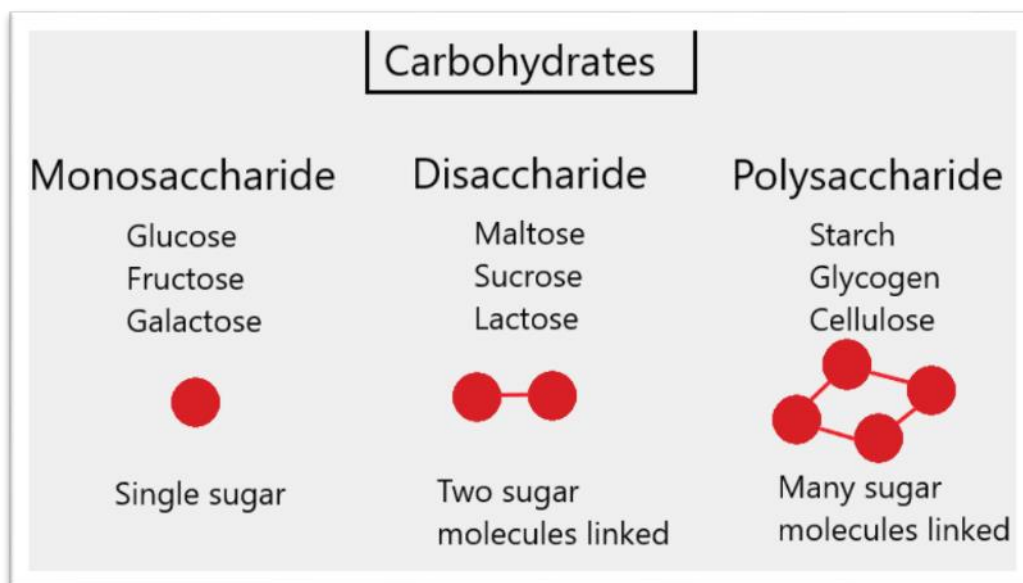


Overview of Carbohydrates

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 $(CH_2O)_n$ (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 ₄ sugars	Pentose C ₅ sugars	Hexose C ₆ sugars	Heptose C ₇ 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 Tollens' reagent (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.

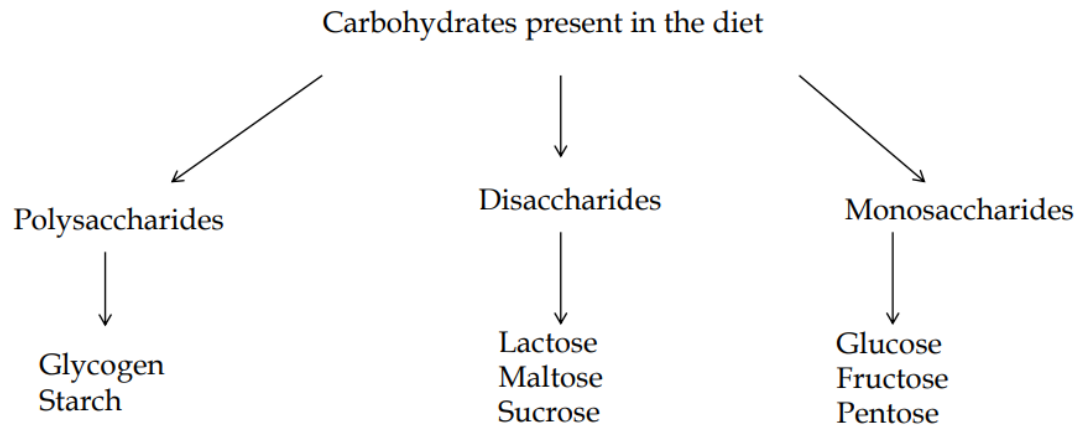
Reducing and non-reducing sugars:

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.

