccharide ; sugar).
- Monosaccharides are simple sugars. They are sweet in taste. They are soluble in water. They are crystalline in nature.
- They contain 3 to 10 carbon atoms, 2 or more hydroxyl (OH) groups and one aldehyde (CHO) or one ketone (CO) group.
- They are represented by the general formula $(CH_2O)n$.

Properties o f Monosaccharides

1. **Colour-**Monosaccharides are colourless.
2. **Shape**-They are crystalline compounds.
3. **Solubility-**They are readily soluble in water
4. **Taste-**They have sweet taste.
5. **Optical Activity**
   - They are optically active. They rotate the plane polarized light.
   - When a monosaccharide rotates the plane polarized light in the clockwise direction or to the right (dextrorotatory) the monosaccharide is called 'd' form.
   - When a monosaccharides rotates the light in the anticlockwise direction or to the left (levorotatory) the monosaccharides is called 'l' form.

6. Mutarotation

- Monosaccharides exhibit mutarotation. The change in specific rotation of an optically active compound is called mutarotation.
- When a monosaccharide is dissolved in water, the optical rotatory power of the solution gradually changes until it reaches a constant value.
- The value of mutarotation for a-D-glucose is +59.5° This is obtained by substracting the final value from the original value [(+112.20°)-(+52.7°)
- A freshly prepared solution of B-D-glucose has a rotationvalue of +18.7° It also gradually increases and reaches thesame final value, +52.7°

+112° Alpha-D-glucose → +52.5° ← Beta-D-glucose +19°

1. Reducing Agents(Oxidation)

- Monosaccharides act as best reducing agents. They readily reduce oxidizing agents such as ferricyanide, hydro gen peroxide or cupric ion. In such reactions, the sugar is oxidized at the carbonyl group and the oxidizing agent be. comesreduced.
- Glucose and other sugars capable of reducing oxidizing agents are called reducing sugars. This property is useful in the analysis of sugars. By measuring the amount of an oxidizing agent that is reduced by a solution of a sugar, it is possible to estimate the concentration of the sugar.
- In this way blood and urine can be analyzed for content of glucose in the diagnosis of diabetes mellitus.
- Glucose reduces Tollen's reagent, Fehling's solution, Benedict's reagents, etc. At the same time glucose is oxidized to gluconic acid.

Glucose+ Tollen's reagent ⟶ Gluconic acid+Silver Mirror

Glucose+ Fehling's solution ⟶ Gluconic acid

2. Formation of Osazone

- Aldoses and ketoses react with phenylhydrazine Glucose consumes 3 molecules of phenyl hydrazine and produces osazones, aniline and ammonia. Reaction with phenylhydrazine involves only

2 carbon atoms, namely the carbonyl carbon atom (the aldehyde or ketone group) and the adjacent one.

7. Fermentation

- Is the conversion of carbohydrates to alcohol and carbon dioxide, or organic acids using yeasts, bacteria or a combination of that under anaerobic (no oxygen) conditions
- Fermentation results in the production of energy in the form of ATP molecules and produces less energy than aerobic process of cellular respiration
- Glucose gives ethyl alcohol and CO_2 during fermentation by Zymase.

Glucose $\xrightarrow{\text{Zymase}}$ Ethyl alcohol+CO_2

14. Explain the Occurrence, Chemistry and Biological Functions of Starch. (Nov 2022)

Definition:

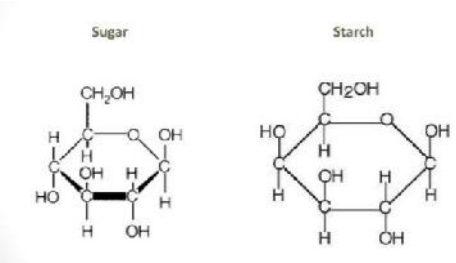
- Starch is a tasteless, fluffy white powder that is insoluble in cold water, alcohol, and other solvents.
- Starch is a polysaccharide made up of 1,4 linkages between glucose monomers. The chemical formula of the starch molecule is $(C_6H_{10}O_5)_n$.
- Starch is made up of long chains of sugar molecules that are connected together.
- The linear polymer amylose is the most basic form of starch, while amylopectin is the branched form.
- The primary role of starch is to help plants in storing energy. In an animal's diet, starch is a source of sugar.
- Amylase, an enzyme contained in saliva and the pancreas that breaks down starch for energy, is used by animals to break down starch.

Occurrence:

- Starch is the most important source of carbohydrates in the human diet and accounts for more than 50% of our carbohydrate intake.

15.

- It occurs in plants in the form of granules, and these are particularly abundant in seeds (especially the cereal grains)and tubers, where they serve as a storage form of carbohydrates.
- The breakdown of starch to glucose nourishes the plant during periods of reduced photosynthetic activity.
- We often think of potatoesas a “starchy” food, yet other plants contain a much greater percentage of starch (potatoes 15%, wheat 55%, corn 65%, and rice 75%). Commercial starch is a white powder



Chemistry:

- Starch is made of long chains of glucose molecules that are bonded together through covalent bonds called glycosidicbonds.
- Typically, starch is referred to as a polysaccharide because it is made up of multiple sugar molecules.
- However, because the molecules are all the same kind of sugar (glucose) starch is sometimes called a homopolysaccharide.
- Carbohydrates like star chare macromolecules composed of the following chemical elements usually in the ratio of 1:2:1.
- Carbon, hydrogen, and oxygen chemically bond together to make glucose, represented by the following chemical formula: $C_6H_{12}O_6$

Biological functions:

- Starch is the most important **energy source** for humans.
- The body digests starch by metabolizing it into glucose, which passes into the bloodstream and circulates the body.
- Glucose fuels virtually every cell, tissue, and organ in thebody.
- If there is excess glucose, the livers to resit as glycogen.
- Glucose is essential for brain function. An adult’s brain is responsible for20–25%Trusted Source of the body’s glucose consumption.

Uses of Starch

- Foods that are high in star chare a good source of nutrition.
- They are broken down into glucose, which is the body's main fuel, particularly for our brain and muscles, after they are ingested. B vitamins, iron, calcium, and folate are all essential nutrients found in starchy foods.
- Glucose is the only carbohydrate that our body can use. Glucose circulates in our bloodstream, where it is absorbed by cells and used as a source of energy.
- Starch's primary role is to help plants store energy. In an animal's diet, starch is a source of sugar.
- Amylase, an enzyme contained in saliva and the pancreas that breaks down starch for energy, is used by animals to break down starch.

CO.3BL:61.Name any two unsaturated fatty acids. (Nov 2020)

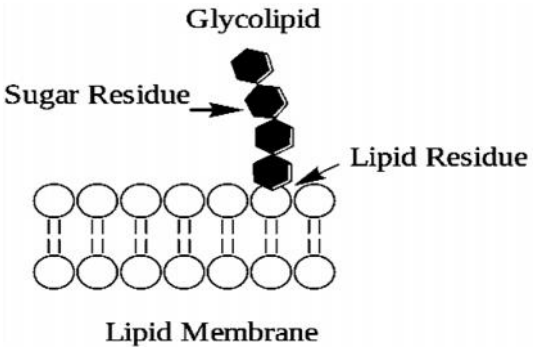
- Unsaturated fatty acid in which there is at least one double bond within the fatty acid chain. A fatty acid chain is monounsaturated if it contains one double bond, and polyunsaturated if it contains more than one double bond

  a. **OLEIC ACID -**Oleic acid is a mono-unsaturated omega-9 fatty acid found in various animal and vegetable sources.

  b. **LINOIC ACID -** It is a polyunsaturated omega-6 fatty acid.The18-carbonisafattyacidsthataremostlyfoundin plant oil

CO.1BL:32.What is glycolipid? Give examples.(Nov2020)

1. Glycolipids are a type of complex lipids comprising carbohydrates, fatty acids, sphingolipids or a glycerol group.



- Glycolipids are essential constituents of cellular membrane comprised of hydrophobic lipid tail and one or more hydrophilic sugar groups linked by a glycosidic bond

CO.3BL:63.Define phospholipid.(Nov2020)

1) Phospholipids are esters of glycerol, fatty acids, phosphoric acid, and other alcohols.
2) **A** phospholipid is a type of lipid molecule that is the main component of the cell membrane.

   Example: **Lecithin**.It is found in eggyolks, wheat germ, and soybeans.

CO.3 BL:6 (Apr 2021) **4. Write about essential fatty acids? Give examples.**

- The term essential fatty acids (EFA) refers to those polyunsaturated fatty acids (PUFA) that must be provided by foods because these cannot be synthesized in the body yet are necessary for health.

There are two families of EFA, omega-3(ω-3)and omega-6(ω-6).

CO.1BL:1 **5.What are saturated fatty acid. Give examples. (Apr 2021)**

- Fats that have single bonds along with fatty acid chains are called saturated fatty acid
- Saturated fat is mainly found in animal foods, but a few plant foods are also high in saturated fats
- Processed and deep fried foods are rich in saturated fats
- Stearic acid, palmitic acid, myristic acid, and lauric acid.

6. Draw the structure of cholesterol.(Apr2021)(Expected)

- Cholesterol is an organic compound, fat-like insoluble waxy substance which is found in all the cells of our body and is circulated through the blood cells with the help of Lipoproteins.

- In the human body, cholesterol is synthesized in the liver.

7. What is Bad Cholesterol? Write the Reason.(Nov2022)

LDL (bad) cholesterol. LDL cholesterol is considered the “bad” cholesterol, because it contributes to fatty buildups in arteries (atherosclerosis). This condition narrows the arteries and increases the risk for heart attack, stroke and peripheral artery disease, or PAD

PART B— (5×5 =25marks)

Answer any FIVE questions, each in 200 words.

8. Explain the biological importance of cholesterol.(Nov2020)

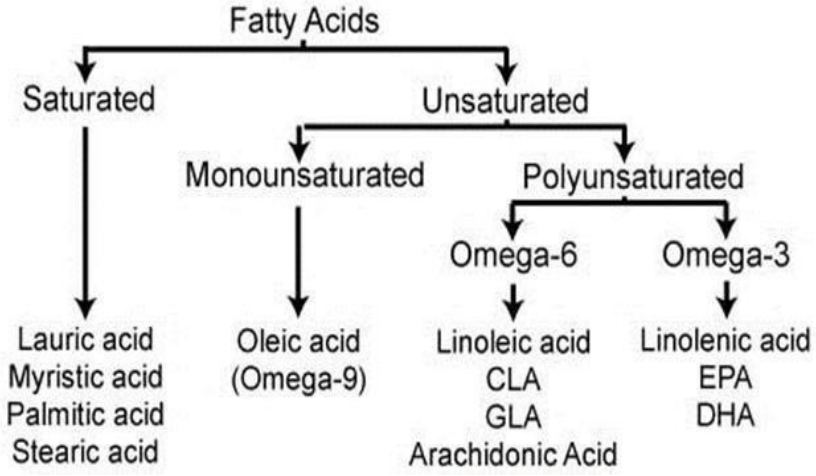
- Cholesterol is a 27 carbon compound with a unique structure with a hydrocarbon tail, a sterol nucleus made of four hydrocarbon rings and a hydroxyl group. The central sterol nucleus or ring is a feature of all steroid hormones. The hydrocarbon tail and the central ring are non polar and therefore do not mix with water.
- Cholesterol is packed together with apoproteins in order to be carried through the blood circulation as lippoprotein
  - Cholesterol is a fat molecule that is essential for normal cell function and hormonal balance.
  - Cholesterol is required for normal cell growth and repair of tissue.
  - Cholesterol is needed to maintain neurotransmitter and brain function, build brain and nerve tissue. It makes us think and remember better.
  - Cholesterol is required for production of steroid hormones, which help control metabolism, immune functions and sexual characteristics.
  - Sunlight converts 7-dehydroCholesterol in our skin to vitamin D.
  - Cholesterol is required for absorption of fat-soluble vitamins (A, D, E and K) from food.
  - Cholesterol is required for production of bile acid, which aids digestion of fat.
  - Steroid hormones – glucocorticoids, androgen, oestrogen are synthesised from cholesterol

9. Comment on the classification of fatty acids. (Apr2021)

- Fatty acids are also called “Carboxylic acids” due to the presence of carboxyl group (-COOH).
- Degree of unsaturation of fatty acids depend upon the no. of double bonds present in the hydrocarbon chain of the fatty acid.
- Fatty acids may be Saturated or unsaturated depending upon the degree of unsaturation. Greater the degree of unsaturation in a fatty acid more would be the chances of lipid oxidation.
- Fatty acids are “Amphipathic” in nature. It contains both, non-polar hydrocarbon chain and a polar carboxyl group; therefore, act as hydrophobic as well as hydrophobic.

