

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



Role of Salivary Glands and Stomach in Digestion

By

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Objectives:

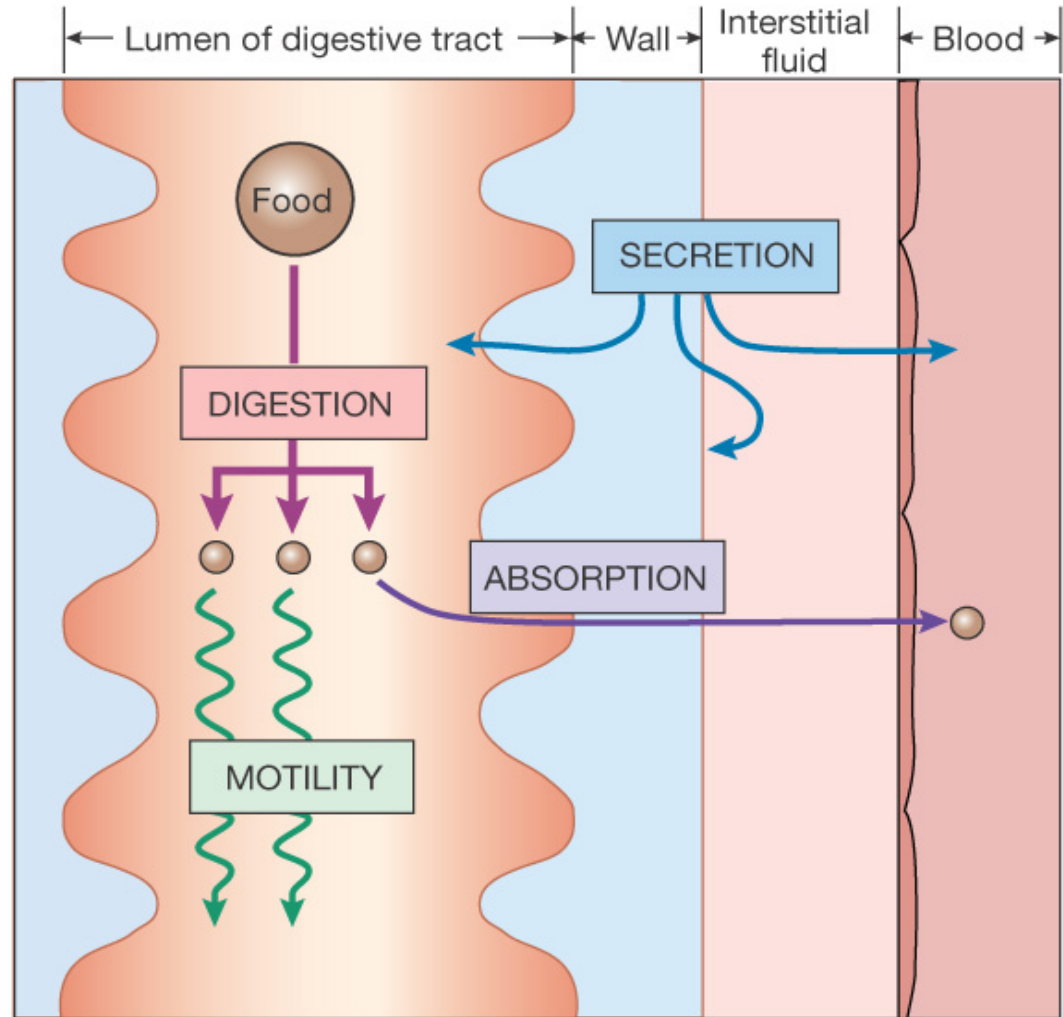
- **Understand the principle and importance of digestion of dietary foodstuffs**
- **Understand the role of salivary glands in digestion**
- **Understand the role of stomach in digestion**

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**

Processes of the digestive system

- Motility
- Secretion
- Absorption
- Elimination



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

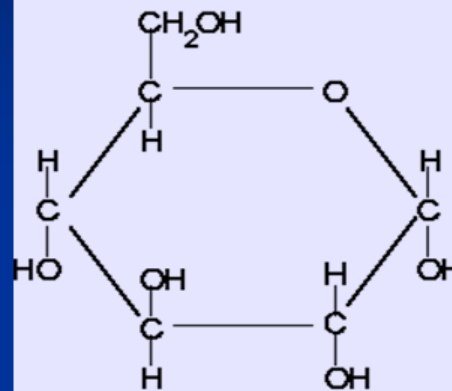
Contains lingual lipase

Salivary α -Amylase

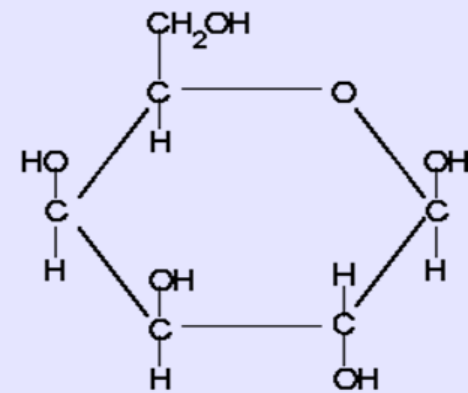
- **Secreted by: Parotid glands**
- **Optimum pH: 6.6 – 6.8**
- **Substrate: Starch and glycogen**
- **Hydrolyzes: $\alpha(1,4)$ glycosidic bonds**
- **Produces: Short oligosaccharides**

