



SCHOOL OF INDIANA
HOME OF VISIONARIES

GRADE TWELVE CHEMISTRY

Monday May 18, 2020

C. Polysaccharides

Definition - Polysaccharides consists of a large number of monosaccharide units bonded together by glycosidic bounds.

The three important polysaccharides, all made – up of glucose units, are cellulose , starch and glycogen

Note:- Polysaccharides are addition polymers whereas disaccharides are condensation polymers because disaccharide involves the removal of water (simple molecules)

- ✓ Cellulose
 - Cellulose is the most abundant polysaccharide.
 - It is the structural component of the cell walls of plants.
 - Structurally, cellulose is a linear (unbranched) glucose polymer
 - In cellulose, the glucose units are linked by β - 1, 4- glucosidic linkage.
 - Cellulose is not a source of nutrition for humans because humans lack the enzyme cellulase.
 - Animals, such as horses, cows, and sheep contain bacteria in their intestine that produce cellulase.
 - Cellulase hydrolyze the β - 1,4- glucosidic bonds and produce free glucose from cellulose.
 - Grasses and other plant materials are sources of nutrition for these animals.
- ✓ Cotton is composed of pure cellulose.
 - The cotton fiber forms around the seeds of the cotton plant is designed to help carry the seeds long distance on the wind so that the plant can distribute itself.
 - Cotton is the most widely used natural- fiber for clothing.

2. Starch

- ✓ Starch is used for energy storage in plants.
 - If excess glucose enters a plant cell, it is converted to starch and stored for later use.
 - Starch can be separated into two principal polysaccharides, amylose and amylopectin.
- ✓ Amylose – is a straight – chain glucose polymer and accounts for 20-25% starch
 - The glucose units in amylose are connected by α -1,4 – glycosidic bonds,
 - The number of glucose units present in amylose chain depends on the source of the starch.
- ✓ Amylopectin – is a highly branched glucose polymer, which accounts for 75-80% of starch.
 - Like amylose, all the linkages in amylopectin are α -1,4 – glycosidic bonds.
 - A branch occurs in amylopectin about once in every 25-30 glucose units.

- o The branch points involves α -1,6- linkage
- o Because of the branching, amylopetin has a large average molecular mass than the linear amylase.

Note - All of the glycosidic linage in starch (both amylase and amylopetin) are α - type

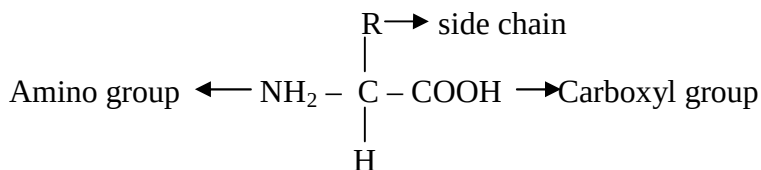
- ❖ In amylase – they are all α -1,4- linkages
- ❖ In amylopetin – both α -1,4- linkage and α -1,6- link age present.

3. Glycogen

- ✓ Glycogen – is a glucose storage polysaccharide in humans and animals.
 - o Glycogen is called animal starch.
 - o Liver cells and muscle cells are the storage sites for glycogen in humans.
 - o Like amylopetin, glycogen units are joined by α -1,4 – and α -1,6- linkage
 - o However, glycogen is about three times more highly branched than amylopetin.
 - o When excess glucose is present in the blood, the liver and muscle tissues convert the excess glucose to glycogen, which is then stored in these tissues.
 - o If the glucose blood level decreases, some stored glycosen is hydrolyzed back to glucose

Proteins

- ✓ The name protein comes from the Greek word “ptoteios” which means “primary”
- ✓ All proteins contains carbon, hydrogen , oxygen & nitrogen (CHON)
 - o Many proteins also contain sulphur.
- ✓ Proteins are made by the polymerization of the twenty naturally occurring amino acids.
- ✓ An amino acid is a cpd that contains both an amino (-NH₂) group and a carboxylic acid (-COOH) group
- ✓ The amino acids found in proteins are always α - amino acids (the amino group is attached to the carbon atom adjacent to the carboxyl group).
- ✓ The structural formula for an α - amino acid is:



- ✓ Based on the side- chain polarity, amino acids can be grouped into four catagories
 - a. Non polar amino acid
 - b. Polar neutral amino acid
 - c. Polar acidic amino acid
 - d. Polar basic amino acid
- 1. Nonpolar amino acids
- ✓ Nonpolar amino acids contains one amino group, one carboxy group and a non polar side chain.
 - o These amino acids are hydrophobic (water fearing) and are not attached to water molecules.
 - o They are generally found on the interior of proteins.
 - o There are eight non polar amino acids. These are:-

▪ Glycine (Gly, G)	- Isoleucine (Ile,I)
▪ Alanine (Ala,A)	- methionnylaline (met,m)
▪ Valine (Val, V)	- Phenylalanine (Phe,F)

- Lucine (Leu, L)
- Proline (Pro, P)

Note- Either three letters or one letter can represent each amino acid.

