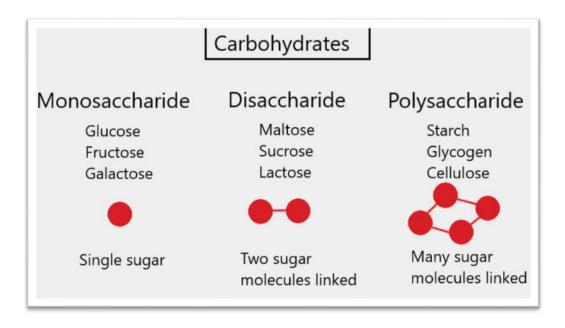
# Overview of Carbohydrates Monosaccharide's ,Disaccharides

## and Polysaccharides



## **Background:**

- Carbohydrates are the key source of energy used by living things.
- Also serve as extracellular structural elements as in cell wall of bacteria and plant.
- Carbohydrates are defined as the polyhydroxy aldehydes or polyhydroxy ketones.
- Most , but not all carbohydrate have a formula (CH2O) n (hence the name hydrate of carbon)
- In human body, the D-glucose is used.
- Simple sugars ends with –ose.

## Several classifications of carbohydrates have proven useful, and are outlined in the following table:

Complexity	Simple Carbohydrates monosaccharides		Complex Carbohydrates disaccharides, oligosaccharides & polysaccharides		
Size	Tetrose C <sub>4</sub> sugars	Pentose C <sub>5</sub> sugars	Hexose C <sub>6</sub> sugars	Heptose C <sub>7</sub> sugars	etc.
C=O Function	Aldose sugars having an aldehyde function or an acetal equivalent. Ketose sugars having a ketone function or an acetal equivalent.				
Reactivity	Reducing sugars oxidized by <u>Tollens' reagent</u> (or Benedict's or Fehling's reagents). Non-reducing sugars not oxidized by Tollens' or other reagents.				

#### **Classification :**

#### **1-Simple sugar (one unit) :**

Monosaccharide's contain one monosaccharide unit.

#### 2-Complex sugar (more than one) :

- Disaccharides contain two monosaccharide units.
- Oligosaccharides contain 3-9 monosaccharide units.
- Polysaccharides can contain more than 9 monosaccharide units.

-Complex carbohydrates can be broken down into smaller sugar units through a process known as hydrolysis.

## **Reducing and non-reducing sugars:**

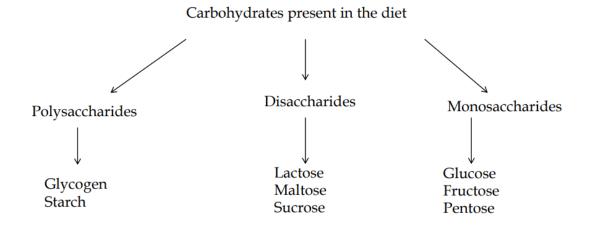
Reducing and non-reducing sugar : If the oxygen on the anomeric carbon of a sugar is not attached to any other structure, that sugar can act as a reducing agent and is termed a reducing sugar.

## **Solubility of sugars [physical property]:**

Monosaccharide and disaccharide can be dissolved freely in water because water is a polar substance, while polysaccharide cannot be dissolved easily in water, because, it has high molecular weight, which give colloidal solutions in water.

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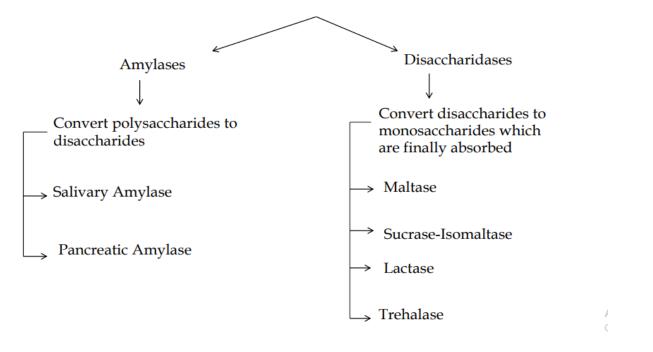
## **Digestion and Absorption of Carbohydrates:**



In GIT, all complex carbohydrates are converted to simpler monosaccharide form which is the absorbable form

## **Details of Digestion of Carbohydrates:**

Two types of enzymes are important for the digestion of carbohydrates



### **Digestion in the Mouth:**

• Digestion of Carbohydrate starts in the mouth, upon contact with saliva during mastication.

