Role of Salivary Glands and Stomach in Digestion

Objectives:

- Understand the principle and importance of digestion of dietary foodstuffs
- Understand the role of salivary glands in digestion
- Understand the role of stomach in digestion

Background:

- Most of dietary foodstuffs are ingested in the form that cannot be readily absorbed from the digestive tract
- Digestion: The breakdown of the naturally occurring foodstuffs into smaller, easily absorbable forms

Digestion:

- **Mechanical effects:**

  e.g., mastication

- **Enzymatic effects:**

  Digestive enzymes (hydrolases)

End Products of Digestion:

- Carbohydrates ⟶ Monosaccharides
- Triacylglycerols (TAG) ⟶ Fatty acids & monoacylglycerols
- Proteins ⟶ Amino acids

Role of Salivary Glands in Digestion

- They secrete saliva
- Saliva:

  Acts as lubricant

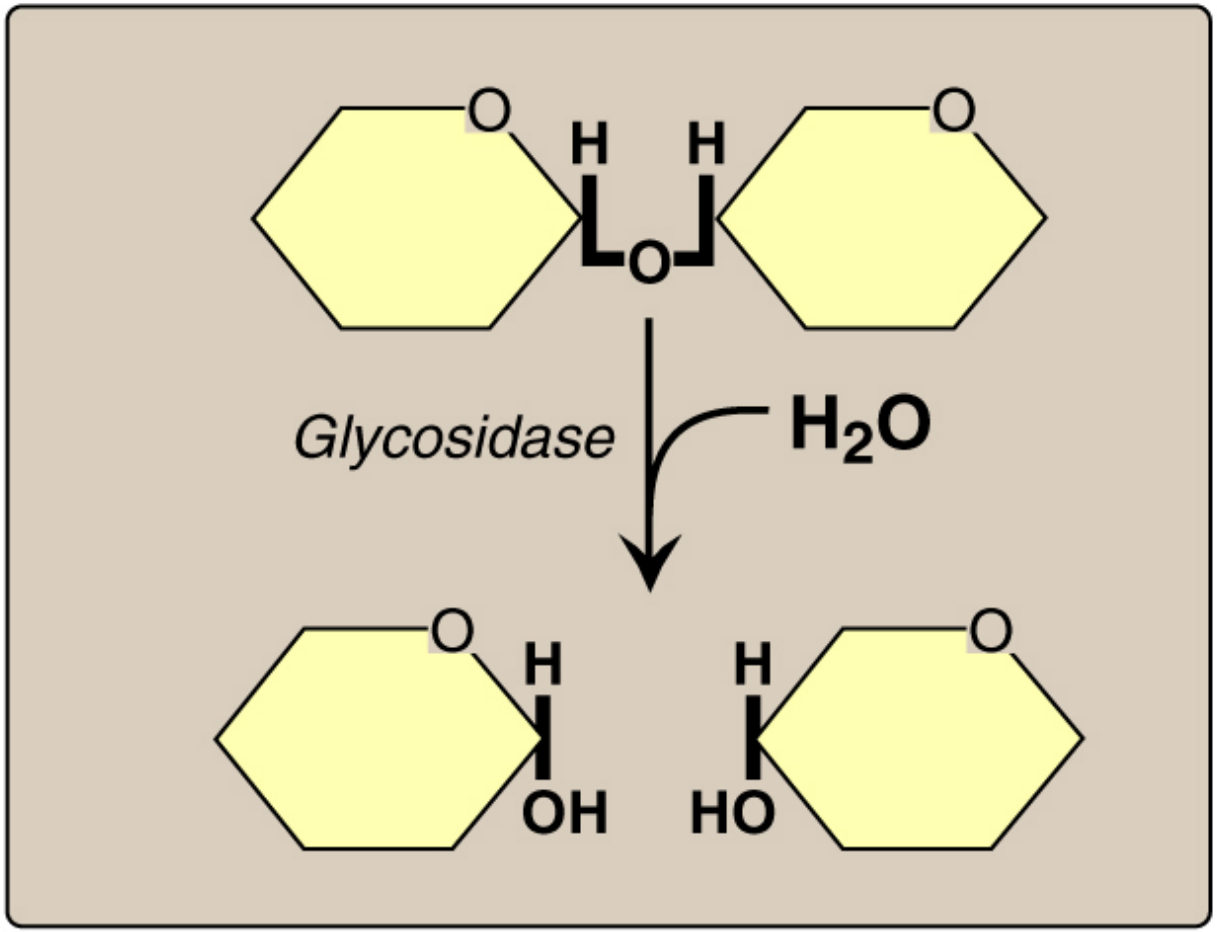
  Contains salivary α-amylase

  Contains lingual lipase

Salivary α-Amylase

- **Secreted by:** Parotid glands
- **Optimum pH:** 6.6 – 6.8
- **Substrate:** Starch and glycogen
- **Action:** Hydrolysis of α(1,4) glycosidic bonds
- **Products:** Short oligosaccharides