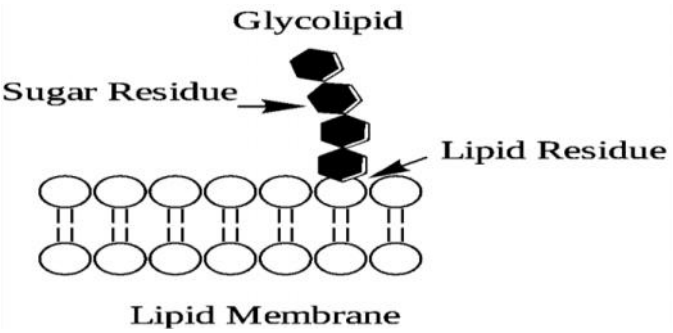
Classification of fatty acids:

- Properties of fatty acids varies due to the difference in chain length, chain structure, degree of unsaturation, position of double bonds, etc.
- Because of various characteristics, fatty acids are classified into different categories.
  - According to the chain length.
  - According to the body requirement.
  - According to the degree of unsaturation.
  - According to the position of H-atoms



10. Write a note on glycolipids. (Apr2021) (Expected)

Glycolipids are a type of complex lipids comprising carbohydrates, fatty acids, sphingolipids or a glycerol group.



Glycolipid:

- Glycolipids are glycoconjugates of lipids.
- The term glycolipid designates any compound containing one or more monosaccharide residues bound by a glycosidic linkage.
- It is a structural lipid.

Types of Glycolipid:

Cerebrosides- Cerebroside (from cerebro=brain) are glycolipids that are found primarily in the brain and peripheral (other areas of the body) nervous tissues.

Function:

- Provide protective coating to each nerve and act as insulator.
  1. **Gangliosides**– These glycolipids (glycosphingolipids) are neutral (uncharged). The gangliosides are acidic in pH and they are the more complex of the glycolipids.
  2. **Sulfoglycospingolipids –**These Cerebrosides are also called sulfatides, they are simply Cerebrosides with a sulfate residue on the sugar portion of glycolipid.

Occurrence:

- This particular lipid is found primarily in the medullated nerve fibres.

Function of Glycolipid:

- The glycolipids are an essential part of cell membranes.
- Glycolipids also help determine the blood group of an individual.

Glycolipid act as receptors at the surface of the red blood cell.

- Some viruses, bacteria (e.g., Cholera) use glycolipids on their cell surface as well. This helps the immune system destroy and clear the pathogen from the body.

11. **Compare and Contrast Saturated and Unsaturated Fatty Acids. (Nov 2022).**

Saturated Fatty Acids:

- Fats that have single bonds along their fatty acid chains are called saturated fatty acids.
- Animal fats are saturated, while plant and fish fats are unsaturated.
- Processed and deep fried foods are also rich in saturated fats.
- Dairy products that are made from whole milk, such as yog hurt, cheese, butter and ice cream, have high proportions of saturated fat.
- Coconut and palm kernel oils also have high saturated fat content.

Unsaturated Fatty Acids:

- A fatty acid, the **carbon chain of which possesses one or more double or triple bonds** (for example, oleic acid, with one double bond in the molecule, and linoleic acid, with two); called unsaturated because it is capable of **absorbing additional hydrogen.**
- Unsaturated fatty acids area component of the phospholipids in cell membranes and help maintain membrane fluidity.
- Phospholipids contain a variety of unsaturated fatty acids, but not all of these can be synthesized in the body.
- Avocados, olives, Nuts, Fatty fish, dark chocolates, has the rich amount of the Unsaturated fatty acids.
- Unsaturated fatty acids are used for improve levels of high-density lipoprotein.HDL carries bad cholesterol to your liver so it can be flushed out of your body.

PARTC—(3×10=30marks)

Answer any THREE questions, each in 500words.

CO.1 BL:412. What are phospholipids? Explain its classification.

What are phospholipids? Explain its classification.(Nov2020)

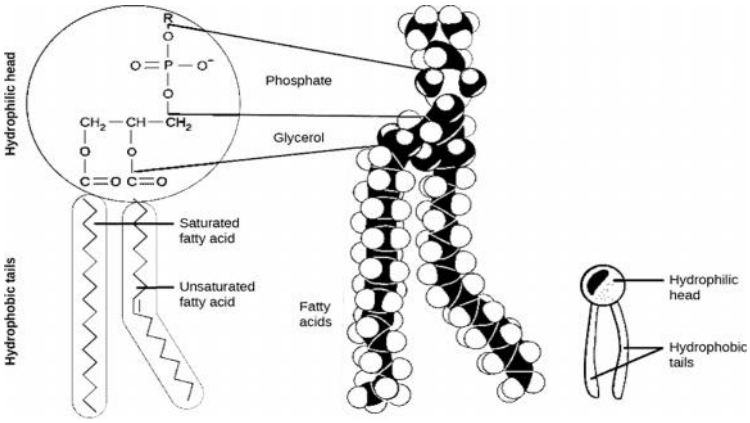
- Phospholipids are esters of glycerol, fatty acids, phosphoric acid, and other alcohols.
- A phospholipid is a type of lipid molecule that is the main component of the cell membrane.

  Example: **Lecithin**. It is found in egg yolks, wheat germ, and soybeans
- A**phospholipid**is composed of aglycerol backbone attached on one end to two fatty acids and the other end has the esterified phosphoric acid and an organic alcoholic group. Phospholipids are basically complex lipids.
- Phospholipids are the naturally occurring molecules and a major component of all living cells. Phospholipids are the building blocks of all the biological membranes that play a plethora of cell organelle functions and cellular functions. Because of its amphiphilic nature, the phospholipid membrane has acharacteristic bilayerstructurein the cellular membranes.
- Phospholipids are important components of cellular membranes, such as the plasma membrane. The basic component of the cellular membrane is phospholipid proteins and cholesterol, of which phospholipids are the major components.
- Membrane phospholipids provide membrane fluidity and flexibility because of which the cell can perform the function, like endocytosis.
- Moreover, the phospholipid functions to impart selective permeability to the membrane, and hence they control the movement of molecules across the cell membrane.
- Thus, based upon the backbone, types of phospholipids are:
  - **Glycerophospholipids** (or*phosphoglycerides*), or glycerol phospholipids wherein backbone is glycerol
  - **Sphingophospholipids**, wherein the backbone is sphingosine

Properties of Phospholipids:

- Amphiphilic in nature
- Have the capability to self-assemble
- Weak hydrophobic interactions hold the lipid bilayer formed due to self-assembly

- The membrane formed by the phospholipids, i.e., the membrane phospholipids, has the capability to restrict the movement of molecules across the lipid bilayer.
- Phospholipids are the building blocks of the cellular membrane and anchor the membrane proteins in it.
- The phospholipids impart membrane fluidity and flexibility asa result of which cellular processes like pinocytosis and endocytosis, can occur



Functions of Phospholipids:

Biological functions of phospholipids:

- Phospholipids are one of the primary components of the cell membranes.
- Phospholipids impart cellular membrane fluidity and flexibility.
- Phospholipids also help in cellular signal transduction.
- Phospholipids along with cholesterol are important membrane components. High intake of alcohol results in a reduction in the number of phospholipids in the hepatic or liver cells.
- Cell polarity is maintained with the help of the phospholipid- binding capacity of polarity regulators of the cell.
- Phospholipids are essential for lipid metabolism and absorption.
- Dietary supplementation of phospholipids is reported to inhibit prostagland in synthesis and thus exert an anti- inflammatory effect.

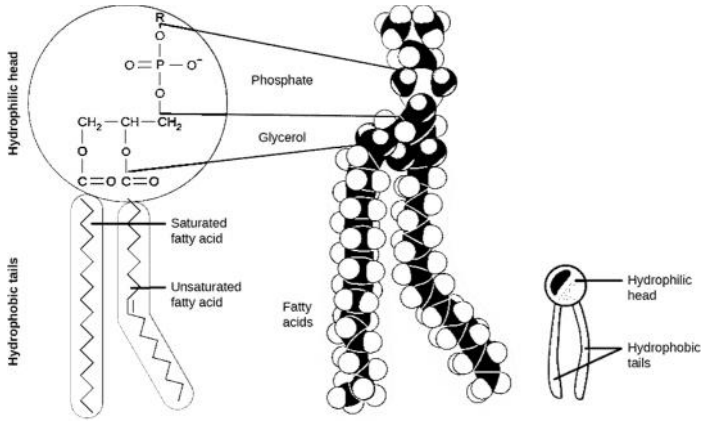
13. Describe compound lipids with examples.(Apr 2021)

- Compound (conjugated) lipids are lipids conjugated with other substances.

- They include:
  - Phospholipids formed of lipid, phosphoric acid and nitrogenous base.
  - Glycolipids, formed of lipid part and carbohydrate part.

1. **Phospholipids:**

- Phospholipids are esters of glycerol, fattyacids, phosphoric acid, and other alcohols.



- A phospholipid is a type of lipid molecule that is the main component of the cell membrane.

  Example: **Lecithin**. It is found in egg yolks, wheat germ, and soybeans

- A**phospholipid**is composed of a glycerol backbone attached on one end to two fatty acids and the other end has the esterified phosphoric acid and an organic alcoholic group. Phospholipids are basically complex lipids.
- Thus, based upon the backbone, types of phospholipid sare:

  - **Glycerophospholipids** (or*phosphoglycerides*), or glycerol phospholipids wherein backbone is glycerol
  - **Sphingophospholipids**, where inthe backbone is sphingosine

Functions of Phospholipids:

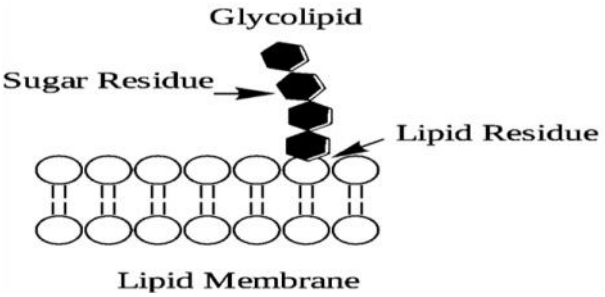
Biological functions of phospholipids:

- Phospholipids are one of the primary components of the cell membranes.
- Phospholipids impart cellular membrane fluidity and flexibility.
- Phospholipids also help in cellular signal transduction.
- Phospholipids are essential for lipid metabolism and absorption.

- Dietary supplementation of phospholipidsis reported to inhibit prostaglandin synthesis and thus exert an anti- inflammatory effect.

2. **Glycolipids:**

- Glycolipids are a type of complex lipids comprising carbohydrates, fatty acids, sphingolipids or a glycerol group.



- Glycolipids are glycoconjugates of lipids.
- The term glycolipid designates any compound containing one or more monosaccharide residues bound by a glycosidic linkage.
- It is a structural lipid.

Types of Glycolipid:

1. **Cerebrosides -** Cerebroside (from cerebro=brain) are glycolipids that are found primarily in the brain and peripheral (other areas of the body) nervous tissues.

   Function:

   - Provide protective coating to each nerve and act as insulator.
2. **Gangliosides**– These glycolipids (glycosphingolipids) are neutral (uncharged). The gangliosides are acidic in pH and they are the more complex of the glycolipids.
3. **Sulfoglycospingolipids –** These Cerebrosides are also called sulfatides, they are simply Cerebrosides with a sulfate residue on the sugar portion of glycolipid.

   Occurrence:

   - This particular lipid is found primarily in the medullated nerve fibres.

14. Discuss in detail About Lipoproteins. (Nov2022).

Definition:

- Lipoproteins are complex lipids consisting of cholesteryl ester and triacylglycerol and are encompassed by a single surface layer of amphipathic phospholipid and cholesterol molecule.
- These biomolecules comprise proteins and lipids molecules, which function by permitting the movement of fats through the water molecules, both inside and outside the cells.
- Cholesterol and triglycerides are fatty molecules. Because of their fat-like properties, they are not able to easily circulate in the bloodstream.
- In order for cholesterol and triglycerides to travel in the blood, theyare often carried by proteins that make the cholesterol and triglycerides more soluble in blood.
- This lipid and protein complex is referred to as a lipoprotein.
- When triglycerides and cholesterol are removed from this lipoprotein complex, and you have the protein alone, the protein component is referred to as an Apo lipoprotein.
- Different types of a polipoproteins are associated with different lipoproteins.

