DIGESTION OF CARBOHYDRATES

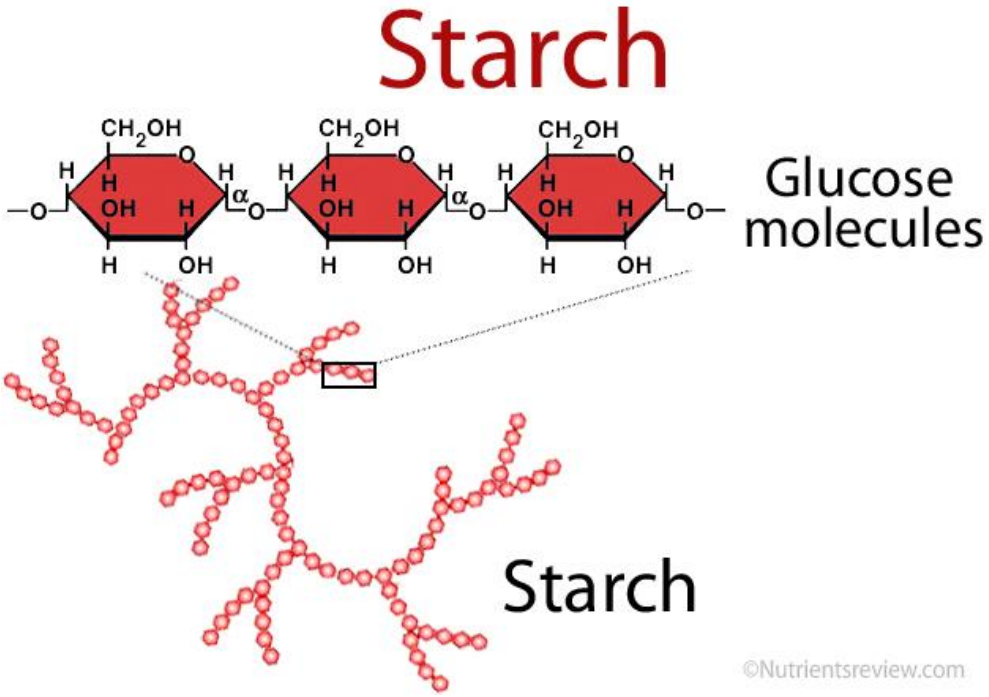
What are carbohydrates?

Carbohydrates are **a type of macronutrient found in certain foods and drinks.**

Three major sources of carbohydrates in the normal human diet :
Starches → A large polysaccharides present in almost all non-animal foods, particularly in potatoes and different types of grains.
Lactose → A disaccharide found in milk; and
Sucrose → A disaccharide popularly known as cane sugar.

Digestion in the Mouth .