Hydrolysis of α(1,4) Glycosidic Bonds



Effect of α-Amylase on Glycogen

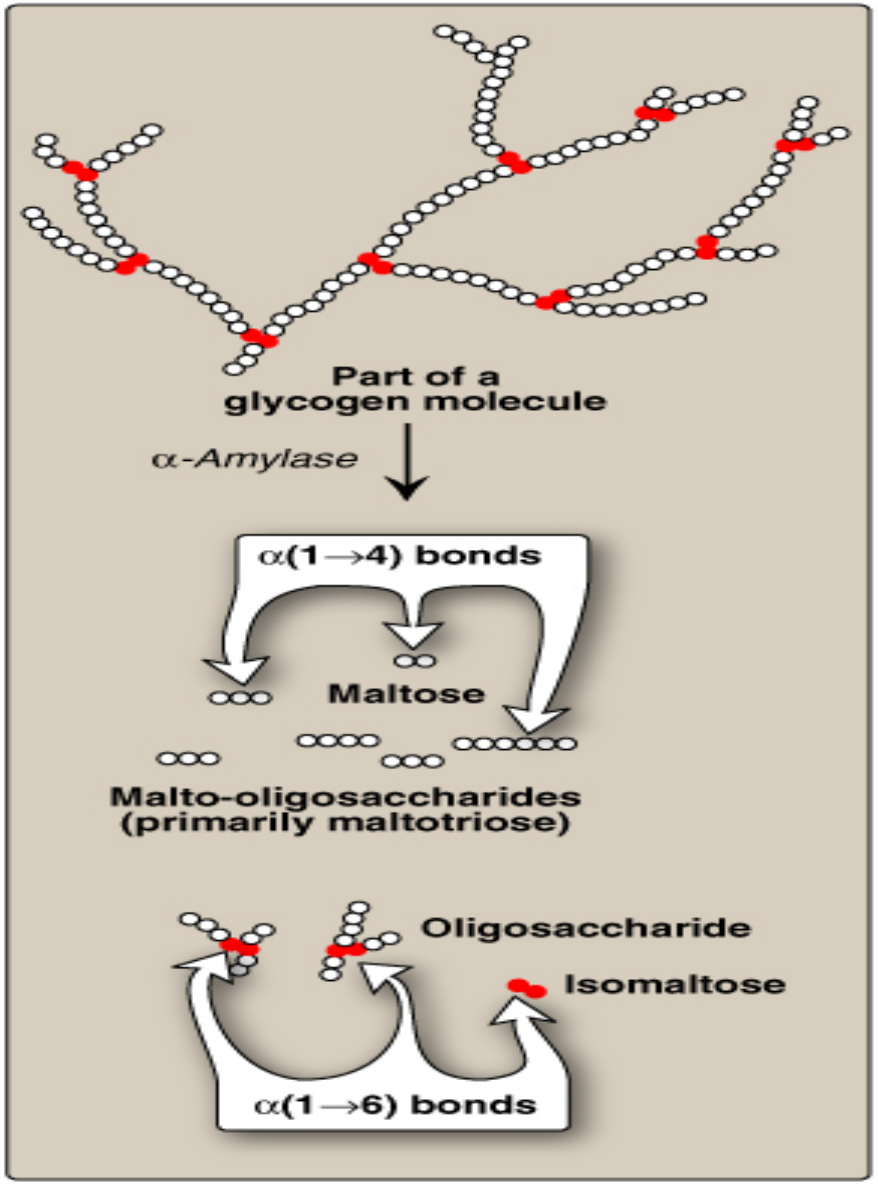
- **Hydrolysis of:**

  α(1,4) glycosidic bonds

- **Products:**

  Mixture of short oligosaccharides (both branched & unbranched)

  Disaccharides: Maltose and isomaltose



Salivary α-Amylase

CONT'D

- Its digestive action on the polysaccharides is of little significance because of the short time during which the enzyme can act on the food in the mouth
- Salivary amylase is inactivated by the acidity of stomach (The enzyme is inactivated at pH 4.0 or less)

Salivary α-Amylase

CONT'D

- Salivary α-amylase does not hydrolyze:

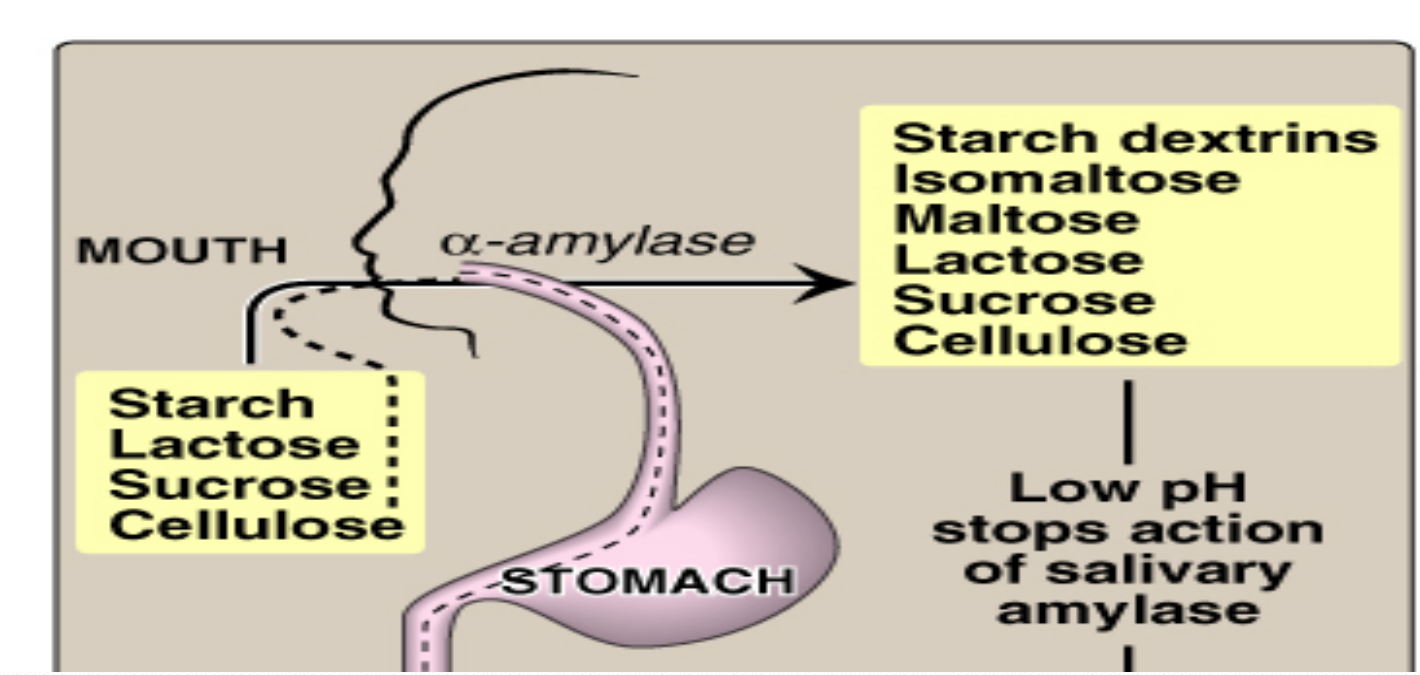
  α(1,6) glycosidic bonds

  (The branch points of starch and glycogen)

- Salivary α-amylase cannot act on:

  β(1,4) glycosidic bonds of cellulose

Digestion of Carbohydrates in the Mouth



Lingual Lipase

- Secreted by the dorsal surface of the tongue (Ebner's glands)
- Acts in the stomach for the digestion of TAG
- Produces fatty acids and monoacylglycerols