Types and Functions:

- There are five different types of lipoproteins in the blood, and they are commonly classified according to their density.
- The main types of lipoproteins that are analyzed in a lipidpanel include very low-density lipoproteins (VLDS), low- density lipoproteins (LDL), and high-density lipoproteins (HDL).

Very Low-Density Lipoproteins(VLDL):

- These lipoproteins consist of mainly triglycerides, some cholesterol molecules, and less protein. The more fat a lipoprotein contains, the less density it has.
- VLDL is less dense than most lipoproteins because of its high lipid composition.
- VLDL is made in the liver and is responsible for delivering triglycerides to cells in the body, which is needed for cellular processes.
- As triglycerides get delivered to cells, VLDL is made up less off at and more of protein, leaving cholesterol on the molecule.

- As this process occurs, VLDL will eventually become an LDL molecule.

Low-Density Lipoproteins(LDL):

- LDL consists of more cholesterol than triglycerides and protein.
- Because it contains less lipid and more protein in comparison to VLDL, its density is greater.
- LDL is responsible for carrying cholesterol to cells that need it.
- Elevated LDL levels are associated with an increased risk of cardiovascular disease.
- Certain forms of LDL - specifically small, dense LDL (sdLDL) and oxidized LDL (oxLDL) - have been associated with promoting the formation of atherosclerosis by depositing fats on the walls of arteries in the body.
- Because increased levels of LDL are associated with the development of cardiovascular disease, LDL is also known as the “bad” cholesterol.

High-Density Lipoprotein (HDL):

- Compared to LDL, HDL consists of less cholesterol and more protein, making these lipoproteins the densest.
- HDL is made in the liver and in the intestines.
- It is responsible for carrying cholesterol from cells back to the liver.
- Because of this, HDL is also considered the“good” cholesterol.
- Other Lipoproteins
- There are also other lipoproteins that also function in transporting fats to cells, but are not commonly measured in a routine lipid panel. These include

Chylomicrons:

- Chylomicrons are the least dense out of all of the lipoproteins.
- These molecules are primarily made up of triglycerides and a small amount of protein.
- Chylomicrons are responsible for transporting lipids from the intestinal tract to cells in the body.

Intermediate Density lipoproteins(IDL):

- Intermediate density lipoproteins (IDL) are less dense than LDL molecules but denser than VLDL particles.

- As the triglycerides on VLDL are broken down by the cells that need it, the particle becomes denser due to the change in the lipid to protein ratio.
- This results in VLDL being converted into IDL.
- As triglycerides and cholesterol are delivered to more cells in the body, IDL will gradually be converted into LDL.

UNIVERSITY OF MADRAS

B.SC.DEGREE COURSE IN MICROBIOLOGY SYLLABUS WITH EFFECT FROM 2023-2024 SUB.CODE :136E1A

ALLIED-I:BASIC AND CLINICAL BIOCHEMISTRY(Theory)

(For Microbiology branch Students)

(NOVEMBER2023 QUESTIONS ARE ANALYSED)

UNIT- II

Biomolecules - Amino acids - General properties, functions, structure, classification and biological significance. Proteins - General structure, properties, functions, structure, classification and biological significance.

PARTA—(10×2=20marks)
Answer any TEN questions, each in 30words.

1. What are the four groups present in the amino acid?

Answer :

Amino acids have four substituent groups that occupy the core carbon atom's four valency locations (alpha carbon). These are the following: hydrogen, amino, carboxyl, and a variable group known as the R group. Because of the substituent groups, amino acids are sometimes referred to as substituted methanes.

2. Define hypoglycemia.

Answer :

When the amount of glucose in your blood falls below what is considered healthy for you, you have low blood glucose, also known as hypoglycemia or low blood sugar. This translates to blood glucose levels of less than 70 milligrams per deciliter (mg/dL) for a large number of diabetics.

3. What is zwitter ion?

Answer :

A functional group molecule with at least one positive and one negative electrical charge is called a zwitterion. The net charge of the entire molecule is negative. Amino acids are the most well-known examples of Zwitterions. They consist of an acidic group of carboxyls and a basic group of amines.

4. Mention all the sulphur containing amino acids.

Answer :

The third most common mineral in your body is sulfur. Methionine and cysteine, two amino acids required to synthesise proteins, contain it. Your skin, hair, and nails are composed of both of these amino acids, which support the strength and flexibility of these tissues.

5. Differentiate between essential and non-essential amino acids.

Answer :

The amino acids classified as essential are those that the body is unable to produce on its own and must thus be received through diet. As the name suggests, non-essential amino acids are ones that the body is capable of producing and it is not essential for us.

6. What is salting in?(Nov2020)

When the Solubility of proteins increased in low concentration of salts it called salting in. When low concentrations of salt is added to a protein solution, the solubility increases.

These proteins bind and carry atoms and small molecules within Salting in refers to the observation that solutions of low salt concentrations, the solubility of a protein increases with additional of salt

7. What is salting out? (Apr2021)

- When the proteins precipitate at adding high concentration of salts is called salting out
- Salting out is a purification method that relies on the basis of protein solubility (by reducing the solubility).
- When the ionic strength of a protein solution is increased by adding salt, the solubility decreases, and protein precipitates.

8. What is a dipeptide?(Nov2020)

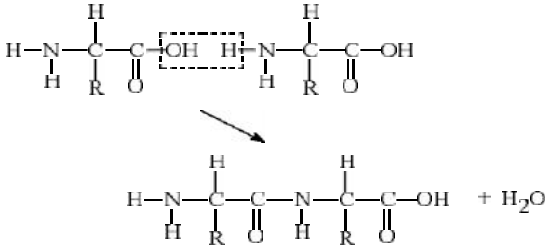
- A dipeptide is formed when two Amino acids join together by one Peptide bond.
- The dipeptide has a free amine group on one end of the molecule (known as the N-terminus) and a free carboxyl group on the other end (known as the C-terminus).

9. Write any two biological roles of proteins.(Apr2021)

- These proteins provide structure and support for cells. Bind and carry atoms and small molecules within cells and throught the body.
- Main tain properfluid and acid-base balance.
- Proteins are important for catalyzing chemical reaction.

10. Define peptide bond.(Apr2021)

- Peptide bond is a chemical bond that is formed by joining the carboxyl group of one amino acid to the amino group of another.



11. What is Isoionic point? (Nov 2022).

- The isoionic point is the **pH value at which a zwitterion molecule has an equal number of positive and negative charges and no adherent ionic species.**

- The *isoionic point*is defined as the point at which dissociable groups of the substance combine equally and only, with hydrogen and hydroxyl ions.
- The isoelectric and isoionic points are equal when the concentration of charged species is zero.

PARTB— (5×5 =25 marks)

Answer any FIVE questions, each in 200 words.

1. Give any three chemical properties of proteins.

Answer :

The huge molecules known as proteins are composed of amino acids, which are necessary for the proper structure, operation, and control of the body's tissues and organs. Diverse chemical characteristics of proteins are essential to their biological roles. Among the essential chemical characteristics of proteins are:

i.Acid-Base Properties: Because amino acids contain carboxyl and amino acid groups, proteins can function as both bases and acids. Proteins can have positive or negative charges at certain pH levels, which can impact their solubility and interactions with other molecules.

ii.Hydrophobic and Hydrophilic Interactions: The side chains of amino acids in proteins can either be hydrophilic (attracting water) or hydrophobic (repelling water). Because hydrophobic amino acids tend to group together in the protein core to avoid contact with water, these qualities have an impact on the folding and structure of proteins.

iii. Denaturation: The precise three-dimensional structure of proteins is essential to their operation. Heat, pH shifts, and chemical exposure are examples of factors that can cause denaturation, a process that upsets a protein's structure and results in function loss.

iv.Binding Properties: Through particular binding sites, proteins can attach themselves to other molecules, including ligands, substrates, or other proteins. The chemical characteristics of the binding site and the structure of the protein frequently dictate the binding specificity.

2. What are the five main functions of proteins?

Answer :

Proteins:

a.The nutrient known as protein is needed for the construction, maintenance, and repair of bodily

tissues.

b.All bodily tissues and fluids, with the exception of urine and bile, include protein.

Amino acids, carbon, hydrogen, carbs, and oxygen make up a protein. Protein functions include:

i. The proteins that comprise the digestive enzymes aid in the process of digestion.

ii. The protein facilitates communication between cells, tissues, and organs byacting as a chemical messenger.

iii. Proteins aid in the synthesis and regeneration of DNA molecules.

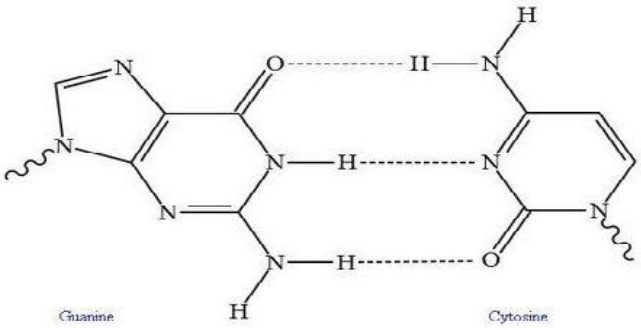
iv. Proteins called receptors aid in a cell's communication with neighboring cells and the outside world.

v. Antibodies are used by the immune system to heal bodily cells, which are primarily composed of proteins.

3. Describe the various forces involved in the maintenance of the protein structures. (Nov 2020)

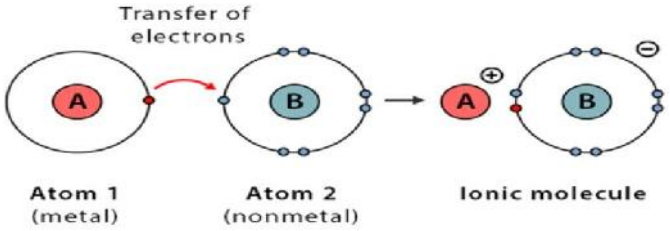
1. **Hydrogen bonding**

- A hydrogen bond is the electro magnetic attractive interaction between polar molecules (OH-NH2 etc. participate in H- bond).
- Hydrogen bonds are very week bonds
- In these secondary and tertiary structure of proteins, hydrogen bonds are involved in stabilizing process.
- Thus, the formation of hydrogen bonds gives a regular shape to the polypeptide chain such as alpha helix and beta plates.



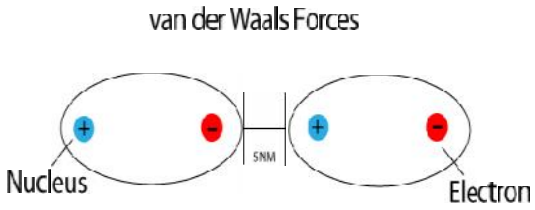
1. **Ionic Bonding:**

- The electrostatic force of attraction which holds the two oppositely charged ions together is called the ionic bond.
- In proteins, the ionic bonds are formed between ionized acidic or basic groups of amino acids.
- Ionic bonds are weak bonds and they are very fragile in an aqueous medium.



2. Vander Waals force of attraction

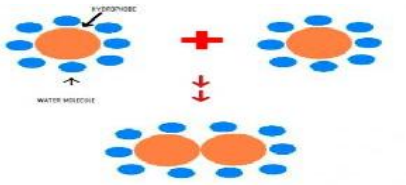
- Vander Waals interactions are important to protein stability and function.
- These interactions are usually identified empirically based on protein 3D structures



3. Hydrophobic interaction

- Some R groups in the amino acids are Non polar

  The Non polar R groups are Hydrophobic and they try to stay away from the water
- Example Alanine, Valine, Leucine, Isoleucine and Methionine
- Hydrophobic Interactions are important for the folding of proteins.
- This is important in keeping a protein stable and biologically active, because it allow to the protein to decrease in surface and reduce the undesirable interactions with water.



2. Write the various biological roles of proteins (Nov2020).

1. Digestive Enzymes:

- Certain proteins act as digestive enzymes.
- In other words, they catabolize nutrients into constituent monomeric units.
- Examples of digestive enzymes include peps in and amylase.

2. Structural Proteins

- Proteins are integral as they form components of certain structures.
- Examples include keratin and tubulin.

3. Hormonal Functions

- Hormones are paramount for regulating body functions.
- Insulin is one such example.

4. Transportation

- Proteins play a major role in transporting substances throughout the body.
- Examples of such proteins include haemoglobin.

5. Defence and Protection

- Another major function of proteins is that they form a part of the immune system and protect the body from pathogens.
- Example of such a protein is immunoglobulin.