Simple Sugars -

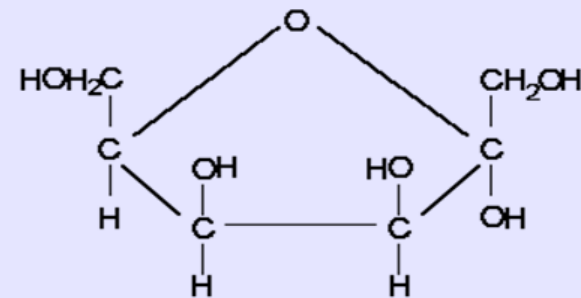
Structures of Common Monosaccharides



Glucose

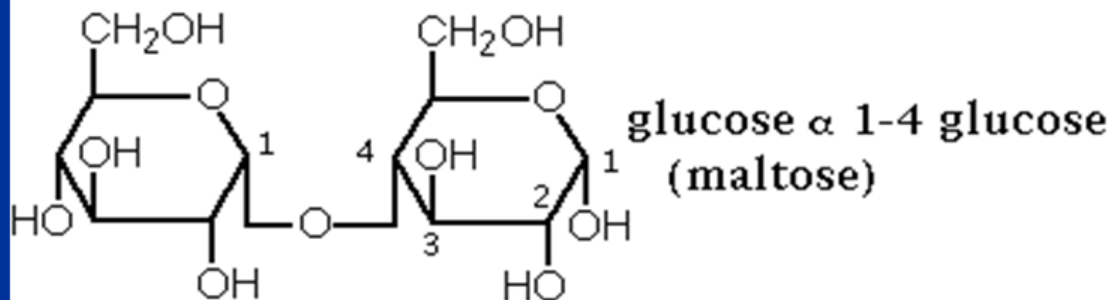
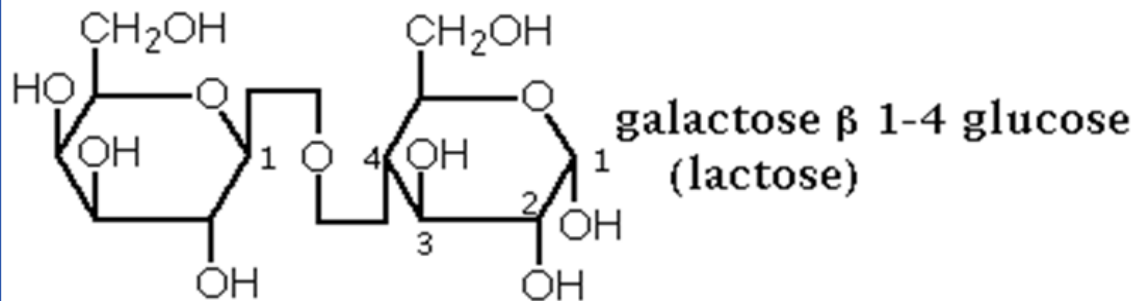
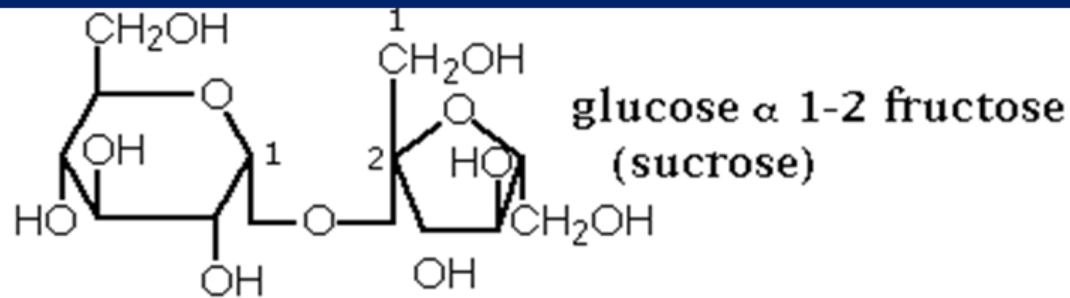


