

# BOTANY EXCEL 6 - BIOMOLECULES

## CARBOHYDRATES

1. One molecule of glucose yield **2880kJmol** energy.
2. **Gum** is a carbohydrate.
3. **Formula** of Glucose and Fructose is **C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>**
4. **Formula** of Sucrose is **C<sub>12</sub>H<sub>22</sub>O<sub>11</sub>**
  1. **Formula** of cellulose and Starch is ( **C<sub>6</sub>H<sub>10</sub>O<sub>5</sub> ) n**
  2. **Formula** of Rhamnose is **C<sub>6</sub>H<sub>12</sub>O<sub>5</sub>** and that of Rhamnohexose is **C<sub>7</sub>H<sub>4</sub>O<sub>6</sub>**.
  3. Monosaccharides - Glucose, Fructose.
  4. Disaccharides - Sucrose, Maltose.
  5. Polysaccharides - Starch, Cellulose, Glycogen, Chitin.
  6. **Reducing sugar** - Glucose, Maltose, Lactose. Free aldehyde or Ketonic group reduce Fehling's solution or Tollen's solution to give a red precipitate.
11. **Non-reducing sugar**- Sucrose. Aldehyde or Ketonic group is bonded.
12. **Alpha glucose** and **Beta glucose** differs only in the orientation of two hydroxyl groups at C1. This carbon is called as **Anomeric carbon** or Anomer.
8. **Ripe grape** contains about 20% glucose.
9. **Fructose** is called as **Grape sugar** and it is the *most sweetest sugar*.
10. **Sucrose** on hydrolysis with dilute acid gives **Glucose and Fructose**.
11. **Alpha – D – glucose** has a specific rotation of + 112 degree.
12. When glucose solution is allowed to stand, its rotation falls to +52.7 degree.
13. **Beta –D-glucose** has the specific rotation of +19 which increases to + 52.7 degree.
14. This phenomenon is called as **Mutarotation**.
15. When Starch is digested by **Diastase**, it yields Maltose.
16. Lactose is a reducing sugar and on digestion, it yields Glucose and Galactose.
17. **Sweetness of sugars**

Sucrose – 100	Glucose – 74	Fructose – 173
Galactose – 32	Maltose – 32	Lactose – 16
18. **Pectin** is a Polysaccharide.
19. Starch contains Amylose and Amylopectin.
20. **Amylose** is water soluble and contains about 200 glucose units linked by Glycosidic bonds.
21. **Amylopectin** is insoluble in water and contains branched chains of glucose.
22. **Glycogen** is called as Animal Starch and its structure is similar to that of Amylopectin.
23. **Cellulose** is a linear polymer of **Beta glucose units**.
24. Cellulose on nitration gives the **Gun powder** ( Cellulose nitrate ) which is used in explosives.
25. **Cellulose acetate** is used in Photographic film and in Varnish.
26. Rayons, Cellophane, Celluloid are made from Cellulose.
27. **Pectin** is a polysaccharide found in the Fruit skin which is used to make jelly.
28. **Alginate**, a polysaccharide obtained from Seaweeds.

29. Gum and Alginate are used as Stabilizers and Emulsifiers.

## LIPIDS

1. The term Lipid was coined by **Bloor** in 1943.
2. Fatty acids contain terminal Carboxyl group.
3. **Acetic acid** is a **simple fatty acid** and **Stearic acid** is a **complex fatty acid**.
4. Fatty acids generally contains **even number** of carbon atoms – 14 – 24.
5. Saturated fatty acids have **single carbon bonds** and Unsaturated fatty acids have **more than one double bonds**.
6. Mono Unsaturated Fatty Acids – **MUFA** – have *only one double bond*.
7. Poly Unsaturated Fatty Acids – **PUFA** – have *more than one double bonds*.
8. Most common MUFA is **Oleic acid**.
9. Unsaturated fatty acids have *low melting points*.
10. Fats and Oil are derived from Glycerol.