6. Storage Functions

- Proteins also provide nourishment for development of embryo – such as albumin, or the egg white.

3. Describe the secondary structure of proteins.(Apr2021)

Introduction

The two main types of secondary structure are the α-helix and the ß- sheet. The α-helix is a right-handed coiled strand. β-pleated sheet structure of proteins is stabilized by intermolecular hydrogen bonding.

Bond involved in secondary structure:

A hydrogen bond

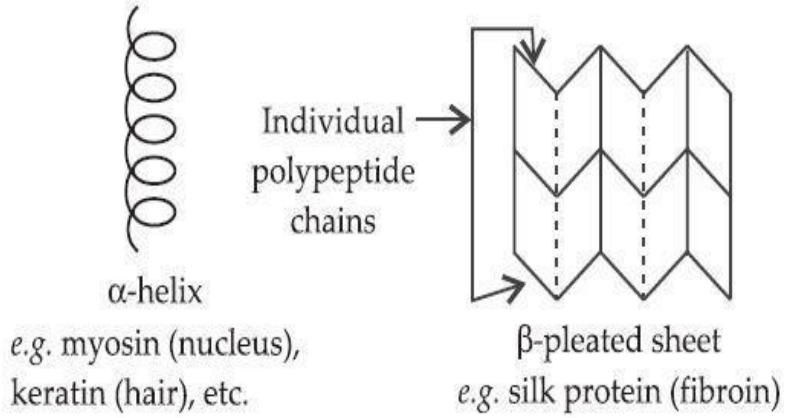
- A hydrogen bond is the electromagnetic attractive interaction between polar molecules (OH,-NH2 etc. participate in H- bond).
- Hydrogen bonds are very week bonds
- In the secondary and tertiary structure of proteins, hydrogen bonds are involved in stabilizing process.
- Thus, the for mation of hydrogen bonds gives a regular shape to the polypeptide chain such as alpha helix and beta plates.

Alpha-Helix Protein,(Egg albumin)

- The most common type of secondary structure of a protein is the alpha-helix.
- Linus Pauling predicted the structure of the alpha-helix protein.
- The prediction was confirmed when the first three-dimensional structure of protein myoglobin was determined by X-ray crystallography.
- In the alpha-helix protein, a hydrogen bond is formed between the N−H group to the C=O group of the amino acid.

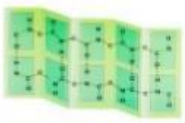
Beta-Pleated Sheets of Protein(Keratin)

- The second essential type of secondary structure of a protein is the Beta-Pleated Sheets of Protein. It consists of various beta strands linked by hydrogen bonds between adjacent strands. Three to ten amino acids are combined to create a beta-strand polypeptide.
- Beta sheets are involved in forming the fibrils and protein aggregates observed in amyloidosis.
- Alike alpha-helix, the residue hydrogen bond between the adjacent strands is separate from each other.



(c) Define beta-pleated sheet.(Apr2019)(Keratin)

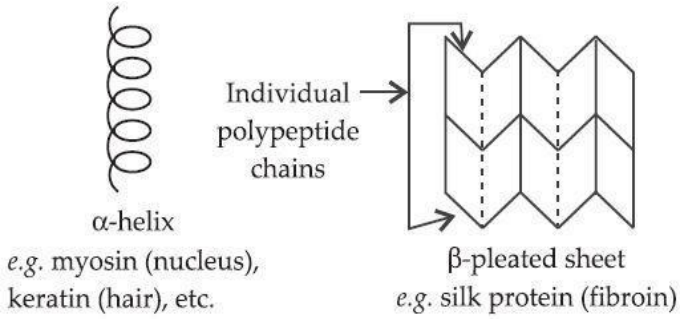
Comparison of ∝-helix and β-sheet

	∝-helix 	β-sheet 
Structure	1 polypeptide chain	1 or more polypeptide chains
polypeptide	Coiled	Almost fully extended
Hydrogen bonds	- Formed between 2 peptide bonds of 4 amino acids apart in the primary structure. - Parallel to the axis of polypeptide chain.	- Formed between amino acids which has no relation in primary structure. - Perpendicular to the axis of polypeptide chain.
R groups	- Protrude outside the helix	- Project above and below the plane of the sheet

Beta- Pleated Sheets of Protein

- The second essential type of secondary structure of a protein is the Beta-Pleated Sheets of Protein.
- It consists of various beta strands linked by hydrogen bonds between adjacent strands.
- Three to ten aminoacids are combined to create a beta-strand polypeptide.
- Beta sheets are involved informing the fibrils and protein aggregates observed in amyloidosis.
- A like alpha-helix, the residue hydrogen bond between the adjacent strands is separate from each other.
- Amino acids exist in an almost entirely extended conformation, i.e. linear or sheet-like structure.
- Beta sheets are formed by linking two or more beta strands by intermolecular hydrogen bonds.
- Three to ten aminoacids are combined to form a beta-strand polypeptide.
- Beta-Sheet cannot be in a single chain Polypeptide.

- There must be two or more beta-strands.
- Alkyl groups are oriented both inside and outside of the sheet.
- Example: Skin Fibres or Fibroin.



4. **What are the classification of proteins based on the source and biological function?(Apr 2021)**

Protein classification based on Sources

- On the basis of their chemical composition, proteins may be divided into two classes: simple and complex.

Simple proteins

- Also known as homoproteins, they are made up of only amino acids. Examples are plasma albumin, collagen, and keratin.

Conjugated proteins

- Sometimes also called heteroproteins, they contain in their structure a non-protein portion.
- Three examples are glycoproteins, chromoproteins, and phosphor proteins.

Glycoproteins

- They are proteins that covalently bind one or more carbohydrate units to the polypeptide backbone.
- Typically, the branches consist of not more than 15-20 carbohydrate units, where you can find arabinose, fucose (6-deoxygalactose),galactose, glucose, mannose, N-acetyl glucosamine (GlcNAc or NAG), and N-acetylneuraminic acid (Neu5Ac or NANA).

Examples of glycoproteins are:

- Glycophorin, the best known among erythrocyte membrane glycoproteins;
- Fibronectin, that anchors cells to the extracellular matrix through interactions on one side with collagen or other

  Fibrous proteins, while on the other side with cell membranes;
- All blood plasma proteins, except albumin;
- Immuno globulins or antibodies.

Chromo proteins

- They are proteins that contain coloured prosthetic groups.
- Typical examples are:
- Haemoglobin and myoglobin, which bind, respectively, one and four heme groups;
- chlorophylls, which bind a porphyrin ring with a magnesium atom at its centre;
- Rhodopsin's, which bind retinal.

Phosphoproteins

- They are proteins that bind phosphoric acid to serine and threonine residues.
- Generally, they have a structural function, such as tooth dentin, or reserve function, such as milk caseins (alpha, beta, gamma and delta), and egg yolk phosvitin.

5. Exemplify Salting In and Salting Out Process.(Nov 2022).

- Protein contains various sequences and compositions of amino acids.
- Therefore, their solubility to water differs depending on the level of hydrophobic or hydrophilic properties of the surface.

1. Salting in:

- When the Solubility of proteins increased in low concentration of salts it called salting in.
- When low concentrations of salt is added to a protein solution, the solubility increases.
- E.g. The effects of salt such as sodium chloride on increasing the solubility of proteins.

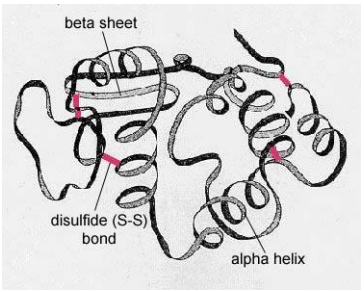
2. Salting out:

- When the proteins precipitate at adding high concentration of salts is called salting out.
- Salting out is a purification method that relies on the basis of protein solubility (by reducing the solubility).
- When the ionic strength of a protein solution is increased by adding salt, the solubility decreases, and protein precipitates.
- Because the salt molecules compete with the protein molecules in binding with water.

6. Demonstrate Tertiary structure of Proteins with Examples. (Nov 2022)

Tertiary Structure of Protein

- This structure arises from further folding of the secondary structure of the protein.
- H-bonds, electrostatic forces, disulphide linkages, and Vander Waals forces stabilize this structure.
- The tertiary structure of proteins represents overall folding of the polypeptide chains, further folding of the secondary structure.
- It gives rise to two major molecular shapes called fibrous and globular.
- The main forces, which stabilize the secondary and tertiary structures of proteins, are hydrogen bonds, disulphide linkages, vander Waals and electro static forces of attraction.



PARTC—(3×10=30marks)

Answer any THREE questions, each in 500 words.

7. Explain the various levels of organization of proteins.(Nov 2020)

Primarys tructure of Protein

- The simplest level of protein structure, **primary structure**, is simply the sequence of amino acids in a polypeptide chain.
- The primary structure of the protein is stabilized by peptide bonds.
- For example, the pancreatic hormone insulin has two polypeptide chains, A and B, and they are linked together by disulfide bonds.

Hydrogen bonding

- A hydrogen bond is the electromagnetic attractive interaction between polar molecules(OH-NH2etc.participateinH-bond).
- Hydrogen bonds are very week bonds
- In the secondary and tertiary structure of proteins, hydrogen bonds are involved in stabilizing process.
- Thus, the formation of hydrogen bonds gives a regular shape to the polypeptide chain such as alpha helix and beta plates.

Secondary structure of Protein:

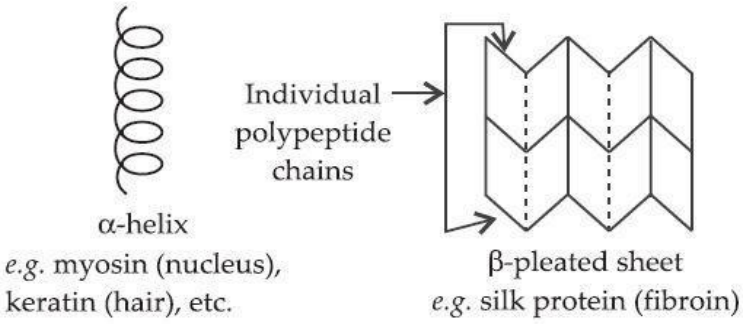
Alpha-Helix Protein, (Egg albumin)

- The most common type of secondary structure of a protein is the alpha-helix.
- Linus Pauling predicted the structure of the alpha-helix protein.
- The prediction was confirmed when the first three- dimensional structure of protein myoglobin was determined by X-ray crystallography.
- In the alpha-helix protein, a hydrogen bond is formed between the N−H group to the C=O group of the amino acid.

Beta-Pleated Sheets of Protein (Keratin)

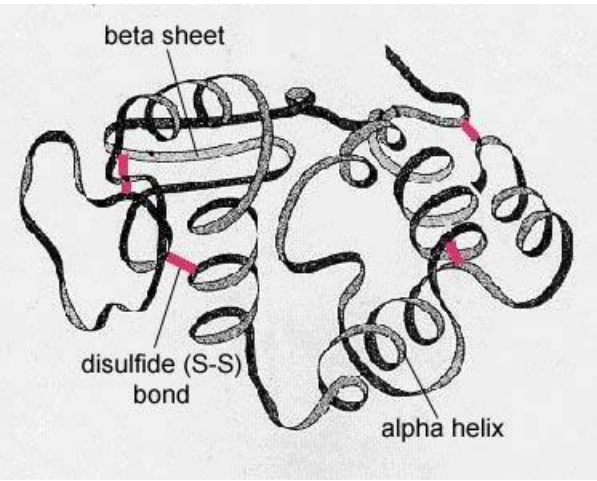
- The second essential type of secondary structure of a protein is the Beta-Pleated Sheets of Protein. It consists of various beta strands linked by hydrogen bonds between adjacent strands. Three to ten amino acids are combined to create a beta-strand polypeptide.
- Beta sheets are involved in forming the fibrils and protein aggregates observed in amyloidosis.

- Alike alpha-helix, the residue hydrogen bond between the adjacent strands is separate from each other.



Tertiary Structure of Protein:

- This structure arises from further folding of the secondary structure of the protein.
- H-bonds, electrostatic forces, disulphide linkages, and Vander Waals forces stabilize this structure.
- The tertiary structure of proteins represents overall folding of the polypeptide chains, further folding of the secondary structure.
- It gives rise to two major molecular shapes called fibrous and globular.
- The main forces, which stabilize the secondary and tertiary structures of proteins, are hydrogen bonds, disulphide linkages, vander Waals and electrostatic forces of attraction.