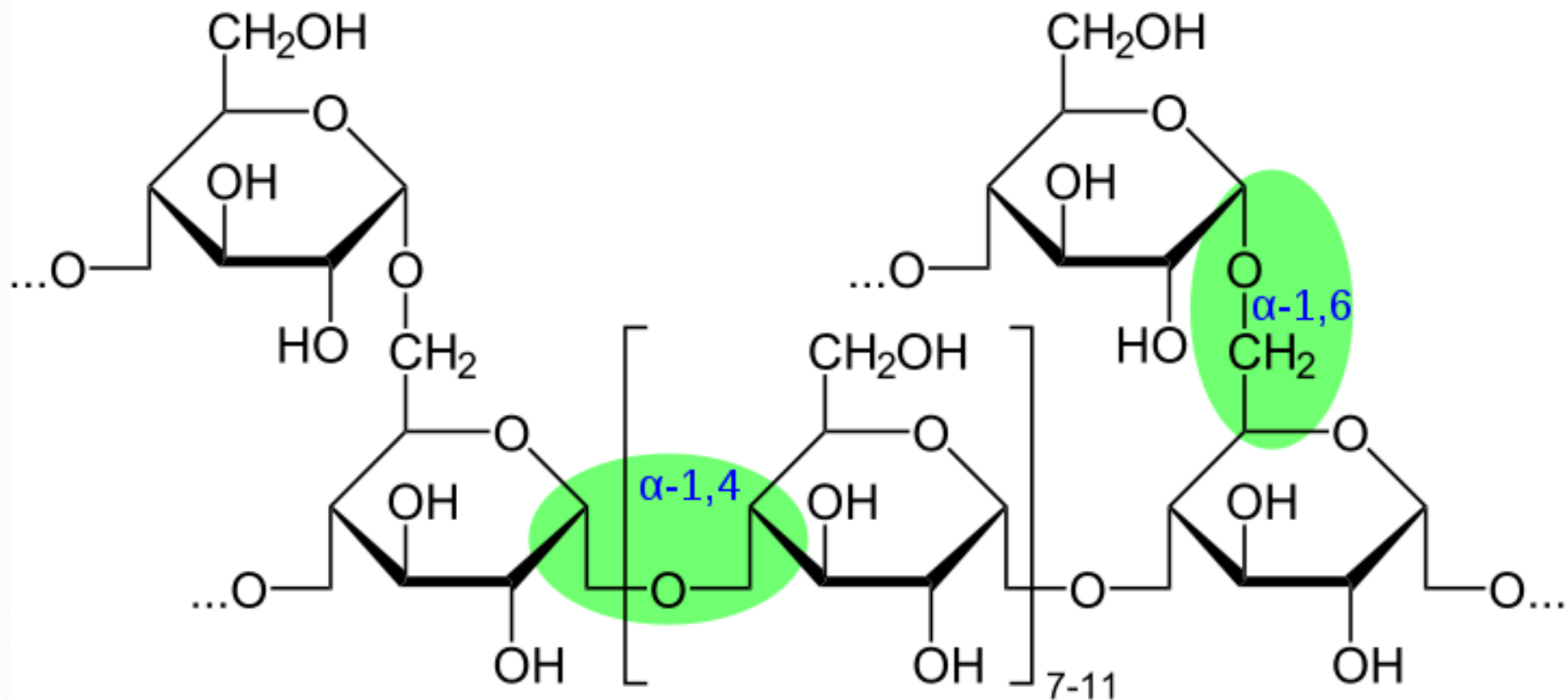
Galactose



Fructose

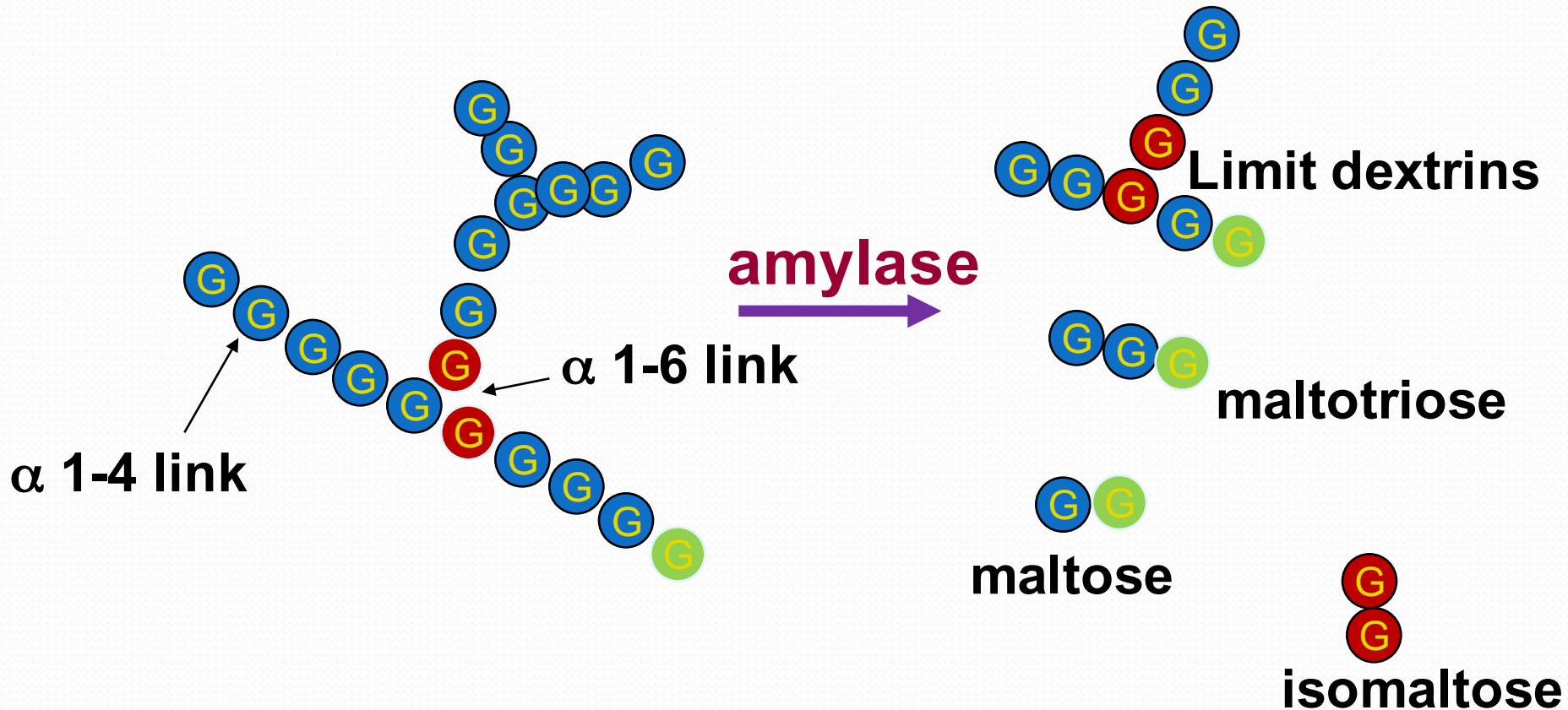
Disaccharides



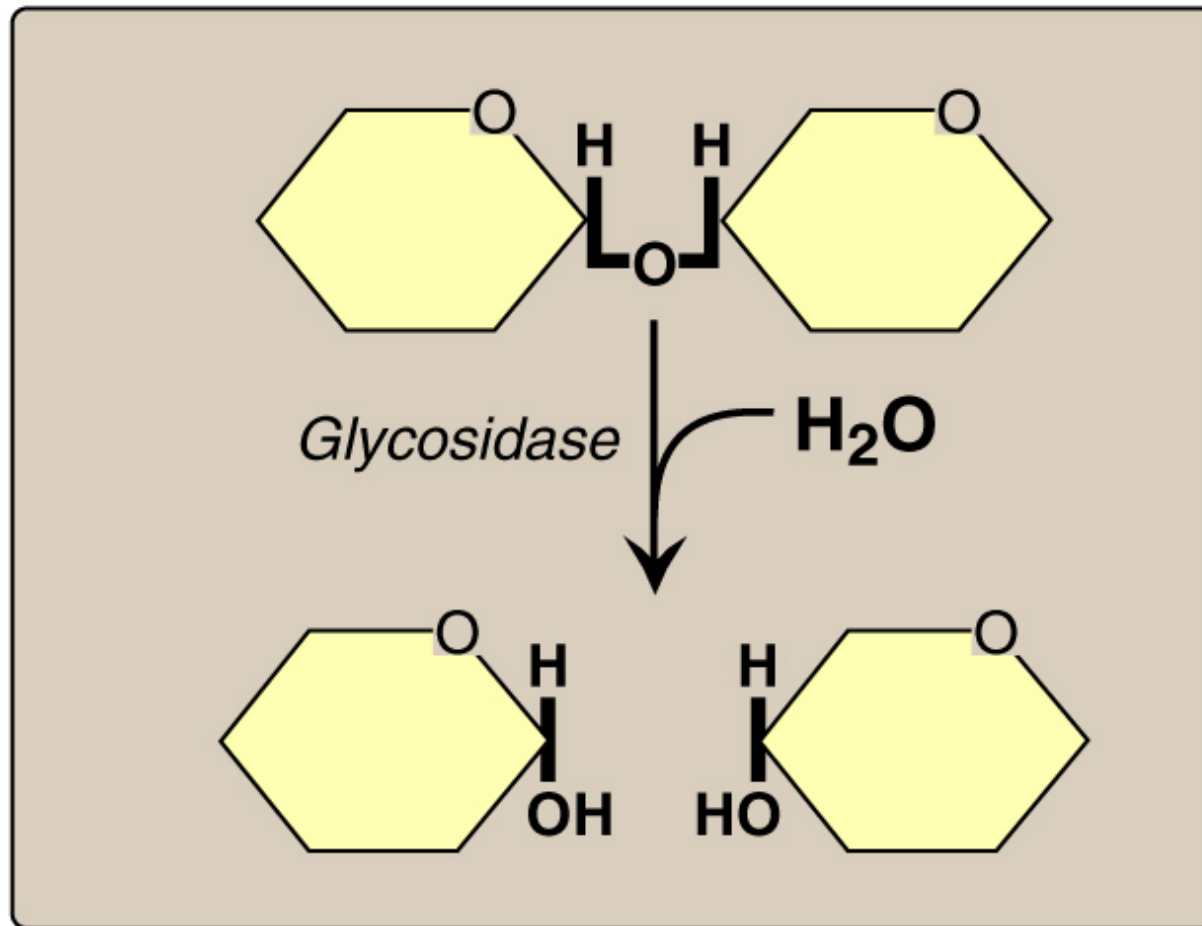


Digestion

- Pre-stomach – Salivary amylase : α 1-4 endoglycosidase



Hydrolysis of $\alpha(1,4)$ Glycosidic Bonds



Effect of α -Amylase on Glycogen

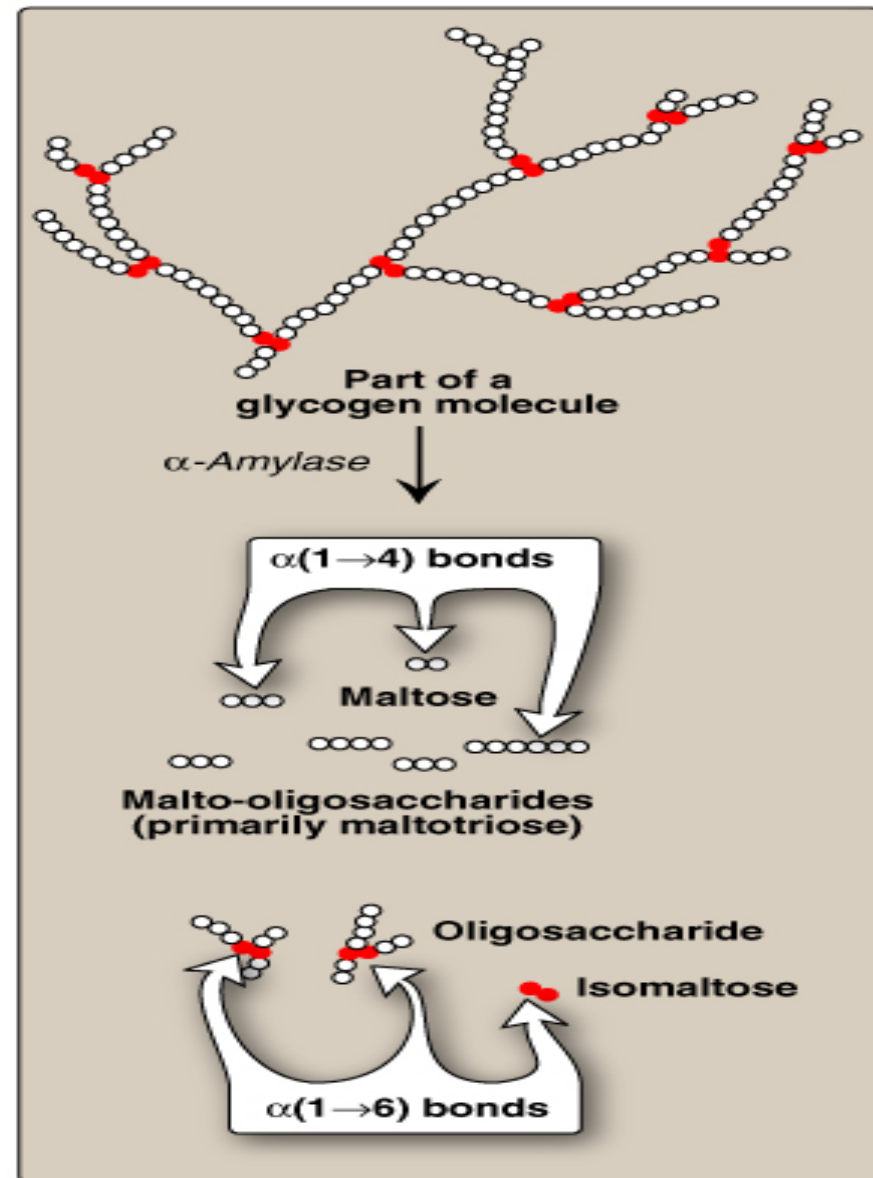
➤ Hydrolysis of:

