two pyranose ring structures are proposed. They are alpha D plus gluco pyranose and beta D plus gluco pyranose.

FRUCTOSE

It is a simple sugar. It is a monosaccharide. It cannot be hydrolysed further. They are sweet in taste. They are soluble in water. They are crystalline in nature. It occurs in plants and honey. It is a reducing sugar. It is an optically active compound. It plays an important role in cellular metabolism. It rotates lights in left direction. So it is called levo sugar.

Structure of Fructose

Fructose is a ketone and consists of six carbon atoms in a straight chain with the keto functional group at position 2 of the carbon chain (**Fig.8**). As the open chain structure fails to explain certain facts like its existence in two isomeric forms and the formation of hydrogen sulphite addition product, the ring structure was established. The cyclic structure is a five-membered ring. Therefore, there are two possible isomeric forms. The two cyclic forms differ in the configuration of the hydroxyl group at C2. These isomers are called anomers. The five-membered ring structure of fructose is called furanose. The cyclic structures of the two anomers are named α-D-(-)-fructofuranose and β-D-(-) fructofuranose (**Fig.11**).

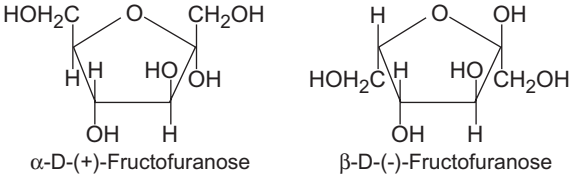

Fig. 11 : ***Cyclic Structure of Fructose.***

Galactose : It is a monosaccharide. It is a simple sugar. It is acomponent of milk sugar. In liver, galactose is changed into glucose. It is a reducing sugar. It is soluble in water. It is sweet in taste. It is an aldohexose. It is in crystalline form. It occurs in molasses, malted milk shake (**Fig.12**).

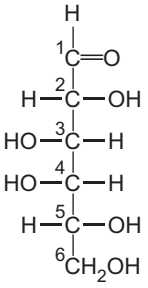

Fig. 12 : ***Galactose.***

Ribose : It is a monosaccharide. It is a pentosugar. Molecular formula is $C_5H_{10}O_5$. It is a simple sugar. It is a reducing sugar. It is soluble in water. It is sweet in taste. It is in crystalline form. It exhibibits isomerism. It remains in

polysaccharides are classified into two groups, homopolysaccharides and heteropolysaccharides.

Homopolysaccharides

Homopolysaccharides are composed of only one type of monosaccharides. On hydrolysis they yield only one type of monosaccharides Eg. starch, glycogen, cellulose, inulin, pectin and hemicelluloses. They yield only glucose on hydrolysis.

Starch

It is a homopolysaccharide. It is a non sugar. It yields glucose on complete hydrolysis. This is the reserve food in plants. They are abundantly found in root, stem, vegetables, fruits and cereals. Rice, wheat and vegetables are a rich source of starch. Starch occurs in the forms of grain which may be spherical or oval in shape. Microscopically, the starch grains are found to differ in size and shape according to their sources. Starch is made up of two structurally different homopolysaccharide units. They are amylose and amylopectin. Glucose molecules are arranged in a linear form in amylose where as glucose molecules are arranged in a highly branched form in amylopectin. Amylose has (1-4)-glycosidic linkages. The glycosidic bond occurs between OH group of C1 in one glucose unit is joined to that of C4 of the next unit. A solution of starch react with iodine to give blue colour. The blue colour formation is mainly due to the presence of amylose in starch.

Amylose : It has a simple unbranched structure . It is soluble in water. It has α,(1-4)-glycosidic linkages. Gives blue colour with dilute iodine solution. The molecular weight ranges from 10,000-50,000

Amylopectin : It has branched chain structure. It is insoluble in water, can absorb water and swells up. It has α,(1-4)-glycosidic and α,1-6 glycosidic linkages. It gives yellow or orange colour with iodine solution. The molecular weight ranges from 50,000 – 1,00,000.

Starch digestion

Digestion of starch begins in the mouth. Salivary enzyme α amylase randomly hydrolyses all the α,1-4 glycosidic bonds of starch. Starch digestion continues in the small intestine under the influence of pancreatic amylase. This enzyme degrades starch to a mixture of disaccharide maltose and the trisaccharide maltotriose. These oligosaccharides are hydrolysed to their component monosaccharides by specific enzymes persent in the brush border membranes of the intestinal mucosa. The resulting monosaccharides are absorbed in the intestine and transported to the blood stream.

Glycogen

Glycogen is a homopolysaccharide. It gives only glucose units on hydrolysis. It is the major reserve carbohydrate in animals. It is also called animal starch. It is stored in liver. Glycogen is present in all cells of skeletal muscle and liver and occur as cytoplasmic granules. Glycogen is readily available as immediate

Table : Time of formation and the shape of osazone.