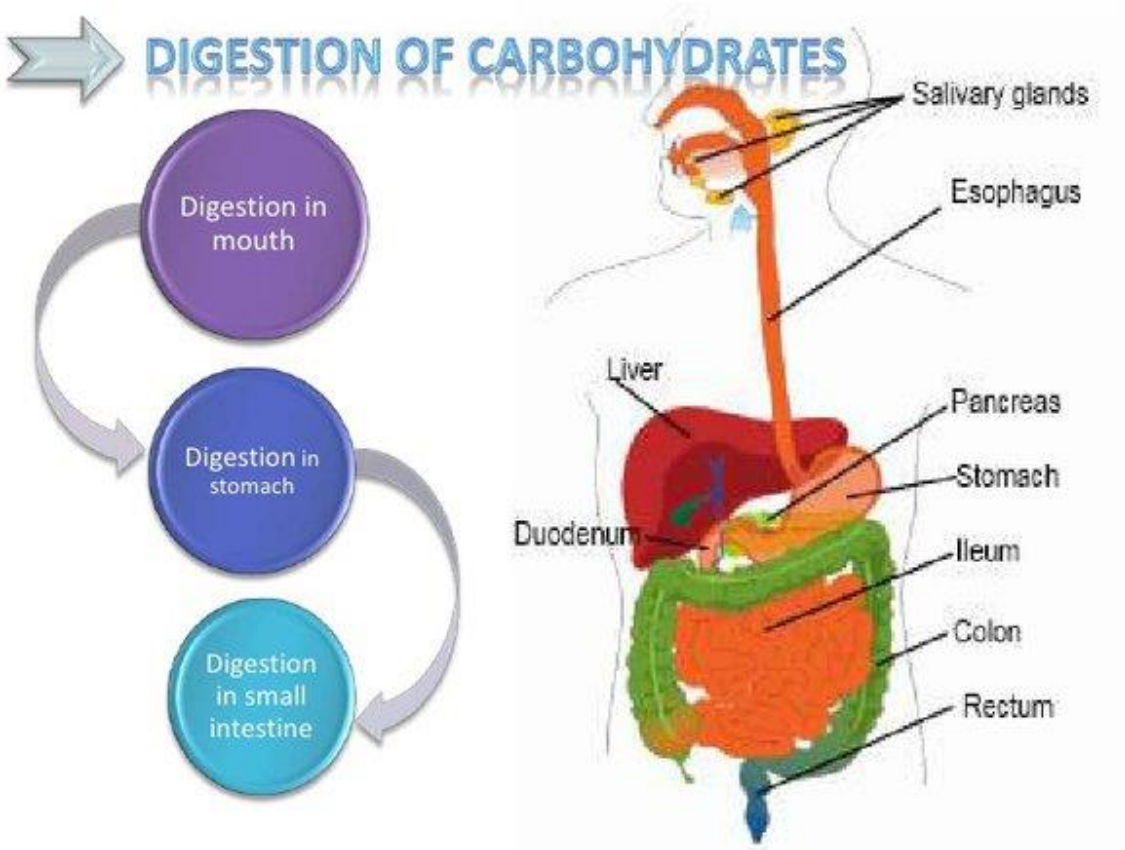
- Carbohydrate digestion begins in the mouth
- The salivary glands in the mouth secrete saliva
- Saliva contains the digestive enzyme ptyalin (α-amylase) secreted mainly by the parotid glands.
- This enzyme hydrolyzes starch into the disaccharide maltose and other small polymers of glucose that contain three to nine glucose molecules.



- The food remains in the mouth only for a short time, so less than 5 %of total starch is hydrolyzed here.

Digestion in Stomach

- After the carbohydrate food is chewed into smaller pieces and mixed with salivary amylase and other salivary juices, it is swallowed and passed through the esophagus.
- Starch digestion sometimes continues in the stomach. Activity of the salivary amylase is the in blocked by acid of the gastric secretions.
- Amylase is essentially inactive as an enzyme once the pH of the medium falls below about 4.0.

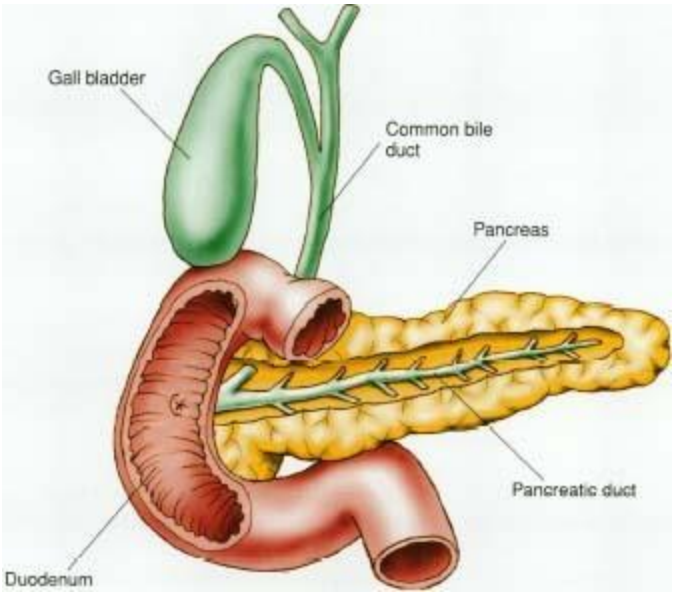


Digestion in the small Intestine

Role of Pancreatic Amylase.