- Its role is of little significance in adult humans

Role of Stomach in Digestion

- No further digestion of carbohydrates
- Lipid digestion begins by lingual and gastric lipases
- Protein digestion begins by pepsin and rennin

Lingual and Gastric Lipases (Acid-Stable Lipases)

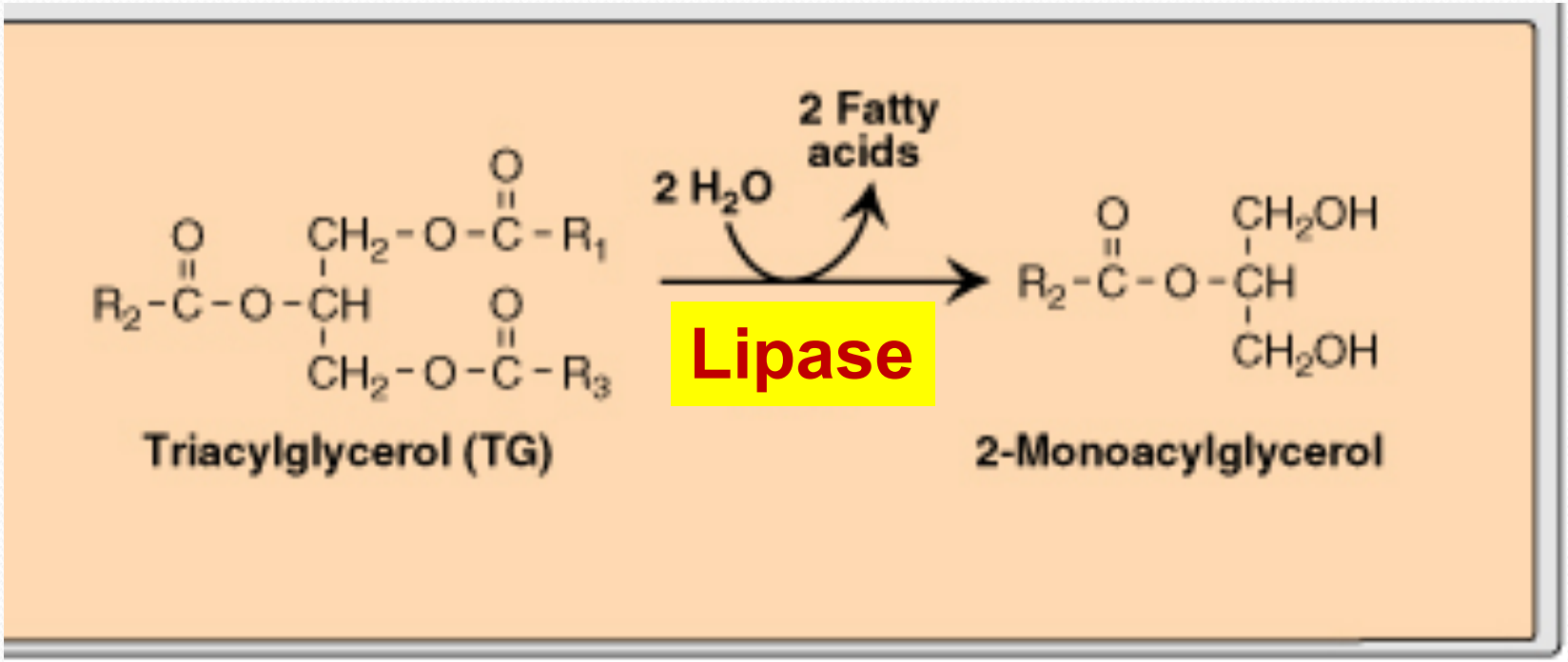
- **Substrate: TAG molecules, containing medium- and short-chain fatty acids; such as found in milk fat**
- **The end products are:**