$\alpha(1,4)$ glycosidic bonds

➤ Products:

Mixture of short oligosaccharides
(both branched & unbranched)

Disaccharides: Maltose and
isomaltose



Salivary α -Amylase

CONT'D

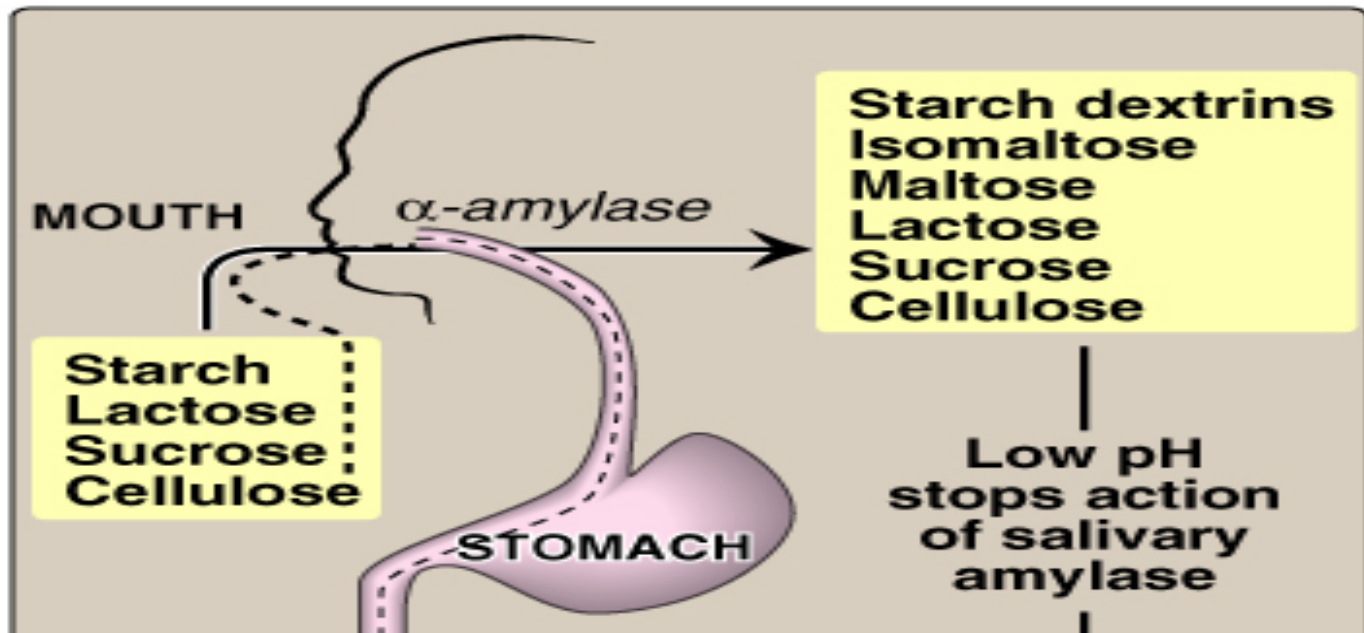
- Its digestive action on the polysaccharides is of little significance because of the short time during which the enzyme can act on the food in the mouth
- Salivary amylase is inactivated by the acidity of stomach (The enzyme is inactivated at pH 4.0 or less)

Salivary α -Amylase

CONT'D

- Salivary α -amylase does not hydrolyze:
 $\alpha(1,6)$ glycosidic bonds
(The branch points of starch and glycogen)
- Salivary α -amylase cannot act on:
 $\beta(1,4)$ glycosidic bonds of cellulose
Salivary α -amylase does not hydrolyze
disaccharides