- Saliva secreted by pancrease, contains a large quantity of α-amylase that is almost identical in its function to the α-amylase of saliva but is several times as powerful.
- pancreatic amylase is secreted by the **pancreas** into **the small intestine**. The optimum pH of alpha-amylase is **6.7–7.0.**

- After the chyme empties from the stomach into the duodenum and mixes with **pancreatic juice**, virtually all the carbohydrates will have become digested.



- In general, the carbohydrates are almost totally converted into maltose and other small glucose polymers before passing beyond the duodenum.

Role of Intestinal Epithelial Enzymes

- Enzymes of the intestinal epithelial cells are

  lactase,

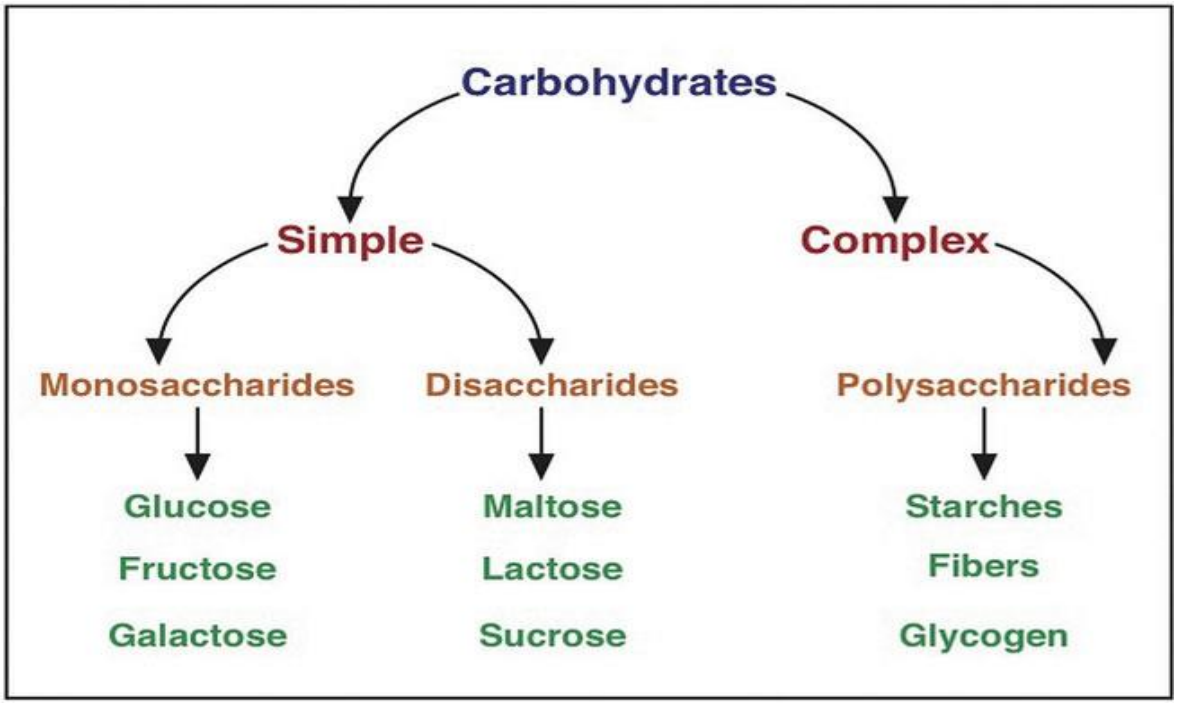
  sucrase,

  maltase etc.