  2-monoacylglycerols and fatty acids
- **The role of both lipases in lipid digestion is of little significance in adult human**

  (The lipids in the stomach is not yet emulsified. Emulsification occurs in duodenum)

Lingual and Gastric Lipases

CONT'D



Target substrate for acid-stable lipases is TAG containing:

R1 – C – O and R3 – C – O as short- or medium-chain fatty acids

Lingual and Gastric Lipases

CONT'D

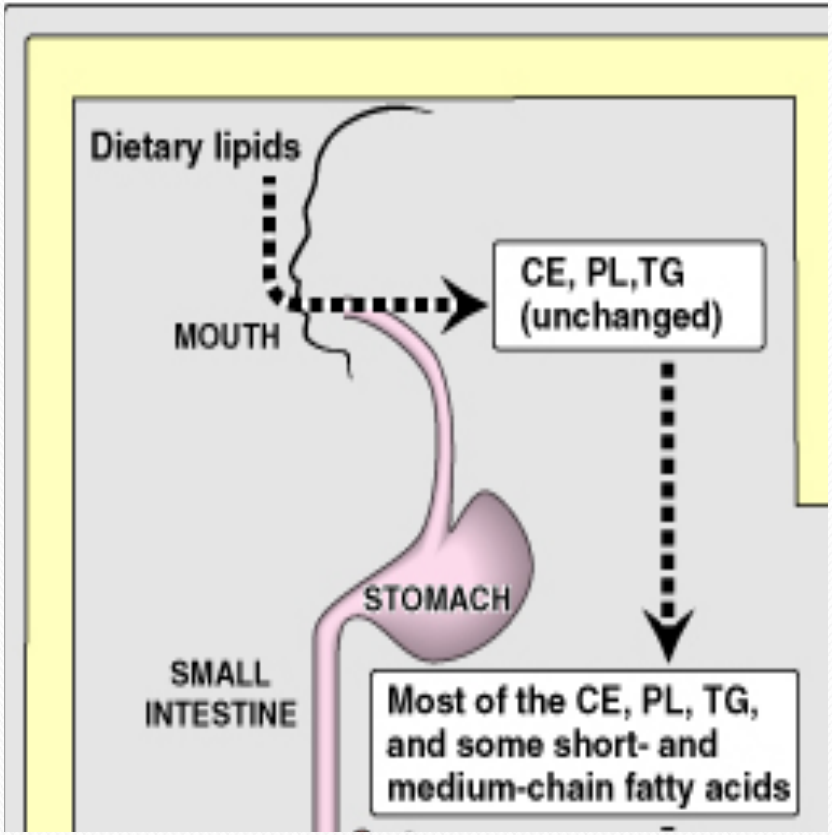
- They are important in neonates and infants for the digestion of TAG of milk

- They are also important in patients with pancreatic insufficiency where there is absence of pancreatic lipase

Digestion of Lipids in Stomach

In adults, no significant effects because of lack of emulsification that occurs in duodenum

In neonates and infants, digestion of milk TAG and production of short- and medium-chain fatty acids