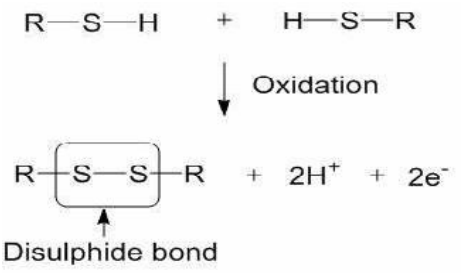


15. Define and explain the following terms:(Apr2021)

(a) Disulfide linkages (b)Vander waals force.

(c)Hydrogen bond. (d)Salt linkages

Disulfide linkages: They are strong covalent bonds.

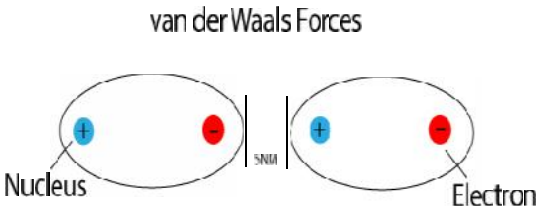


A.

- A disulfide linkage is a **covalent bond that is derived from two thiol groups.**
- A disulfide refers to a functional group whose structure can be written as R-S-S-R'.
- This bond or linkage between the two thiol groups is called a disulfide linkage.
- A disulfide linkage is also called the disulfide bridge or S-S bond.

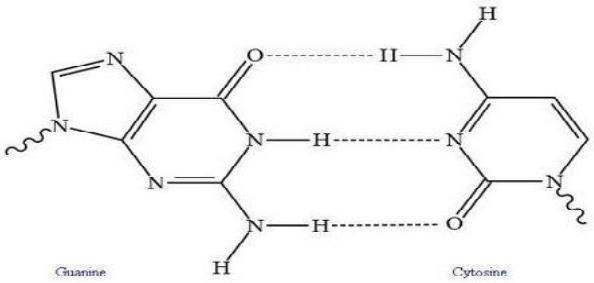
B. Vander Waals force of attraction:

- Vander Waals interactions are important to protein stability and function.
- These interactions are usually identified empirically based on protein 3D structures



A. Hydrogen bonding

- A hydrogen bond is the electromagnetic attractive interaction between polar molecules (OH,-NH2 etc. participate in H- bond).
- Hydrogen bonds are very week bonds
- In the secondary and tertiary structure of proteins, hydrogen bonds are involved in stabilizing process.



- Thus, the formation of hydrogen bonds gives a regular shape to the polypeptide chain such as alpha helix and beta plates.

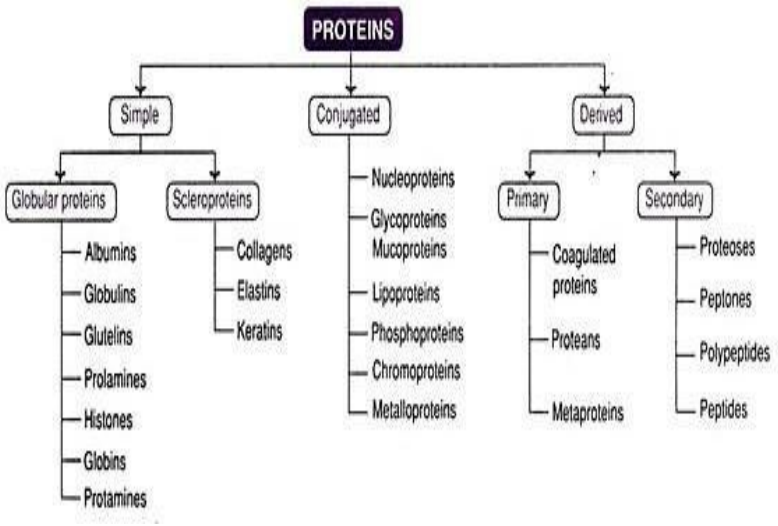
C. Salt linkages or Ion pair(Atom attractor repel based on charges)

- Salt bridges in proteins are bonds between oppositely charged residues that are sufficiently close to each other to experience electrostatic attraction.
- The final shape of the protein complex is once again stabilized by various interactions , including hydrogen-bonding, disulfide- bridges and salt bridges.

15. Illustrate the Classification of Proteins .(Nov2022)

Introduction:

- Proteins are very large molecules composed of basic units called amino acids.
- Proteins contain carbon, hydrogen, oxygen, nitrogen, and sulphur.



- Protein molecules are large, complex molecules formed by one or more twisted and folded strands of amino acids.
- Proteins are highly complex molecules that are actively involved in the most basic and important aspects of life.
- These include metabolism, movement, defense, cellular communication, and molecular recognition.

1. **Primary (first level) –**Protein structure is a sequence of amino acids in a chain.

2. **Secondary (secondary level) –**Protein structure is formed by folding and twisting of the amino acid chain.

3. **Tertiary (third level) –**Protein structure is formed when the twists and folds of the secondary structure fold again to form a larger three dimensional structure.

4. **Quaternary (fourth level) –**Protein structure is a protein consisting of more than one folded amino acid chain.

- Proteins can bond with other organic compounds and form “mixed” molecules.
- For example, glycoproteins embedded in cell membranes are proteins with sugars attached. Lipoproteins are lipid-protein combinations.

Functions o f Proteins:

- Positive negative attractions between different atoms in the long amino acid strand cause it to coil on itself again and again to form its highly complex shape.
- Folded proteins may combine with other folded proteins to form even larger more complicated shapes.
- The folded shape of a protein molecule determines its role in body chemistry.
- Structural proteins are shaped in ways that allow them to form essential structures of the body.
- Collagen, a protein with a fibre shape, holds most of the body tissues together.
- Keratin, another structural protein forms a network of waterproof fibres in the outer layer of the skin.
- Functional proteins have shapes that enable the mto participate in chemical processes of the body.
- Functional proteins include some of hormones, growth factors, cell membrane receptors, and enzymes.

UNIVERSITY OF MADRAS

B.SC.DEGREE COURSE IN MICROBIOLOGY SYLLABUS WITH EFFECT FROM 2023-2024 SUB.CODE :136E1A

ALLIED-I:BASIC AND CLINICAL BIOCHEMISTRY(Theory)

(For Microbiology branch Students)

(NOVEMBER2023 QUESTIONS ARE ANALYSED)

UNIT-III

Disorders of metabolism : Disorders of carbohydrate metabolism: Diabetes mellitus, Ketoacidosis, Hypoglycemia, Glycogen storage diseases, Galactosemia and lactose intolerance. Disorders of lipid metabolism: Hyperlipidemia, Hyperlipiproteinemia, Hypercholesterolemia, Hypertriglyceridemia, Sphingolipidosis.

PARTA—(10×2=20marks)

Answer any TEN questions, each in 30words.

1.What dietary restrictions are necessary for individuals with galactosemia? (Nov.2023)

Answer :

A person who has galactosemia needs to stay away from all dairy products and foods that include milk, including:

A.butter made from cow's milk

B.cheese and yogurt ice cream

Additionally, during infancy, any foods or medications containing any of the following components should be avoided:

A.curds made of casein

B.Whey Solids

2.What is the primary treatment for hypoglycemia? (Nov.2023)

Answer :

To swiftly elevate your blood sugar level, eat or drink something high in sugar or carbohydrates. The recommended course of treatment is pure glucose, which comes in tablets, gels, and various forms. Higher-fat foods, like chocolate, don't cause blood sugar levels to rise as quickly.

3. Describe the primary symptoms of sphingolipidosis. (Nov.2023)

Answer :

- Spasticity.
- Neurodenegeration (leading to death)
- Hypertonia.
- Hyperreflexia.
- Decerebration-like posture.
- Blindness.
- Deafness.

4. What is the genetic basis of sphingolipidosis? (Nov.2023)

Answer :

Sphingolipids accumulate in various tissues and cell lysosomes and affects the organ to damage.

Causes genetic defects like lysosomal enzyme deficiency.

PARTB — (5×5 =25marks)

Answer any FIVE questions, each n 200 words.

1. Discuss the genetic and dietary factors contributing to hypercholesterolemia and its association with atherosclerosis. (Nov.2023)

Answer :

Hypercholesterolemia is a lipid disorder in which low-density lipoprotein (LDL), or bad cholesterol, is too high. This makes fat collect in arteries (atherosclerosis), which puts at a higher risk of heart attack and stroke. Atherosclerosis is the main cause of

cardiovascular disease, which is the reason for more deaths than anything else in the world.

Symptoms:

There are no symptoms of hypercholesterolemia in most people. However, if have severe hypercholesterolemia, may have cholesterol deposits on eyelid skin (xanthelasma) or connective tissue (xanthoma). Also, may have cholesterol in eye. This is called a corneal arcus.

What Causes

Hypercholesterolemia causes include:

- Our genes (pure or familial hypercholesterolemia).
- A diet that includes a lot of saturated and/or trans fats.
- A lack of exercise.
- Tobacco products.
- Obstructive liver disease.
- Diabetes.
- Hypothyroidism.
- Anorexia nervosa.
- Chronic kidney failure.
- Nephrotic syndrome.
- Amiodarone
- Rosiglitazone
- Cyclosporine
- Hydrochlorothiazide

To lower the amount of LDL in your blood, you can:

- Drink less alcohol.
- Eat more fruits, vegetables and whole grains.
-

- Eat less saturated fat, like those in dairy products, some meats (like red meats) and desserts.

Atherosclerosis:

- Atherosclerosis is a condition in which the inner lining of an artery becomes thicker or harder due to a buildup of plaque.
- High blood pressure, high cholesterol, high triglyceride levels, smoking, diabetes, obesity, physical activity, and consumption of saturated fats are examples of risk factors.
- A blood clot, aneurysm, heart attack, or stroke can all be brought on by atherosclerosis.
- To lessen the consequences of atherosclerosis, you might require medication, therapies, or surgery.

2. Describe the process of gluconeogenesis and its significance in glucose homeostasis.(Nov.2023)

Answer :

i. The cytoplasm or mitochondria of the liver or kidney is where glucose synthesis starts. Two pyruvate molecules must carboxylate before they can be converted to oxaloacetate. One ATP (energy) molecule is needed for this.
ii. Oxaloacetate is changed by NADH into malate, which is thereafter able to exit the mitochondria.
    Malate oxidizes back to oxaloacetate after exiting the mitochondria.
iii. Oxaloacetate is converted to phosphoenolpyruvate by the enzyme phosphoenolpyruvatecarboxykinase (PEPCK).
iv. Fructose 1,6-bisphosphate is produced from phosphoenolpyruvate by reversing glycolytic activities.
v. Fructose-1,6-bisphosphatase catalyzes the process that releases inorganic phosphate by converting fructose-1,6-bisphosphate to fructose-6-phosphate.
vi. Fructose 6 phosphate is changed into glucose 6 phosphate by the enzyme phosphoglucoisomerase.

vii. The production of inorganic phosphate by glucose-6-phosphate results in the release of free glucose into the bloodstream. The enzyme in question is glucose 6-phosphatase.

De novo glucose synthesis from accessible precursors, or hepatic gluconeogenesis, is essential for preserving glucose homeostasis in animals during extended famine in order to meet energy requirements. Hyperglycemia in diabetes is a result of the hepatic gluconeogenesis rate being excessively elevated.

PARTC—(3×10=30marks)

Answer any THREE questions, each in 500 words.

1.Describe the biochemical basis of ketoacidosis in diabetes and the clinical manifestations. (Nov.2023)

Answer :

A dangerous side effect of type 1 diabetes and, far less frequently, type 2 diabetes is diabetic ketoacidosis (DKA). DKA develops when dangerously high blood sugar levels are combined with the buildup of acidic chemicals called ketones in the body.

It is important to distinguish between ketosis, which is safe, and ketoacidosis. Fasting or an exceptionally low-carb diet, referred to as a "ketogenic diet," can induce ketosis. DKA only occurs when the body is unable to metabolize enough insulin to convert blood sugar into energy. In the event that this occurs, our liver begins converting fat into energy, causing the blood to include ketones. Ketone levels in the blood that are too high can be harmful.

Early symptoms of DKA can include:

- Frequent Urination
- Extreme Thirst Or Dry Mouth
- High Blood Sugar Levels, Also Known As Hyperglycemia

- High Levels Of Ketones In The Urine As Dka Progresses
- Nausea Or Vomiting
- Abdominal Pain
- Confusion
- Fruity-Smelling Breath
- Flushed Face
- Fatigue Or Weakness
- Rapid Breathing
- Dry Skin
- Loss Of Consciousness, Also Known As Fainting Or Syncope

If left untreated, DKA can lead to a coma or death. If have type 1 diabetes and have a blood sugar reading of over 240 milligrams per deciliter (mg/dL), should test for ketones using a urine or blood test. People with type 2 diabetes are usually at lower risk of DKA. But the risk can increase when our body is under strain due to injury, infection, or surgery.