• Saliva contains a carbohydrate splitting enzyme called salivary amylase, also known as ptylin.

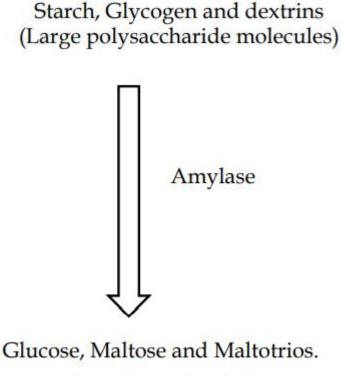
## Action of Ptylin (Salivary Amylase):

• Location: mouth

• It is an  $\alpha$ -amylase and requires Cl – ion for activation with an optimum pH of 6.7 (Range 6.6 to 6.8).

- The enzyme hydrolyse  $\alpha$  1–>4 glycosidic linkages deep inside polysaccharide molecules

• However, ptylin action stops in the stomach when the pH falls to 3.0.



(Smaller molecules)

#### **Drawback:**

- Shorter duration of food in mouth.
- Thus it is incomplete digestion of starch or glycogen in the mouth

## **Digestion in the Stomach:**

• There is no enzyme to break the glycosidic bonds in gastric juice.

• However HCl presents in the stomach causes hydrolysis of sucrose to fructose and glucose. HCl

## **Digestion in Duodenum:**

• Food bolus reaches the duodenum from the stomach where it meets the pancreatic juice.

- Pancreatic juice contains a carbohydrate splitting enzyme.
- Pancreatic amylase (amylopsin) is similar to salivary amylase.

## **Properties of Pancreatic Amylase:**

- It is an  $\alpha$ -Amylase
- Optimum pH=7.1
- Like Ptylin, it requires Cl<sup>-</sup> ion for its activity.

• It hydrolyses  $\alpha$  1 $\rightarrow$ 4 glycosidic linkages situated well inside polysaccharide molecules.

#### -Note:

- Pancreatic amylase, an isoenzyme of salivary amylase, differs only in the optimum pH of action.
- Both the enzymes require Chloride ions for their actions (Ion activated enzymes).

## **Digestion in Small Intestine:**

#### - Note:

• Main digestion takes place in the small intestine by pancreatic amylase.

• Digestion is completed by pancreatic amylase because food stays for a longer time in the intestine.

## What are Disaccharidases?

• They are present in the brush border epithelium of intestinal mucosal cells where the resultant monosaccharide and others arising from the diet are absorbed.

#### • The different disaccharidases are:

1) Maltase

2) Sucrase-Isomaltase (A bifunctional enzyme catalyzing hydrolysis of sucrose and isomaltose)

3) Lactase

## **Reactions catalyzed by Disaccharidases:**

• Maltose  $\xrightarrow{Maltase}$  Glucose + Glucose • Sucrose Isomaltose  $\xrightarrow{Sucrase-Isomaltase}$  3 Glucose + fructose • Lactose  $\xrightarrow{Lactase}$  Glucose + Galactose

## **Absorption of Monosaccharides:**

- The major monosaccharides resulting from carbohydrate digestion are:
- D-glucose
- D-galactose
- D-fructose.
- Monosaccharides are first transported from the lumen to the small intestinal epithelial cells and then into capillaries of portal venous system.

## **Factors affecting rate of absorption of Monosaccharides :**

- The absorption is faster through intact mucosa.
- The absorption is decreased if there is some inflammation or injury to the mucosa.
- Thyroid hormone (increases) the rate of absorption of glucose.
- Mineralocorticoid, i.e: Aldosteron (decreases) the rate of absorption
- Vitamin B6,B12 pantotheni acid, folic acid are required for absorption of glucose. With advancing age, rate of absorption declines.