Pepsin

- Secreted by chief cells of stomach as inactive proenzyme, pepsinogen
- Activated by HCl and autocatalytically by pepsin
- Acid-stable, endopeptidase
- Substrate: denatured dietary proteins (by HCl)
- End product: Smaller polypeptides

Rennin

- Secreted by chief cells of stomach in neonates and infants
- Substrate: Casein of milk (in the presence of calcium)
- End product: Paracasein with the formation of milk clot
- Effect: It prevents rapid passage of milk from stomach, allowing more time for action of pepsin on milk proteins

Digestion of Dietary Proteins in Stomach

HCl:

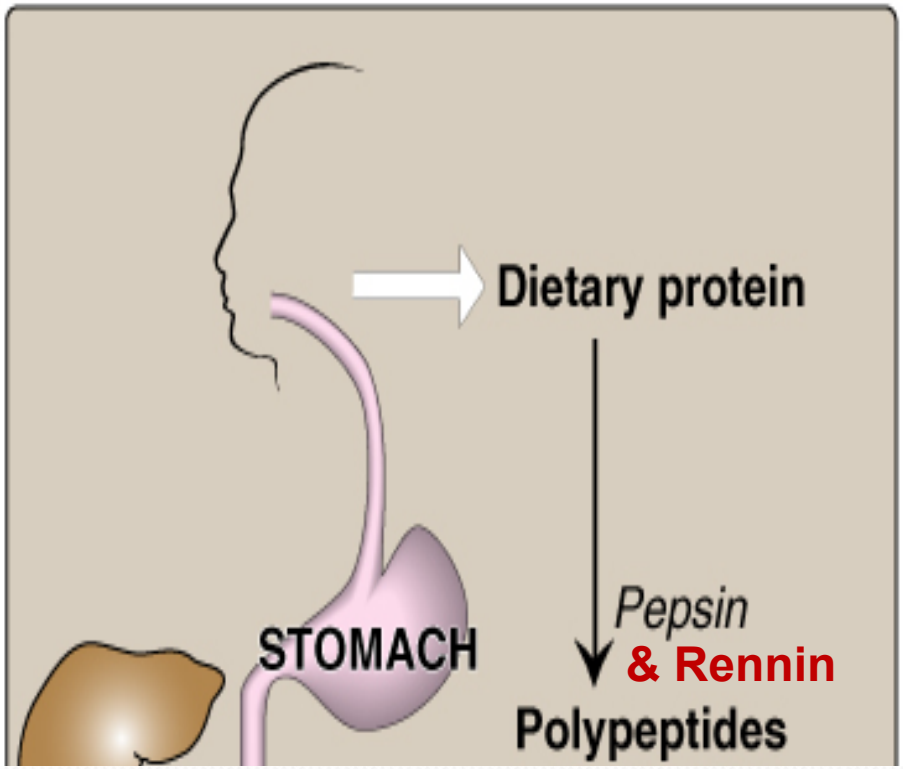
Denatures proteins
Activates pepsin

Pepsin:

Cleaves proteins into polypeptides

Rennin:

Formation of milk clot



Take Home Message

- Digestion involves both mechanical and enzymatic processes
- Digestion makes dietary foodstuffs readily absorbable by the digestive tract
- Salivary α-amylase is of limited, but initial effect on digestion of starch and glycogen in the mouth
- Salivary α-amylase converts starch and glycogen mainly into short oligosaccharides

Take Home Message

CONT'D

- Limited digestion of TAG begins in the stomach by both lingual and gastric lipases producing 2-monoacylglycerols and fatty acids
- Digestion of proteins begins in the stomach by pepsin producing smaller polypeptides
- In neonates and infants, digestion of milk occurs in stomach by:
  - Acid-stable lipases for digestion of milk fat
  - Rennin and pepsin for digestion of milk proteins

Reference

Lippincott's Illustrated reviews: Biochemistry 6th edition, Chapters 7 & 15, Pages 83-90 and 173-180.