Clinical manifestations:

- Fluid replacement
- Electrolyte replacement
- Insulin therapy
- Medications
- Test your blood sugar consistently, as recommended by doctor. This will help you get in the habit of making sure your numbers are in range. If notice a problem, can talk with doctor about adjusting treatment plan. •
- Talk with doctor about adjusting insulin dosage levels based on activity level, illnesses, or other factors, such as what eating. •
- If have high blood sugar and blood or urine test detects ketones, do not exercise. Exercising with high blood sugar can be dangerous when you have diabetes. It’s best to talk with your doctor about how to manage this situation.

3. .Explain the biological significance of lipid transport system. (Nov.2023)

Answer :

Because lipids, such as cholesterol and triglycerides, are insoluble in water these lipids must be transported in association with proteins (lipoproteins) in the circulation. Large quantities of fatty acids from meals must be transported as triglycerides to avoid toxicity.

3.Explain in detail about Diabetes mellitus.

Answer :

Diabetes is a metabolic disorder in which there are high levels of sugar in the blood, a condition called hyperglycemia. Under normal conditions, food is broken down to glucose which then enters the bloodstream and acts as fuel for the body. The pancreas produces a hormone called insulin which helps to carry glucose from the bloodstream into muscle, fat and liver where it can be used as fuel. Diabetics are not able to move this sugar out of the bloodstream because of two primary reasons: 1) their pancreas does not produce enough insulin and/or 2) their cells do not respond normally to insulin, a condition called insulin resistance. This is why people with diabetes have high blood sugar levels.

Symptoms:

- **Type 1 diabetes**– Symptoms of type 1 diabetes develop over a short period of time and include weight loss, frequent urination, excessive thirst and hunger, weakness and fatigue, nausea and vomiting.
- **Type 2 diabetes** –Symptoms develop slowly with some people showing no symptoms at all. They include any of the symptoms of type 1 diabetes, blurred vision, hard to heal skin, gum or bladder infections, and tingling or numbness in the hands or feet.
- **Gestational diabetes–** Symptoms may or may not develop during pregnancy and therefore individuals need to be tested for the condition. Symptoms are same as for type 2 diabetes.

Complications of diabetes:

If not cared for appropriately, it may lead to the following complications–

1. Kidney disease(Diabetic nephropathy)
2. Blindness(Diabetic retinopathy)
3. Heart disease and stroke. Diabetics are 2 to 4 times more likely to have a heart disease and suffer a stroke.
4. Nerve damage
5. Soreson feet and skin possibly resulting in amputations
6. Diabetic coma due to extremely high blood sugar.

Diagnosis:

1. **Fasting blood glucose level** – It is the preferred method of determining diabetes in children and non pregnant adults. Diabetes is diagnosed if blood glucose level is 126 milligrams per decilitre (mg/dL) or higher after an 8-hour fast. Levels between 100-126 mg/dL are considered prediabetes, a condition where individuals have high blood sugar but not high enough to be classified as diabetes. Individuals with prediabetes have higher elevated risk of developing T2D.
2. **HemoglobinA1c test** –This is a blood test that shows how well you are controlling diabetes. It shows the average level of blood glucose over the previous 3 months.
3. **Oral glucose tolerance test (OGTT)** – This is a test to check how well your body breaks down sugar. Diabetes is diagnosed if blood glucose level is 200mg/dL or higher after drinking a beverage containing 75 grams of glucose dissolved in water.

Treatment:

Although there is no cure for diabetes, treatment and control of diabetes involves the following:

1. Insulin injections
2. Weight loss
3. Constant monitoring of blood glucose through frequent blood glucose tests or self-monitoring equipments such as glucometers.
4. Oral medications (recommended by physician)to lower blood glucose
5. Healthy diet including foods with fewer calories, an even amount of carbohydrates and healthy monostaurated fats. Patients should work with their doctor or dietician to design a meal plan to maintain near-normal blood glucose levels.
6. Exercise In all, a healthy lifestyle, insulin and oral medications to maintain normal glucose levels are the foundations of diabetes management and treatment.

4. Ellaborate the types of glycogen storage diseases.

Answer :

Glycogen storage diseases are a group of inherited disorders associated with glycogen metabolism, familial in incidence and characterised by deposition of normal or abnormal type and quantity of glycogen in the tissues.

Six classical types of GSDs will be considered.

Type I : Von Gierke's Disease:

Enzyme deficiency : Glucose-6-phosphatase. The enzyme is absent in liver cells and also in intestinal mucosa.

It is autosomal recessive.

Liver cells, intestinal mucosa and cells of renal tubular epithelial cells are loaded with glycogen which is normal in structure but metabolically not available.

Type II : Pompe's disease:

Enzyme deficiency : Acid Maltase. Enzyme is present in lysosome and catalyses break down of oligosaccharides. It is autosomal recessive.

Glycogen structure is normal. Generalised involvement of organs seen including heart, liver, smooth and striated muscles. Nearly all tissues contain excessive amount of normal glycogen.

Cardiomegaly seen. Muscle hypotonia leading to muscle weakness. No hypoglycaemia.

Type III : Forbe's disease:

Enzyme deficiency :Debranching enzyme. It is Autosomal recessive.

Glycogen structure is limit dextrin type, abnormal short or missing outer chains. Organs involved are liver, heart and muscle. Hepatomegaly, moderate hypoglycaemia, acidosis, progressive myopathy. Similar to type-1 but glycigen is abnormal and runs a milder course. Enzyme deficiency can be demonstrated in leucocytes.

Type IV : Anderson's disease:

Enzyme deficiency : Branching enzyme. It is Autosomal recessive.

Glycogen deposited is abnormal type, few branch points and very long inner and outer unbranched chains.

Main organs affected are Liver, and other organs are heart, muscle and kidney. Hepatomegaly, splenomegaly, ascites, moderate hypoglycaemia, nodular cirrhosis of liver and hepatic failure.

Type V : McArdie's Disease:

Enzyme deficiency : Muscle Phosphorylase. It is Autosomal recessive.

Glycogen deposited is normal in structure, organs involved skeletal muscle. Muscle cramps on exercise, pain, weakness and stiffness of muscles. No lactate is formed. Muscles recover on rest, due to utilisation of FA, for energy.

Type VI : Her's disease :

Enzyme deficiency : Liver phosphorylase.

Glycogen deposited is normal in structure, organs affected are mainly liver and also leucocytes.

Hepatomegaly, mild to moderate hypoglycaemia, mild acidosis, presents like mild case of type-the condition has also been reported to occur in association with Fanconi's syndrome.

UNIVERSITY OF MADRAS

B.SC.DEGREE COURSE IN MICROBIOLOGY SYLLABUS WITH EFFECT FROM 2023-2024 SUB.CODE :136E1A

ALLIED-I: BASIC AND CLINICAL BIOCHEMISTRY(Theory)

(For Microbiology branch Students)

(NOVEMBER2023 QUESTIONS ARE ANALYSED)

UNIT- IV

Disorders of metabolism: Disorders of amino acid metabolism: Alkaptonuria, Phenylketonuria, Phenylalaninemia, Homocysteineuria, Tyrosinemia, Aminoacidurias.

PARTA—(10×2=20marks)

Answer any TEN questions, each in 30words.

1. Explain the term "aminoacidurias". (Nov.2023)

Answer :

The most common cause of aminoaciduria is the congenital lack of an enzyme required for amino acid metabolism. The majority of amino acidopathies are caused by a hereditary lack of an enzyme critical to the metabolism of a certain amino acid.

2. Explain the biochemical basis of alkaptonuria. (Nov.2023)

Answer :

Tyrosine and phenylalanine are two protein building blocks (amino acids) that the body is unable to completely break down, a condition known as alkaptonuria, or black urine disease. It is an extremely rare genetic condition. The body experiences an accumulation of homogentisic acid as a result.

3. Explain the biochemical basis of Phenylketonuria.

Answer :

Due to a lack of phenylalanine hydroxylase (PAH), phenylketonuria (PKU) is an autosomal recessive inborn defect in phenylalanine (Phe) metabolism. Mutations in the PAH gene on chromosome 12q23 produce the majority of PKU and hyperphenylalaninemia (HPA) types.

4. Differentiate between Phenylalaninemia and Tyrosinemia.

Answer :

S.NO	PHENYLALANINEMIA	TYROSINEMIA
1	A metabolic condition in which the body accumulates dangerous amounts of phenylalanine due to a lack of the enzyme phenylalanine hydroxylase.	Tyrosinemia is a hereditary metabolic disease that results in inefficient breakdown of the amino acid tyrosine by the body.
2	Symptoms- Growth retardation, Mental retardation, Vomiting, Irritability, Seizures, Hyperactivity, etc.	Symptoms - Bloody stools, Diarrhea, Fatigue, Poor weight gain, Convulsions, Intellectual disability, Seizures, etc.
3	Treatment - 1. lifelong eating plan with extremely little phenylalanine-containing meals. 2.Taking a PKU formula, a unique dietary supplement, for the rest of your life to ensure that you receive adequate amounts of vital nutrients and protein (free of phenylalanine) for development and overall health.	Treatment - Tyrosine and phenylalanine are low in the TYR modified diet. For the rest of their lives, a person with TYR must continue receiving management. A liver transplant is a further therapeutic option for some TYR patients.

PARTB— (5×5 =25marks)
Answer any FIVE questions , each in 200 words.

1. Discuss the clinical manifestations and treatment strategies for tyrosinemia. (Nov.2023)

Answer :

Tyrosine is an essential amino acid that makes up proteins, and tyrosinemia is a rare hereditary condition that affects the body's ability to break it down. A lack of certain enzymes in the tyrosine metabolism pathway results in tyrosinemia and the build-up of harmful byproducts.

Symptoms:

Tyrosine buildup in the skin, neurological system, and eyes is the primary cause of the symptoms of Tyrosinemia Type II. The most typical indications are:

- **Eye issues:** Tyrosine crystal accumulation in the eye tissues causes excessive tearing, redness, pain, sensitivity to light, and inflammation of the cornea (keratitis). If neglected, this may result in blindness or vision loss.

- **Skin issues:** Increased production of keratin, a protein that forms the skin's outer layer, results in thickened, painful, and cracked skin lesions (hyperkeratosis) on the palms of the hands and soles of the feet. The elbows, knees, and face are just a few other body parts that could be impacted by the skin lesions.

- **Mental health issues:** As a result of compromised brain function, approximately half of individuals with Tyrosinemia Type II have an intellectual disability or developmental delay. Mental health disorders can range in intensity from minor to severe and include behavioral problems, learning disabilities, delayed speech, and seizures.

Treatment :

— Eating a low-protein diet that restricts items high in phenylalanine and tyrosine, such as dairy, meat, and beans. It is possible to prescribe certain diets and formulations to guarantee proper growth and nourishment.

- Consuming nitisinone prevents tyrosine from producing harmful metabolites. Because nitisinone permits a certain amount of tolerance for tyrosine intake, it can also lessen the necessity for a tight diet.

- Regularly checking blood levels of tyrosine and other amino acids to make necessary dietary and medication dosage adjustments.

- Applying topical or oral drugs, surgery, or laser therapy to treat skin and ocular issues.

2. Compare the metabolic pathways affected in alkaptonuria and pkenylketonuria. (Nov.2023)

Answer :

S.NO	PHENYLKETONURIA	ALKAPTONURIA
1	A lack of phenylalanine hydroxylase, which is responsible for converting phenylalanine into tyrosine, results in phenylketonuria. Consequently, phenylalanine builds up in the bloodstream and transforms into phenylpyruvate, a phenyl ketone that is ultimately eliminated in the urine—thus the term phenylketonuria.	Tyrosine and phenylalanine are two protein building blocks (amino acids) that the body is unable to completely break down, a condition known as alkaptonuria, or black urine disease. It is an extremely rare genetic condition. The body experiences an accumulation of homogentisic acid as a result.

2	PKU results from a phenylalanine hydroxylase enzyme deficiency, which raises phenylalanine levels and, if addressed, may cause mental retardation.	Tyrosine and phenylalanine's metabolic route is disturbed in alkaptonuria, a hereditary illness. An intermediary in the pathway called homogentisic acid (HGA) accumulates in the patients' bloodstream and is eliminated through urine.
3	The metabolic route pertaining to PKU involves the transformation of phenylalanine into tyrosine, another amino acid. This pathway is crucial because it eliminates excess phenylalanine and makes it possible to produce enough tyrosine.	A rare hereditary inborn defect of protein metabolism is called alkaptonuria. Homogentisate 1,2dioxygenase, or HGD, is an enzyme deficiency that causes homogentisic acid to build up in connective tissue and cause ochronosis.