- These enzymes are capable of splitting the disaccharides lactose, sucrose, and maltose and other small glucose polymers, into their constituent monosaccharides.

Lactose → Galactose + glucose.
Sucrose → Fructose + glucose.
Maltose → Multiple molecules of glucose.
+
(Other small glucose polymers)

- Thus, the final products of carbohydrate digestion are all monosaccharides. They are all water soluble and are absorbed immediately.

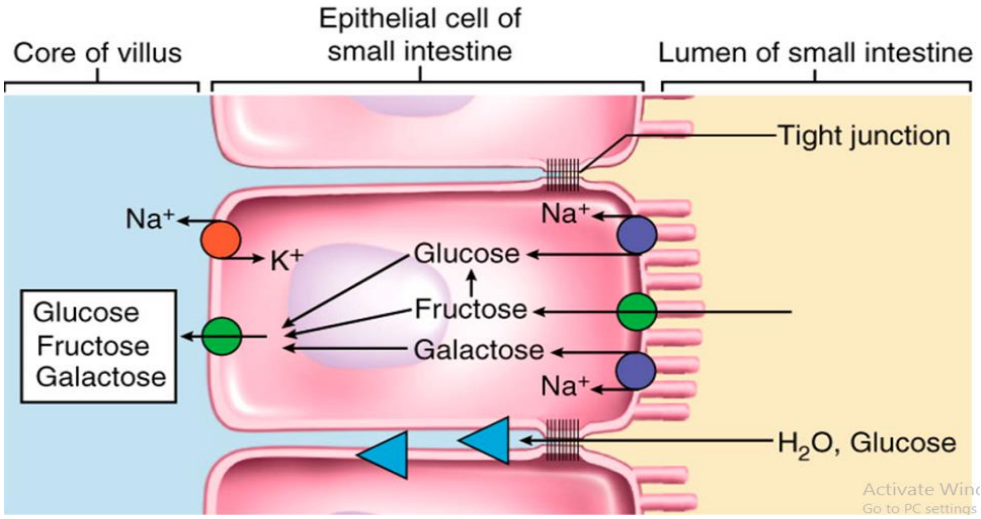


Carbohydrate Absorption

- Carbohydrates are mainly absorbed as monosaccharides.
- Only a small fraction is absorbed as disaccharides and almost none is absorbed as larger carbohydrate compounds .
- About 80% of the absorbed monosaccharides are glucose.
- The remaining 20 percent of absorbed monosaccharides is composed almost entirely of galactose and fructose—the galactose derived from milk and the fructose as one of the monosaccharides digested from cane sugar.
- Virtually all the monosaccharides are absorbed by a secondary activetransport process.
- Glucose absorption occurs in a co-transport mode with

activetransport of sodium.

- Galactose is transported by almost exactly the same mechanism asglucose.



- Fructose transport does not occur by the sodium co-transport mechanism.
- Instead, fructose is transported by facilitated diffusion all the way through the intestinal epithelium and is not coupled with sodium transport.

Lactose Intolerance:

- Lactose, or milk sugar, is a disaccharide composed of glucose and galactose.
- Ingested lactose must be digested before it can be absorbed, a task accomplished by the intestinal brush border enzyme lactase.
- Generally, lactase is found only in juvenile mammals, exceptin some humans of European descent. Those people inherit a dominant gene

that allows them to produce lactase after childhood.

- Scientists believe the lactase gene provided a selective advantage to their ancestors, who developed a culture in which milk and milk products played an important role.
- In cultures in which dairy products are not part of the diet after weaning, most adults lack the gene and synthesize less intestinal lactase.
- Decreased lactase activity is associated with a condition known as lactose intolerance. If a person with lactose intolerance drinks milk or eats dairy products, diarrhea may result. In addition, bacteria in the large intestine ferment lactose to gas and organic acids, leading to bloating and flatulence.
- The simplest remedy is to remove milk products from the diet, although milk predigested with lactase is available.