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**

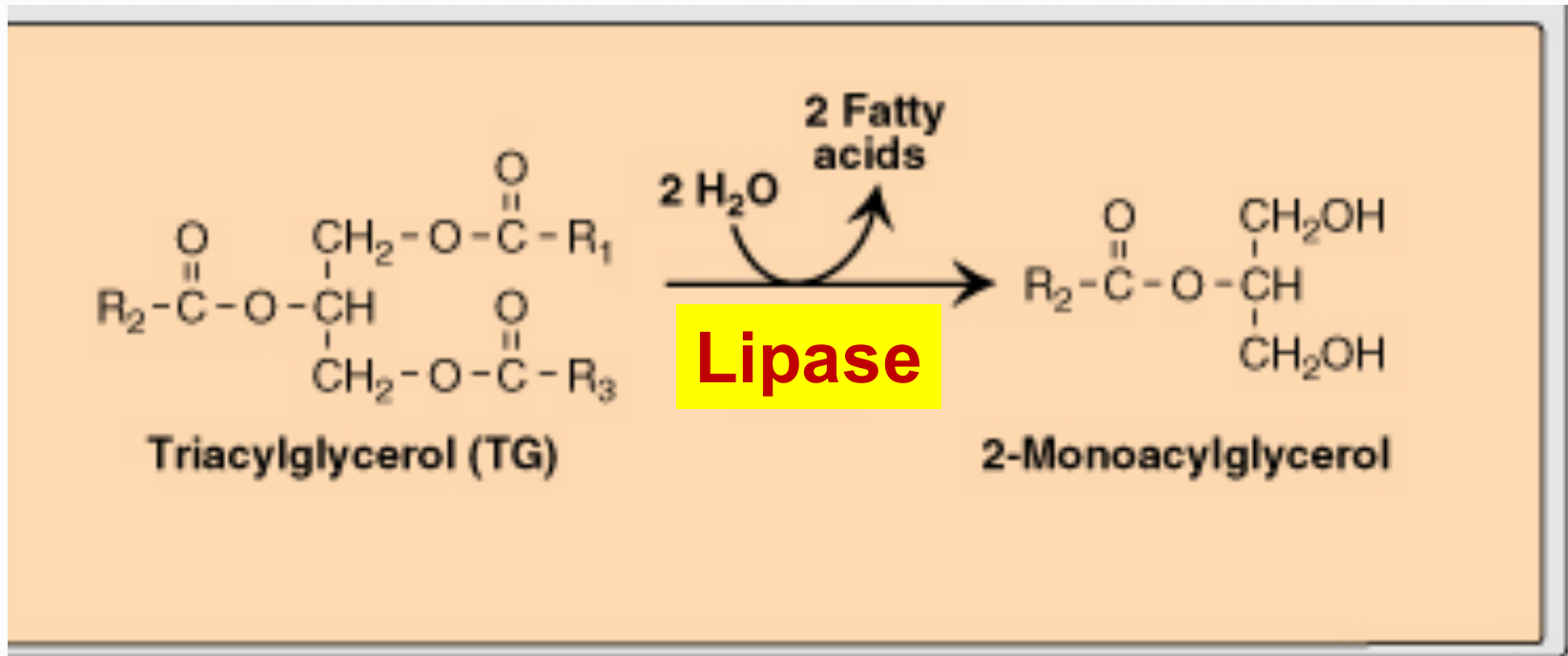
Lingual and Gastric Lipases (Acid-Stable Lipases)

- **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:

$\text{R}_1 - \overset{\text{O}}{\parallel} - \text{C} - \text{O}$ and $\text{R}_3 - \overset{\text{O}}{\parallel} - \text{C} - \text{O}$ as **short- or medium-chain fatty acids**