PKU results from a phenylalanine hydroxylase enzyme deficiency, which raises phenylalanine levels and, if addressed, may cause mental retardation. A homogentisate 1,2-dioxygenase deficiency causes the rare condition alkaptonuria, which over time can cause darkening of the skin and other tissues.

PARTC—(3×10=30marks)

Answer any THREE questions, each in 500words.

1. Describe the pathophysiology of phenylketonuria. (Nov.2023)

Answer :

Definition:

A hereditary disorder known as phenylketonuria (PKU) results in the accumulation of high amounts of phenylalanine in the body. The body needs phenylalanine for regular metabolic processes, but when levels stay consistently higher than normal, issues might occur.

A type of amino acid is phenylalanine. Proteins are made up of substances called amino acids. Phenylalanine can be found in a lot of foods that you eat that combine protein and aspartame, an artificial sweetener. An accumulation of phenylalanine in the body can lead to symptoms such as intellectual impairment if the problem is left untreated.

Symptoms:

- Notable symptoms of phenylketonuria (PKU) are extremely rare because the condition is most commonly diagnosed and treated soon after birth as a result of an abnormal newborn test. Those with undiagnosed or untreated instances experience symptoms.

Untreated PKU symptoms include:

- Dermatitis.
- Discoloration of the skin or hair (less severe than in other family members).
- low head circumference (microcephaly).
- a smell of mold on their skin, urine, or breath.

The following are severe signs of untreated PKU:

- Behavioral difficulties.
- delays in development.

- impairments of the intellect.
- seizures (infrequent).
- Without therapy, individuals with mild hyperphenylalaninemia had a far decreased chance of developing intellectual impairments.

Diagnosis:

Phenylketonuria (PKU) is confirmed by a blood test soon after birth by medical professionals as part of standard newborn screening. Your baby's doctor will perform additional testing, usually blood or urine tests, to confirm the diagnosis and determine the kind of PKU if the phenylalanine levels in their blood sample are high. Given that PKU is a hereditary disorder, the mutation causing the symptoms can be identified through genetic testing.

Even while PKU diagnoses happen most often soon after birth, if newborn screenings were not done, doctors can identify PKU at any age.

Treatment and management:

PKU patients require lifetime care. A certain diet or medication may be part of it. Possible course of treatment:

- Following a specific, nutrient-rich diet low in phenylalanine.
- consuming supplements, minerals, and vitamins.
- addingsapropterindihydrochloride (Kuvan®), an additional medicine, to help your body break down phenylalanine.
- Pegvaliase (Palynziq®) is a medicine that enables persons with PKU to consume an unrestricted diet free of Kuvan or supplements. The enzyme that aids in the breakdown of phenylalanine—which malfunctions in PKU—is replaced by this medicine.

Foods containing phenylketonuria:

A person diagnosed with phenylketonuria (PKU) needs to eat a special diet to limit the amount of foods that contain phenylalanine (if they're not treated with Pegvaliase). You can find phenylalanine in foods high in protein, including:

- Milks
- Eggs
- Cheese
- Nuts
- Fish
- Chicken
- Beef
- Beans
- Artificial sweetener

Prognosis:

Phenylketonuria (PKU) is a lifelong condition and most people living with it lead healthy lives. After diagnosis, regular blood tests to monitor the level of phenylalanine in your blood are necessary.

For those who are on a restrictive diet, many people benefit from working closely with a dietitian who can advise on the best foods to eat, what to avoid and how to get all the nutrients you need to stay healthy.

If you have PKU and are pregnant, your provider and/or dietitian will create a diet plan that ensures you receive proper nutrition while lowering your baby's risk for complications.

2. Ellaborate about the condition of Homocysteinuria.

Answer :

Definition:

A rare hereditary condition called homocystinuria (HCU) impairs your body's capacity to metabolize the amino acid homocysteine. A dangerous accumulation of homocysteine in your blood and urine can happen when you have this illness. Serious

issues affecting your eyes, skeletal system, central nervous system, and circulatory system may result from this accumulation.

The building components of protein are amino acids. Your body uses methionine, another amino acid, to create some homocysteine. Your diet, especially high-protein foods, provides your body with extra methionine.

Normally, homocysteine is produced by your body's metabolism of methionine. Your body lacks an enzyme necessary for correctly metabolizing homocysteine and maintaining it within a normal range if you have homocystinuria. Proteins called enzymes aid in accelerating chemical events in your body.

Symptoms:

Depending on the type of homocystinuria you have, different symptoms apply. Usually, throughout the first several years of life, they develop. However, some people experience no symptoms until they reach maturity.

The following are typical symptoms of the most prevalent kind of homocystinuria:

- Eyes
- Skeletal system
- Central nervous system
- Vascular system
- Dislocation of the lenses of the eyes
- Severe nearsightedness
- Excessive growth
- Long arms, legs, fingers, toes
- Knees bent inward
- Sunken or protruding chest
- Osteoporosis

Diagnosis:

The newborn screening test in the US looks for metabolic disorders such homocystinuria. The homocysteine test determines how much methionine and homocysteine are present in your baby's blood. The healthcare practitioner for your kid will ask for other testing to confirm the results if the test is positive.

Tests for newborn screening aren't usually 100% reliable. They occasionally fail to identify specific conditions. As a result, some patients with homocystinuria are not identified until symptoms start to manifest. The majority of symptoms appear in early childhood or toddlerhood, however they can also appear in adults.

Your doctor will request a homocysteine test if you exhibit symptoms of homocystinuria in order to confirm the diagnosis. If the results indicate that you have classical homocystinuria, your healthcare professional will ask for additional testing to identify the specific subtype.

Treatment:

In order to treat homocystinuria, your blood homocysteine levels must be under control in order to manage your symptoms. Taking a vitamin B6 supplement is typically part of the treatment. If you have classical homocystinuria that is susceptible to vitamin B6, vitamin B6 supplementation can be sufficient to lower and manage your homocysteine levels.

Supplementing with vitamin B6 won't be sufficient if you have classical homocystinuria that is either partially or completely vitamin B6-respon

UNIVERSITY OF MADRAS

B.SC.DEGREE COURSE IN MICROBIOLOGY SYLLABUS WITH EFFECT FROM 2023-2024SUB.CODE :136E1A

ALLIED-I:BASIC AND CLINICAL BIOCHEMISTRY(Theory)

(For Microbiology branch Students)

(NOVEMBER2023 QUESTIONS ARE ANALYSED)

UNIT- V

Evaluation of organ function tests: Assessment and clinical manifestations of renal, hepatic, panreactic, gastric and intestinal functions.Diagnostic enzymes: Principle of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase.

PARTA—(10×2=20marks)

Answer any TEN questions,each in 30 words.

1. Mention two pancreatic function test. (Nov.2023)

Answer :

The lipase test and the amylase test are the two types of pancreas blood testing. Amylase: This enzyme aids in the body's digestion of carbohydrates. The amylase test looks for high amylase enzyme concentrations. The lipase enzyme aids in the body's fat digestion.

2.What is the clinical significance of as partate aminotransferase (AST) in liver function? (Nov.2023)

Answer :

Serum AST and ALT measurements are primarily used in medicine for the identification and differential etiologic diagnosis of liver disease. Elevated serum transaminase activity is a marker of hepatic cell injury that appears before clinical symptoms and indicators (like jaundice).

3.Which enzyme is used to assess cardiac muscle damage and why? (Nov.2023)

Answer :

CK-MB was the standard cardiac enzyme for myocardial infarction diagnosis before troponin became widely used. All muscle tissues contain creatine kinase, which is nonspecific for myocyte damage. In contrast, CK-MB is comparatively selective for myocardial tissue.

4.Definecreatine kinase (CK). (Nov.2023)

Answer :

One kind of protein is CK. Your body's muscle cells require CK in order to operate. Following a cardiac attack, skeletal muscle injury, or intense activity, levels of CK may increase. They may also increase as a result of taking specific medications or supplements, as well as excessive alcohol consumption.

5.How is the isoenzyme profile of LDH used to determine the source of tissue damage? (Nov.2023)

Answer :

While it is present in other tissues as well, the lungs are the site of concentration for LDH-3. Blood containing LDH isoenzymes is a sign of sick or damaged tissue. The findings might indicate to your medical professionals which tissues are potentially affected or damaged.

PARTB— (5×5 =25marks)

Answer any FIVE questions, each in 200words.

1. Discuss the clinical manifestations of renal dysfunction and the key tests used to evaluate kidney function. (Nov.2023)

Answer :

Tests for kidney function evaluate how well your kidneys are functioning. The majority of these exams measure how effectively your kidneys remove waste from your body. A 24-hour urine sample, a blood test, or both may be required for a kidney test. Typically, you receive your test results the same day or a few days later.

Tests for kidney function measure how well your kidneys are functioning and can be performed on blood or urine. Glomerular filtration rate (GFR) is measured by the majority of these tests. The GFR measures how well your kidneys remove waste from your body.

Part of your urinary system are your kidneys. Located in the rear of your belly, directly behind your ribs, are the two kidneys. They aid in the removal of waste products from your body as urine. Moreover, your kidneys are essential for generating:

- Hormones that keep blood pressure steady.
- Your body's red blood cells are responsible for transporting oxygen.
- Vitamin D, which keeps muscles and bones healthy.

When to take a kidney function test:

Certain illnesses, such diabetes or hypertension, have an impact on the kidneys' ability to function. Kidney function tests may be used by your healthcare professional to monitor any issues you may have.

If you experience any symptoms that point to potential renal issues, you might also require a kidney function test. These signs could consist of:

- Blood in your urine (hematuria).
- Painful urination (dysuria).
- Frequent urge to urinate.
- Problems with starting to pee.

Types of Kidney function tests:

One or more kidney function tests may be ordered by our healthcare practitioner.

Blood tests for kidney function could be performed on you, like:

I. Blood urea nitrogen, or BUN, gauges the amount of nitrogen in your blood that is produced when proteins break down.

II. Based on your age, gender, size, race, and protein levels, the estimated GFR (eGFR) determines your filtration rates.
III. Serum creatinine monitors the accumulation of creatinine, a waste product resulting from the breakdown of muscle tissue.

24-hour urine testing may also be used by your healthcare practitioner, such as:

I. A particular protein known as albumin is sought for by microalbuminuria.
II. A urinalysis analyzes the blood, proteins, and function in you

2. Elaborate on the significance of creatine kinase (CK) and aldolase in the diagnosis of muscle-related disorders. (Nov.2023)

Answer :

Creatine kinase (CK):

The enzyme known as creatine kinase (CK) is mostly found in skeletal muscle and the heart, with trace levels being found in the brain. When damaged, the cells in your brain, heart, or skeletal muscles release creatine kinase into your blood.

A protein known as an enzyme serves as a catalyst to initiate a certain biological reaction.

Your skeletal muscles—the muscles that are connected to your bones and tendons—are the major source of the trace amount of calcium kinase (CK) that is typically present in your blood. The amount of CK in your blood rises in response to any illness, trauma, or incident that damages muscles and/or impairs their ability to produce or use energy. For instance, vigorous activity may raise CK levels.

CK levels can also rise as a result of muscle disorders, or myopathies, like muscular dystrophy.

CK enzymes come in three different types:
The majority of CK-MM is found in your skeletal muscles.
CK-MB: Predominately located in the heart muscle.
CK-BB: Mainly present in brain tissue.

Creatine kinase test:

The level of creatine kinase in your blood is determined by a creatine kinase (CK) test.

Increased levels of calcium kinase (CK) could be a sign of acute (short-term) or chronic (long-term) injury or degeneration of the heart, brain, or skeletal muscles. An alternative term for a creatine kinase test is:

- CK Total.
- CK Creatine.
- Phosphokinase CPK.

Functions:

- The relationship between increased levels of creatine kinase (CK) in a blood test and its normal function is not very clear. CK works by adding a phosphate group—a collection of naturally occurring chemicals—to creatine, which is a material found in muscle cells and aids in the production of energy by the muscles.
- The high-energy molecule phosphocreatine, which your body uses to produce energy, is created when CK adds phosphates to creatine.
- When there is acute or long-term deterioration in your heart, brain, or muscles, CK enters your bloodstream. Your muscles rupture when they are injured, allowing creatine kinase and other substances to seep into your blood.