Carbohydrate	Time of formation	Shape of osazone crystals of osazone
Mannose	1-5 mins	Yellow needle shaped crystals
Fructose	2-3 mins	Yellow needle shaped crystals
Glucose	5-7 mins	Yellow needle shaped crystals
Galactose	15-20 mins	Broken glass like crystals
Lactose	45-50 mins	Badminton ball shaped crystals.
Maltose	35-45 mins	Star shaped crystals
Arabinose	8-10 mins	Chalk powder shaped crystals
Xylose	6-7 mins	Flower shaped crystals
Sucrose	3-7 mins	Needle shaped crystals form after hydrolysis

DIGESTION AND ABSORPTION

Digestion is defined as a process that involves physical and chemical breakdown of insoluble complex food material into soluble simple food materials.

Polysaccharides →→ Glucose
Proteins →→ Amino acids
Lipids →→ Fatty acids + Glycerol

There are two types of digestion, they are intracellular and extracellular digestion. The digestion occurs inside of the cell is called intracellular digestion. Eg. Phagocytosis.

Digestion taking place out side of the cell and inside of the bowl are called extracellular digestion. Eg. The digestion taking place inside of the stomach. It is also called inter cellular digestion as it occur in between the cells in the lumen of stomach.

Digestive system of Man

It includes alimentary canal and digestive glands. Six major functions take place in the digestive system are Ingestion, Secretion, Mixing and movement, Digestion, Absorption and Excretion. Alimentary canal includes mouth, tongue, pharynx, oesophagus, stomach, intestine, rectum and anus.

Mouth : It is a first part of alimentary canal. It is also called oral cavity. The tongue, teeth, and salivary glands are the accessory organs found in mouth, which aids in the digestion of food. Teeth chop food into small pieces, which are moistened by saliva before the tongue and other muscles push the food into the pharynx.

Teeth 32 small, hard organs found along the anterior and lateral edges of the mouth. Each tooth is made of a bone-like substance called dentin and covered in a layer of enamel—the hardest substance in the body.

The tongue is located on the inferior portion of the mouth just posterior and medial to the teeth. It is a small organ made up of several pairs of muscles covered in a thin, bumpy, skin-like layer. The outside of the tongue contains

Place of absorption

'Simple substances' which donot require digestion are absorbed in stomach eg. Water, alcohol, saline, glucose. Small intestine is the main place for absorption. The small intestine has two important adaptations for effective absorption. They are

1. It has great length about 25 feet and is much coiled.
2. The intestinal mucosa is produced into finger like projections called villi into the lumen. Human intestine contains as many as 50,000, 000 villi.

Large intestine absorps water, saline, alcohol and certain drugs.

Absorption of carbohydrates

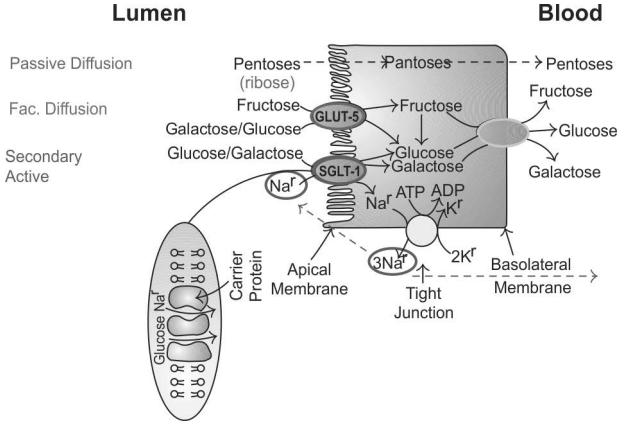

Fig. 29 : ***Absorption of Carbohydrate.***

It is the intake of monosaccharides from the lumen into the blood. Maximum rate of glucose absorption is 120g/hr. Carbohydrate is absorbed in the form of glucose, galactose, fructose, manose and pentose. Glucose and galactose are absorbed through active transport. Plasma membrane of intestinal wall has carrier protein sodium dependent glucose transporters (SGLT). This protein has two binding sites, one for glucose another one for Na^+. it binds with Na^+ and glucose & move towards cytoplasm of the cell which brings Na+ and glucose facing the cytoplasm. Here both glucose and Na^+ are released. Glucose moves along the cytoplasm and diffuses in the blood. The Na^+ is transported back to the lumen through sodium potassium pump. The simultaneous transport of **Na^+** and glucose are called Co-Transport. It is transported in a same direction, it is called symport. SGLT also transports galactose. Fructose is transported by the carrier protein GLUT (Glucose transporters). It is independent of Na^+. Other monosaccharides are transported by diffusion (**Fig.29**).

Absorption of protein

Absorption of protein is the intake of amino acids from the lumen of intestine into the blood. They are transported into the portal system of blood.