Lingual and Gastric Lipases

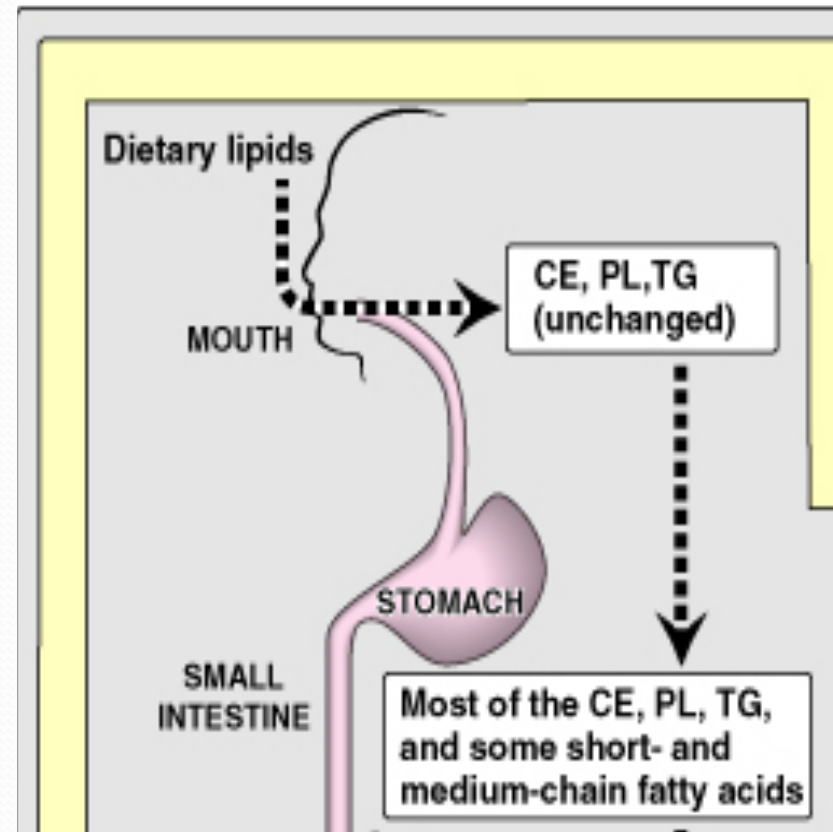
CONT'D

- 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

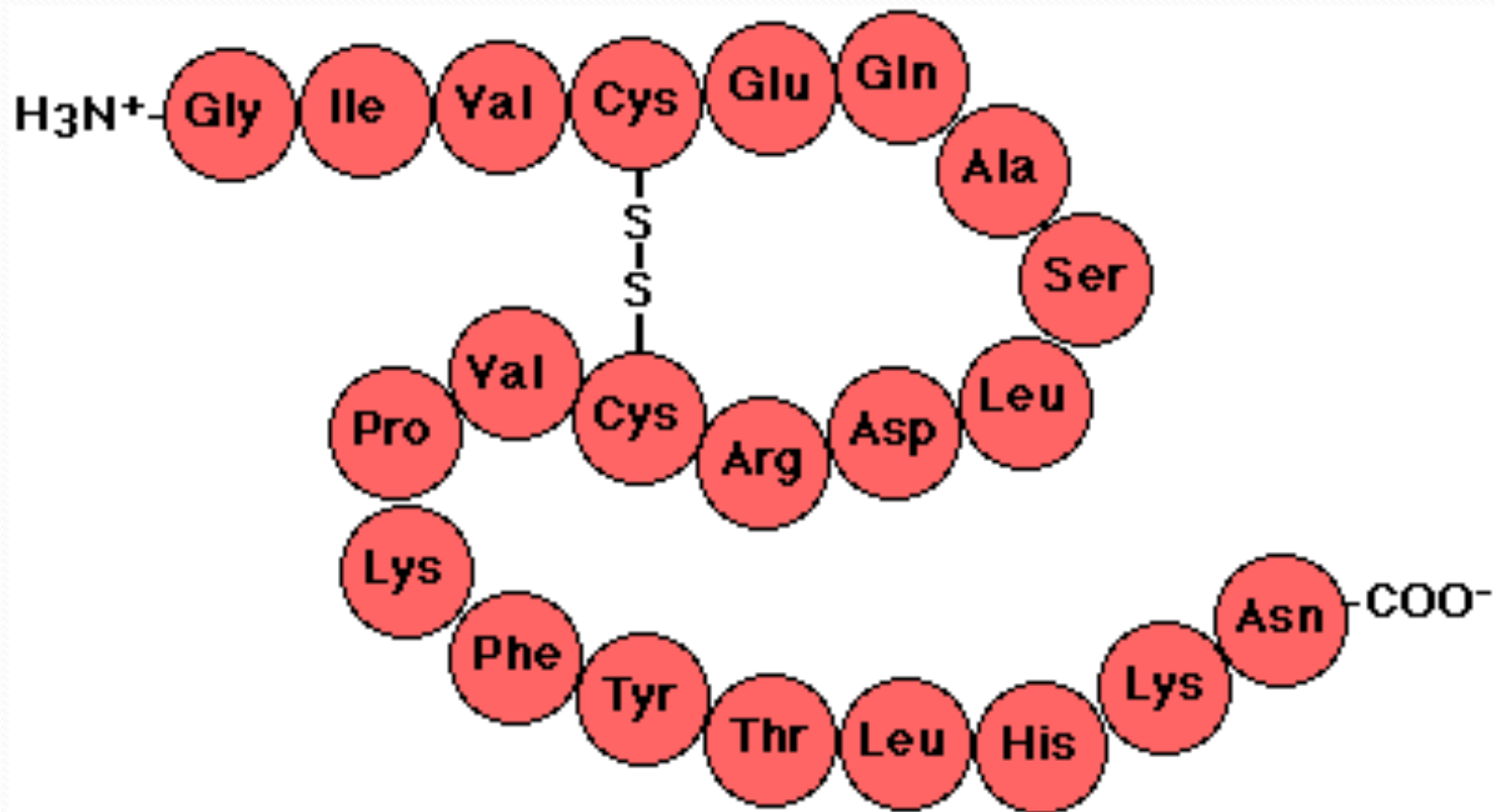
In adults, no significant effects because of lack of **emulsification** that occurs in duodenum