Aldolase:

A protein called aldolase aids the body in converting sugar into energy. Your muscles and liver often contain large amounts of aldolase. Your muscles and liver contain cells that split open when they sustain damage, releasing aldolase into your bloodstream.

Functions:

The cytoplasmic enzyme aldolase is involved in the metabolism of fructose and glucose. In particular, it catalyzes the reversible process that produces glyceraldehydes 3-phosphate and dihydroxyacetone phosphate (DHAP) from fructose 1,6-

bisphosphate. The enzyme is involved in six reversible processes related to glycolysis and gluconeogensis.

Aldolase is a glycolytic enzyme that is widely expressed in the liver, brain, and red blood cells in addition to muscles. Creatine kinase (CK) is a muscle enzyme that is engaged in the phosphocreatine circuit for the energy supply of muscles.

3. Explain the significance of aldolase levels in assessing muscle and liver function. (Nov.2023)

Answer :

Aldolase:

Glucose is a type of sugar that our bodies process to produce energy. There are several steps involved in this process. The enzyme aldolase is one that is crucial to the process.

Although aldolase is present throughout the body, it is most concentrated in the liver and skeletal muscle.

Although there isn't a direct link, liver or muscle damage can result in elevated aldolase levels in the blood.

Aldolase test:

I. The level of aldolase in your blood is determined by the aldolase test. Elevated levels of this enzyme could be a sign of a major health issue.

II. Damage to the liver or muscles is typically indicated by elevated aldolase. For instance, a cardiac attack that damages the muscles generates a lot of aldolase. Aldolase levels are also elevated by liver diseases such as cirrhosis or hepatitis.

III. The aldolase test was once used to check for injury to the muscles or liver.

Doctors now perform more specialized blood tests, such as:

- Aspartate aminotransferase (AST),
- Alanine aminotransferase (ALT),
- Creatine kinase (CK)
  Nowadays, the aldolase test is not frequently performed. Nonetheless, if you have muscular dystrophy, it might be prescribed.

Aldolase levels:

There are minor variations between normal levels for men and women, and the particular ranges for an abnormal test can fluctuate slightly depending on the laboratory.

For individuals 17 years of age and older, normal readings typically fall between 1.0 to 7.5 units per liter (U/L). For individuals up to 16 years old, normal values can be as high as 14.5 U/L.

Elevated or unusual quantities of aldolase:
Health disorders such as the following may be the cause of higher or abnormal levels:

- Muscle Damage
- Dermatomyositis
- Viral Hepatitis
- Cancers Of The Liver, Pancreas, Or Prostate
- Muscular Dystrophy
- Heart Attack
- Polymyositis
- Leukemia
- Gangrene

Testing for hyperaldolaseemia, a disease that results in elevated aldolaselevels, is not a simple process. Hyperaldolasemia is a condition or disease that causes a loss in muscle mass. Initially, muscle breakdown raises aldolase levels. Nevertheless, as the body loses muscular mass, aldolase levels actually drop.

Low amounts of aldolase:
An aldolase level of less than 2.0 to 3.0 U/L is regarded as low. Individuals with low aldolase levels include those who have:

- Fructose Intolerance
- Muscle-Wasting Disease
- Late Stage Muscular Dystrophy

PARTC—(3×10=30marks)

Answer any THREE questions, each in 500 words.

1. Discuss in detail about the various test to assess the gastric and intestinal functions. (Nov.2023)

Answer :

Gastro-intestinal tests:

Gastrointestinal (GI) exams are X-ray exams that examine your GI tract, including your esophagus, stomach, small intestine, large intestine and rectum. A type of X-ray called fluoroscopy allows health care providers to take video images of the organs in action. There are different variations, depending on which organs are being examined. X-ray examinations of the GI tract allow healthcare providers to find problems in these organs. Healthcare providers prefer a type of X-ray called fluoroscopy, which takes video images of the organs in action, to diagnose gastrointestinal diseases. The various versions of the test depend on which organs are being examined. Our digestive system is made up of a series of organs that help process food from its entrance at

your mouth to its exit at your anus. Although the organs have different functions, they are actually all one tube-like pathway, known as the gastrointestinal (GI) tract.

Types of GI tests:

Typical GI examinations consist of:

I. An assessment of the esophagus during swallowing is known as the Barium Swallow Test (Esophagram). (It will take about an hour.)
II. Upper GI Series: An inspection of the esophagus, stomach and duodenum (upper small intestine) while they digest. (Roughly one to one and a half hours.)
III. Small Bowel Series: An investigation of the small intestine (small bowel) as it digests. (Roughly speaking, two to four hours.)
IV. An examination of the colon, rectum, and lower small intestine (ileum) is known as a barium enema or lower bowel series (big bowel). (Approximate time: one to two hours.)

GI examinations are performed to identify the underlying reasons of unexplained gastrointestinal problems, such as:

- Difficulty swallowing.
- Severe indigestion.
- Reflux.
- Abdominal pain.
- Diarrhea.
- Vomiting.
- Blood in your poop.

1) To start an **upper gastrointestinal exam**, you will stand on an X-ray table that tilts. In the event that you need to be leaned back during the exam, the X-ray technologist will use straps to fasten you to the table. If needed, they might give you a small amount of sedation. You will be given a barium contrast solution to drink during the test in order to demonstrate the upper organs and how they handle the substance. Barium is a white, powdery material that works well for

bringing attention to black-and-white pictures but not so well for taste. You'll get some flavoring and sweetness, but it will still taste gritty.

2) For a **lower gastrointestinal exam**, you will first lie on your side on a horizontally tilting X-ray table. After strapping you down, an X-ray tech will give you a barium contrast solution enema. Your lower gastrointestinal tract will be filled with the contrast solution, emphasizing the large and small intestines.
3) The table will be adjusted at different angles during the exam to assist the barium solution flow throughout your body and provide the fluoroscope varied views. Sometimes, to enhance contrast on the X-rays, the technician will pump air into your rectum.
4) Some discomfort, such as gas, cramps, and a strong urge to urinate, may be experienced during the lower GI test. You will be assisted to the restroom or given a bedpan after the initial X-rays are taken, and you will be instructed to move your bowels to remove as much of the barium as you can. Subsequently, you will return to the X-ray examination room for more X-rays, which will focus on the remaining barium solution on the lining of your gut.

2.Describe the diagnostic implications of measuring LDH and its isoenzymes in various clinical scenarios. (Nov.2023)

Answer :

I. An essential enzyme that aids in cellular respiration, or the process by which your body converts glucose (sugar) from the food you eat into energy for your cells, is lactate dehydrogenase (LDH).
II. Proteins called enzymes aid in accelerating your body's chemical reactions, or metabolism. Some materials they construct, while others they demolish. Almost every tissue in your body contains LDH. It is mostly found in red blood cells, liver, kidneys, and muscles.
III. Your body gets rid of older, or "dead," cells while new ones grow in the tissues. Your tissues emit LDH into the bloodstream or other bodily fluids as a regular procedure.
IV. Your body gets rid of older, or "dead," cells while new ones grow in the tissues. Your tissues emit LDH into the bloodstream or other bodily fluids as a regular

procedure. As a result, it's typical for a blood or fluid sample to always have some LDH.

LDH test:

- To assess for tissue damage, an LDH (lactate dehydrogenase) test quantifies the amount of LDH in your blood or other bodily fluid.
- Although some LDH is normal in your blood and other bodily fluids, excess LDH is released into your bloodstream or other bodily fluids when bodily tissues are damaged or injured.
- An acute (short-term) or chronic (long-term) illness or injury may have damaged specific bodily tissues if your LDH blood or fluid levels are increased.

LDH testing is unable to identify the specific bodily tissues that are injured. For this reason, in addition to LDH tests, medical professionals frequently order other tests to aid in the diagnosis of illnesses.

An LDH test goes under other names, such as:

- LD test
- Lactate dehydrogenase
- Lactate acid dehydrogenase

LDH Isoenzymes :

The LDH enzyme comes in five different forms, or LDH isoenzymes. Each isoenzyme is located in particular bodily tissues and has a somewhat distinct structure:

LDH -1 : Present in Red blood cells and heart

LDH - 2 :Mostly found in your white blood cells Red blood cells and your heart both contain it, though in lesser quantities than LDH-1.

LDH - 3 : Mostly found in the lungs. Other tissues contain smaller levels.

LDH-4 is primarily found in the pancreas and kidneys. It can also be found in the placenta, which is the organ that supplies the fetus with nutrition and oxygen when you are pregnant.

LDH - 5 :Your skeletal muscles—the muscles that link to your bones to enable movement—and liver contain the majority of LDH-5.

A certain amount of LDH is normal in the blood. However, if an illness or injury affects tissues that are home to LDH, your blood will become more concentrated in LDH due to the release of LDH isoenzymes by the cells.

3.Explain the clinical manifestations of Pancreatic test.

Answer :

A blood test to assess pancreatic function is known as a pancreas blood test. Tests on your pancreas' blood can be used to gauge how much of particular digestive enzymes it produces. These tests can determine the concentration of these enzymes in your blood.

Types:

Numerous distinct digestive enzymes are produced by our pancreas. The enzymes lipase and amylase are two key ones. The lipase test and the amylase test are the two types of pancreas blood testing.

Amylase: This enzyme aids in the body's digestion of carbohydrates. The amylase test looks for high amylase enzyme concentrations.

Lipase : The lipase enzyme aids in the body's fat digestion. The lipase test looks for high lipase enzyme levels.

Symptoms of pancreatitis:

Symptoms of pancreatitis may include:

- Severe abdominal pain.
- Nausea and vomiting.
- Loss of appetite.
- Fever.
- Back pain.

Abnormal pancreas blood test:

You might require additional testing if your lipase levels are excessive. The severity of pancreatitis cannot be determined by these numbers alone. The examinations could consist of:

- Endoscopy.
- Ultrasound.
- Computed tomography (CT) scan.
- Magnetic resonance imaging (MRI) scan.

Your doctor will notice an issue if your amylase levels are elevated, but it might not be related to your pancreas. In contrast to amylase levels, lipase levels provide more detailed information about the pancreas.

Elevated blood levels of lipase and amylase could indicate pancreatitis or injury to the pancreas. Acute pancreatitis is usually accompanied by three times normal amounts of lipase and amylase.

Diagnosis:

Medical practitioners can diagnose and determine the causes of pancreatitis by using imaging or laboratory investigations. In the early stages, diagnosing chronic pancreatitis can be challenging. In addition, your physician will check for other illnesses including pancreatic cancer or peptic ulcers that share symptoms.

Laboratory examinations :

The following laboratory tests are used to help diagnose pancreatitis:

Blood examinations. A medical practitioner could draw blood from you and send it to a laboratory for analysis of;

1. Elevated levels of blood fats, or lipids; indications of infection or inflammation of the bile ducts, pancreas, gallbladder, or liver.
2. Elevated levels of amylase and lipase, the digesting enzymes produced in the pancreas.

3.High blood glucose, often known as blood sugar; and pancreatic cancer

4.Stool analysis. To determine whether a patient has fat malabsorption, your doctor could examine a sample of their stool.

Imaging examinations:

Imaging tests are another tool used by medical practitioners to identify pancreatitis. In most hospitals, outpatient centers, and physician offices, a technician conducts the tests. For the majority of these tests, anesthesia NIH external link—a medication that helps you stay calm—is not necessary.

1.Ultrasonic : Using a device known as a transducer, ultrasound creates an image of your organs' structure by reflecting safe, painless sound waves off of them. Gallstones can be found with ultrasound.

2.CT scan, or computed tomography : Your gallbladder, bile ducts, and Pancreascan all be seen on a CT scan. Pancreatitis and pancreatic cancer can be shown on CTscans.

3.MRCP stands for magnetic resonance cholangiopancreatography : Using magneticresonance imaging (MRI) technology, MRCP may produce images of your soft tissues and organs without the need for x-rays. To check for pancreatitis reasons, your doctor or a specialist may utilize MRCP to examine your pancreas, gallbladder, and bile ducts.

4. Ultrasound endoscopy (EUS NIH external link) : An endoscope is a thin, flexible tube that your doctor inserts into your small intestine, stomach, and throat. In order to take images of your pancreatic and bile ducts, the doctor activates an ultrasound attachment. For this test, your doctor might refer you to a gastroenterologist.

5. Test of Pancreatic Function (PFT). This test may be used by your doctor to assess your pancreas' reaction to the hormone secretin, which is produced in the small intestine. Only a few centers in the US administer this test.

NOTES