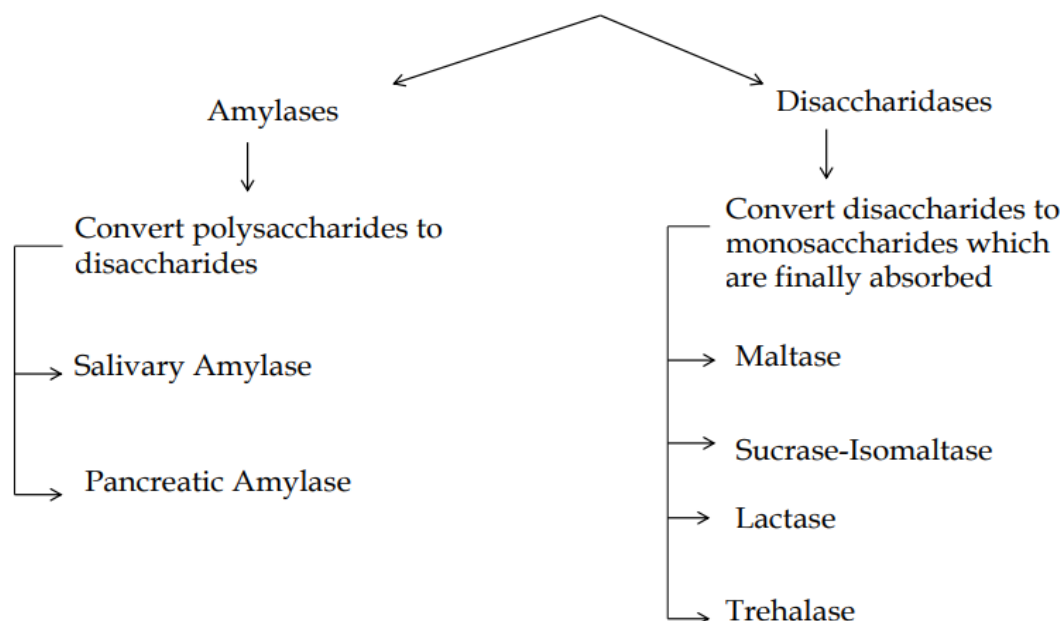
Digestion and Absorption of Carbohydrates:



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

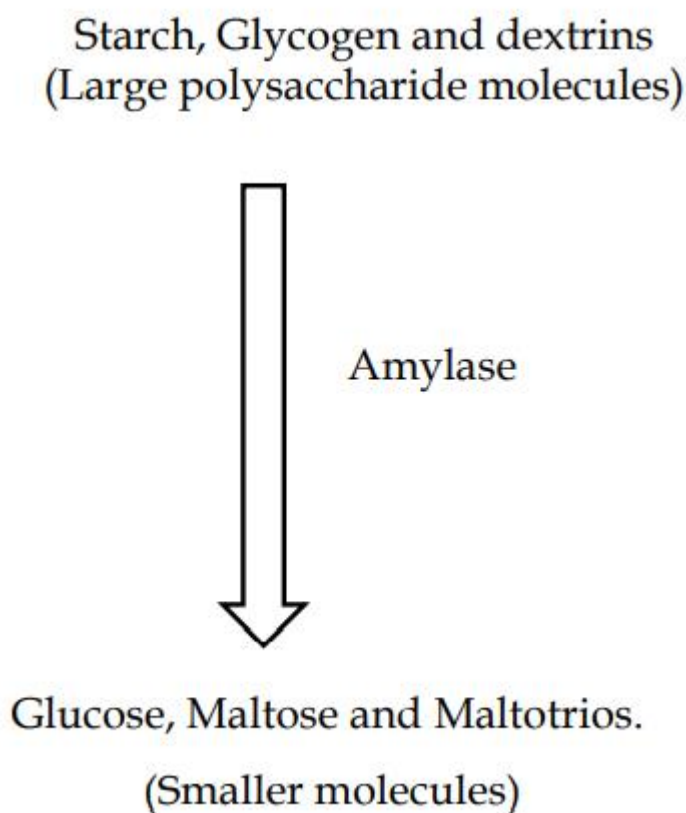


Digestion in the Mouth:

- 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 α -amylase and requires Cl^- ion for activation with an optimum pH of 6.7 (Range 6.6 to 6.8).
- The enzyme hydrolyse α 1 \rightarrow 4 glycosidic linkages deep inside polysaccharide molecules
- However, ptylin action stops in the stomach when the pH falls to 3.0.

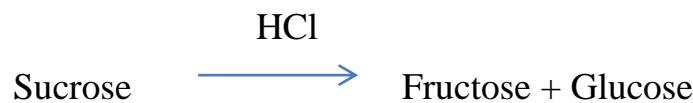


Drawback:

- 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.



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 (amylase) is similar to salivary amylase.

Properties of Pancreatic Amylase:

- It is an α -Amylase
- Optimum pH=7.1
- Like Ptylin, it requires Cl^- ion for its activity.
- It hydrolyses α 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 $\xrightarrow{\text{Maltase}}$ Glucose + Glucose
- Sucrose Isomaltose $\xrightarrow{\text{Sucrase-Isomaltase}}$ 3 Glucose + fructose
- Lactose $\xrightarrow{\text{Lactase}}$ 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: Aldosterone (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.