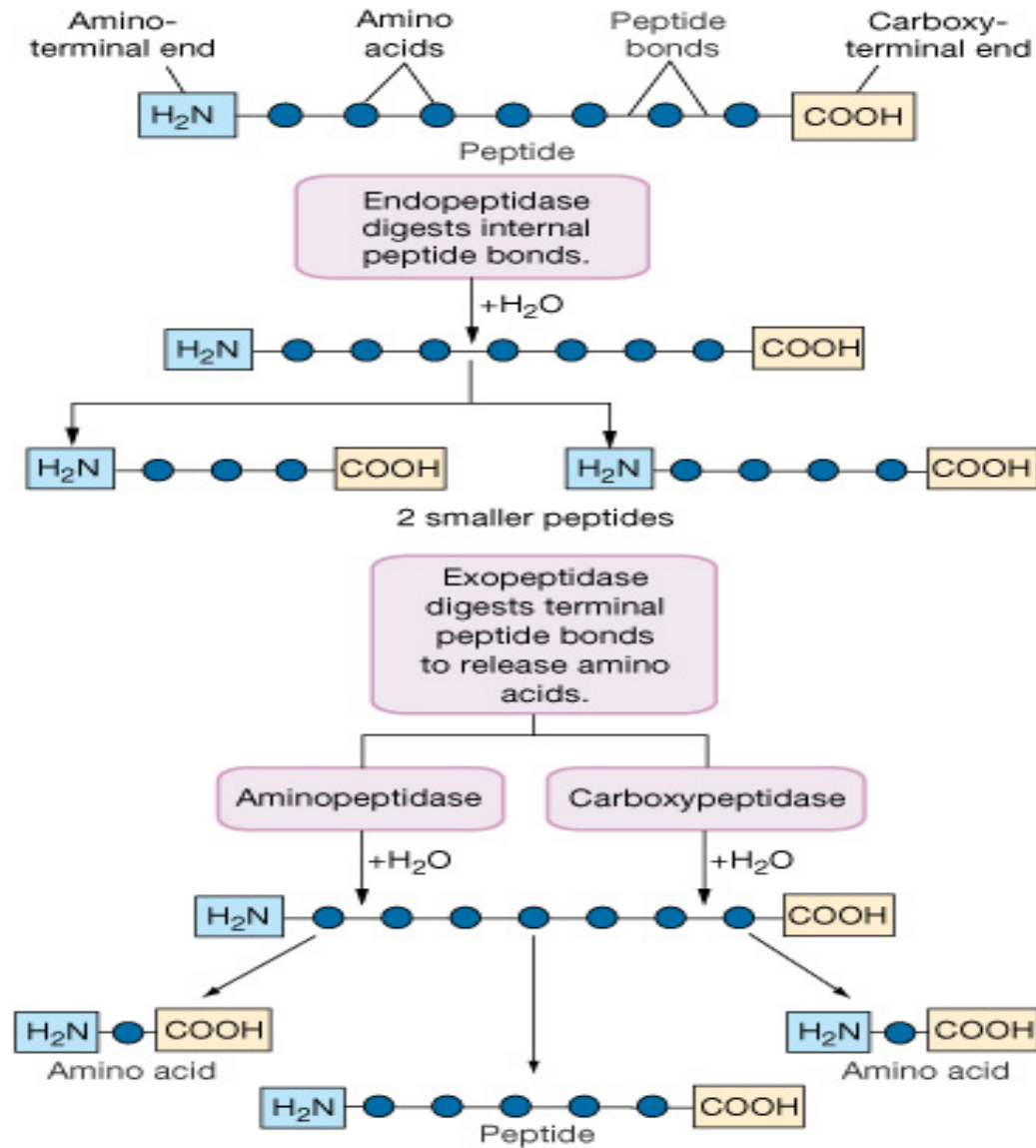
In neonates and infants, digestion of milk TAG and production of short- and medium-chain fatty acids



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





Endopeptidases and exopeptidases

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:

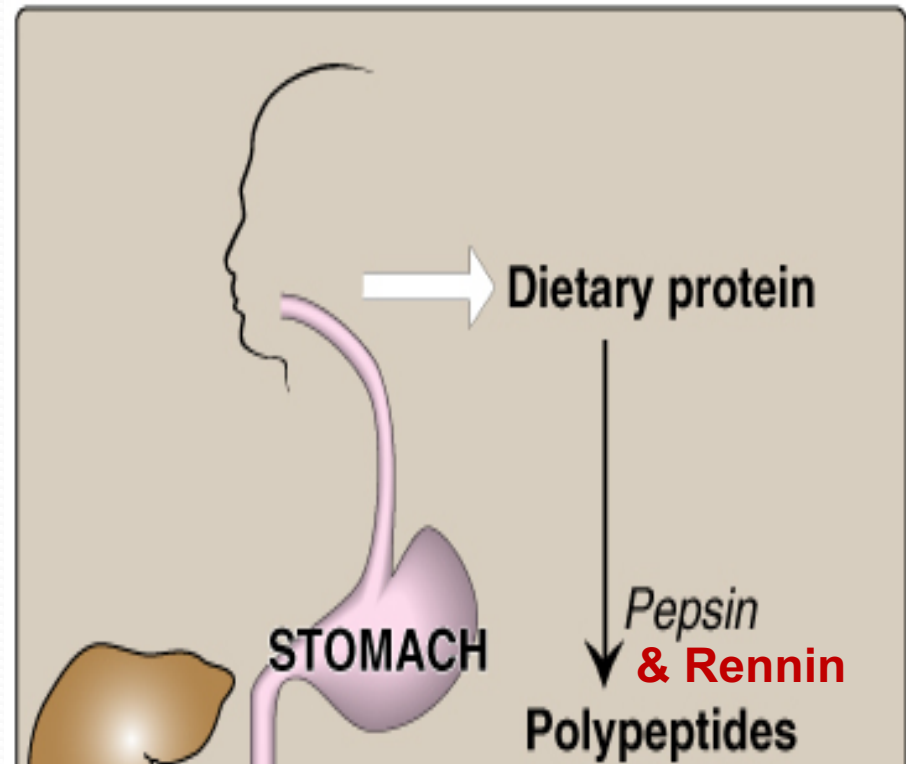
Denatures proteins
Activates pepsin

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 into short, branched 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

Questions?