### 11.Fatty acids

#### *Unsaturated*

Palmitoleic acid  
Oleic acid  
Linoleic acid  
Linolenic acid  
Arachidonic acid

#### *Saturated*

Capric acid  
Lauric acid  
Myristic acid  
Palmitic acid  
Stearic acid  
Arachidic acid

12. Three fatty acids and one Glycerol are present in Triglyceride.
13. **Tripalmitin** is a **Neutral fat** containing 16 carbon Palmitic acid.
14. **Tristearin** is a neutral fat containing 18 Stearic acids.
15. Maximum number of double bonds in **essential fatty acids** is **4**.
16. **Richest source** of PUFA is Vegetable oil.
17. **Coconut oil** contains **minimum fatty acid** content.
18. **Sunflower oil** is rich in **Linoleic acid**.
19. **Mustard oil** is the most Unsaturated one.
20. **Prostaglandins** are synthesized from Essential fatty acids.
21. **Waxes** are chemically inert and contain odd number of carbon atoms ( 25 – 35 ). They are the Oxygenated derivatives of Secondary Alcohol or Ketones.
22. **Cholesterol palmitate** is the Wax present in Blood.
23. **Bee wax** is a mixture of Palmitic acid and Myricyl acid.
24. **Cephalin** is the lipid present in Brain and Nerve membrane.
25. **Steroids** are 4 membered ring ( Phenanthrene ).

## 26.Cholesterol

It is called as Animal Steroid. It is insoluble in water and forms bile salts. It is synthesized from Acetyl CoA or Acetate in Liver. Cholesterol is not a dietary essential substance. It is not found in plants. Cholesterol is minimum in vegetable oils.

### IMPORTANT LIPIDS

- |     |                   |   |
|-----|-------------------|---|
| 1.  | Diosgenin         | Steroid in Yam plant. Used as Anti fertility drug.                        |
| 2.  | Ergosterol        | Plant sterol. Converted into Vit.D by sunlight in animals.                |
| 3.  | Terpenes          | Five carbon compounds found in plants.                                    |
| 4.  | Isoprenes         | Lipids from Vit.A, Coenzyme Q, Carotinoids etc. are formed.               |
| 5.  | Phytosterols      | Plant sterols. Sigma sterol in Soyabean and Sitosterol in Wheat gram oil. |
| 6.  | Carotinoids       | Isoprenoids in plants containing 40 carbon atoms. Precursor of Vit.A.     |
| 7.  | Sterols           | Essential for the growth and flowering in plants.                         |
| 8.  | Terpenes          | Essential oils found in Camphor, Eukalyptus oil, Menthol etc.             |
| 9.  | Phytol            | Terpenoid alcohol in Vit.A and Chlorophyll.                               |
| 10. | Lycopene          | Terpenoid pigment present in Tomato.                                      |
| 11. | Polyterpene       | Natural Rubber.   |
| 12. | Hardest wax       | Spermacetic wax of Whale.   |
| 13. | Cutin and Suberin | Lipids present in plant cell wall.  |
| 14. | Cutin             | Polymerised hydroxy fatty acid.   |
| 15. | Suberin           | Phellonic acid and Glycerol mixture..                                     |

### Clinical importance of Lipids

1. **Tay Sach disease** is due to excess Gangliosides.
2. **Arteriosclerosis** is caused due to excess Cholesterol level.
3. LDL - Low Density Lipoprotein.
4. IDLs - Intermediate Density Lipoproteins.
5. VLDLs - Very low Density Lipoproteins.
6. HDLs - High Density Lipoproteins. Prominent in Blood.
7. **Tangier Disease** - Disease caused by the deficiency of Alpha Lipoprotein.
8. Apolipoprotein - Protein component of Lipoprotein.