2. Polar neutral amino acids

- ✓ Polar neutral amino acids contains one amino group, one carboxyl group and a side-chain that is polar but neutral
 - o These are seven polar neutral amino acids. These are
 - Serine (Ser, S)
 - Crysteine (Cyst, C)
 - Threonine (Thr, T)
 - Asparagine (Agn, N)
 - Glutamin (Gin, Q)
 - Tyrosine (Tyr, Y)
 - Tryphophan (Trp, W)

3. Polar acidic amino acids

- ✓ Polar acidic amino acids contains one amino group and two carboxyl groups.
 - o The second carboxyl group is part of the side chain
 - o There are two polar acidic amino acids. These are Aspartic acid (ASP, D) and Glutamic acid (Gluc, G)

4. Polar basic amino acids

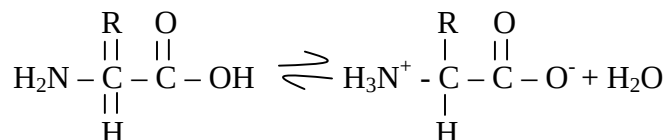
- ✓ Polar basic amino acids contains two amino groups and one carboxyl group.
 - o The second amino group is part of the side chain
 - o There are three polar basic amino acids, these are:-
 - Histidine (His, H)
 - Lysinee (Lys, K)
 - Arginine (Arg, R)

Physical properties of Amino Acids

- ✓ Amino acids have the following properties.
 - a. They have high melting points
 - b. They are colourless crystalline substances
 - c. They are soluble in water but insoluble in non polar solvents.
- ✓ Amino acid resemble ionic compounds. This occurs due to the fact that amino acids contain both an acid (- COOH) and a base (- NH₂)groups.
 - o These acids and basic groups react with each other to form a dipolarion or internal salt.
 - o The dipolar ion of an amino acid is called Zwitterion
 - o Zwitterions – has no net charge
 - o A zwitterions structure changes when the PH of soln containing amino acid is changed from neutral either to acidic (low PH). By adding HCl, or to basic (high PH) by adding NaOH

Note – In acidic solution , the zwitterions accepts a proton (H⁺) to form a positively changed ion

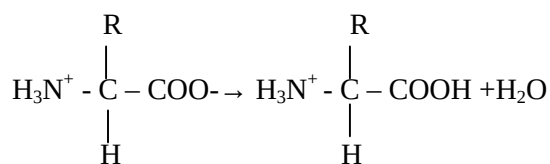
- In a basic solution, the - NH₃⁺ of zwitterions loses a proton and a negatively changed species is formed.



Amino acid

Zwitterion

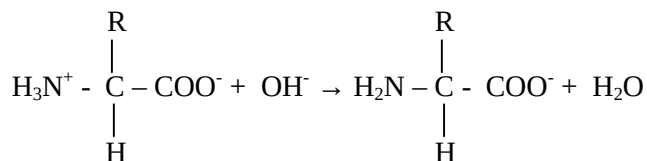
In acidic solution the rxn become: $+ \text{H}_3\text{O}^+$



Zwitterion

Positively charged

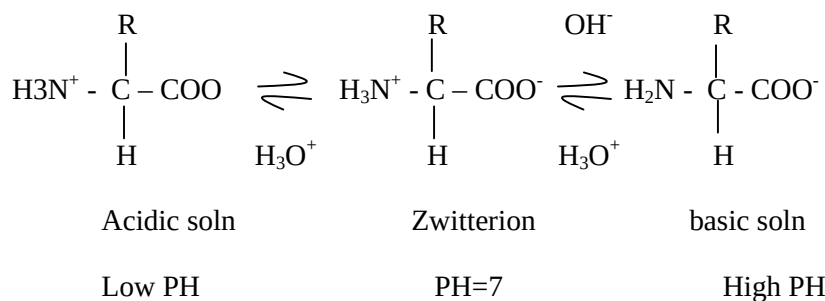
In basic solution the rxn become:



Zwitterion

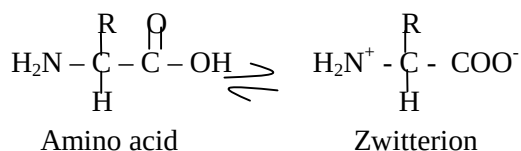
Negatively charged ion

Note – In a solution, three different amino acid forms can exist (Zwitterion, negatively charged ion and positively charged ions)



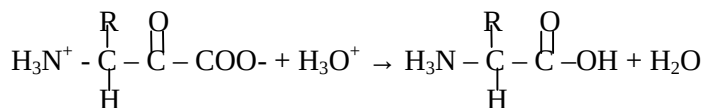
Note: In acidic solution, the Zwitterion accepts a proton (H^+) to form a positively charged ion

- In a basic solution, the $-\text{NH}_3^+$ of zwitterion loses a proton and a negatively charged ion is formed.



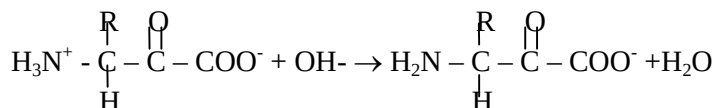
Amino acid

Zwitterion



Zwitterion

Positively charged ion



Zwitterion

Peptide Bond Formation

- ✓ A Peptide bond (amide) is a bond formed between the carboxyl group of one amino acid and the amino group of another amino acid
 - o A cpd containing two amino acids joined by a peptide bond is called a dipeptide.
 - o Either end of the dipeptide can undergo a condensation rxn with another amino acid to form a tripeptide, terapeptide, and soon.

- o A polypeptide – is a sequence of amino acids, containing up to 50 amino acid units.
- o Proteins – are polypeptides that contains more than 50 amino acid units.
 - Proteins have many functions

Types of protein	Examples	Functions
Enzymes	Amylase	Promotes the breakdown of starch to simple sugar (glucose)
Structural protein	Kertain, collagen	Promotes the formation of hair, wool, nails, horns tendons, and cartilages
Contractile protein	Actin, myosin	Contracting fibers in muscle
Hormones	Insulin, glucagon	Regulates use of blood sugar
Storage proteins	Ferritin	Stores iron in spleen
Transport protein	Hemoglobin	Carries oxygen in blood
	Serum albumin	Carries fatty acids in blood
Immunological proteins	Antibodies	Defends the body from foreign invaders.