### AMINO ACIDS

1. Amino acids exists in the non polar and Zwitter ion forms.
2. Zwitter ion that has both positive and negative charges is called as Innert Salt.
3. Acidic amino acids

Aspartic acid, Glutamic acid

4. Basic amino acids  
Lysine, Arginine, Histidine.
5. Neutral amino acids  
Glycine

6. **Essential Amino acids**

Valine  
Leucine  
Isoleucine  
Phenylalanine  
Tryptophan  
Methionine  
Lysine  
Threonine  
Histidine  
Arginine

**Non essential Amino acids**

Alanine  
Serine  
Proline  
Glutamic acid  
Aspartic acid  
Tyrosine  
Cysteine  
Asparagine  
Glutamic acid  
Glycine

7. **Magic 20** Amino acids are called as Magic 20.
8. Amino acids do not form part of protein are Ornithine, Citrulline, Cystine.
9. **Sulphur containing** Amino acids are Methionine, Cysteine, Cystine.
10. **Simplest amino acid** is Glycine. It has no asymmetrical carbon.
11. **Derived Amino acids** are formed from other amino acids by enzymatic reaction Eg. Cystine.
12. Alpha carbon - Central carbon atom of amino acid in which amino and carboxyl groups are attached.
13. Alkyl amino acids - Possess alkyl side chains. Egs. Glycine, Alanine, Valine, Leucine, Isoleucine.
14. Aromatic amino acids - Phenylalanine, Tyrosine, Tryptophan.
15. Dibasic amino acids - Lysine, Arginine, Histidine.
16. Basic amino acids - R group contains Nitrogen - Lysine, Arginine.
17. Acidic amino acids - R group contains Carboxylic acid
18. Iso electric pH - pH at which amino acid becomes Neutral - in Zwitter ion form  
Symbol is pI.

## PROTEINS

1. Primary structure - Polypeptide.
2. Secondary structure - Local 3D folding of protein by covalent bondings.
3. Tertiary structure - Further folding of secondary structure.
4. Quarternary structure - Folding by non covalent linkages.
5. **Native conformation** - Natural conformation by unique arrangement of amino acids.
6. Structural Motifs - Peculiar combination of secondary structure of proteins.
7. Chaperone protein - Heat shock protein. Synthesized when temperature rises.

- 8. **Salt Linkage** - Electrostatic or Ionic linkage found in Proteins.
- 9. Protein Data Book - Structure of various proteins is studied using X-ray diffraction and stored in a data base.
- 10. NMR - is used to study the structure of proteins.
- 11. Methods to separate Proteins - Electrophoresis, Chromatography, HPLC, Affinity chromatography.
- 12. **London Dispersion Force** and Vander waal force – Weakest of the non covalent force
- 13. Keratin - found in Skin, Nail, Hair, Hoof.
- 14. Keratin - contains sulphur containing amino acids like Cystine.
- 15. **Fibroin and Serecine** - Silk proteins of Silk worm.
- 16. Globular proteins - Egg albumin, Haemoglobin, Enzymes, Insulin.

## 17. INSULIN

Insulin is secreted by the Beta cells of Islets. It is the Hypoglycemic hormone reducing The high blood glucose level. **In 1953, Frederic Sanger** identified the amino acid Sequence of insulin. Insulin is a small protein containing 51 amino acids. 21 amino acids In the Alpha chain and 30 amino acids in the Beta chain. The two chains are linked by Disulphide ( S – S ) bonds. It is used in the treatment of Diabetics. Pig ( Porcine ) or Cow ( Bovine ) insulin are used for treatment. Genetically engineered Humulin is used nowadays. Modified Pig insulin is also used. The animal insulin may produce allergic responses in some persons. **Banting and Best discovered Insulin.**

- 18. Hemoglobin contains 574 amino acids.
- 19. **Beta Pleated structure** - Beta helix structure of proteins.
- 20. **Right handed or Alpha helix** - formed by hydrogen bonding between C= O and N-H groups of peptide bonds.
- 21. Forces making protein structure – Hydrogen bonds, Ionic bonds, Covalent bonds, Hydrophobic bonds.
- 22. Invertase - converts Sucrose to Glucose and Fructose.
- 23. Enzymes act at - moderate temperature of – 310 K.
- 24. Streptokinase - Enzyme used to dissolve blood clot.
- 25. Albinism - caused by the deficiency of Tyrosinase enzyme.

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