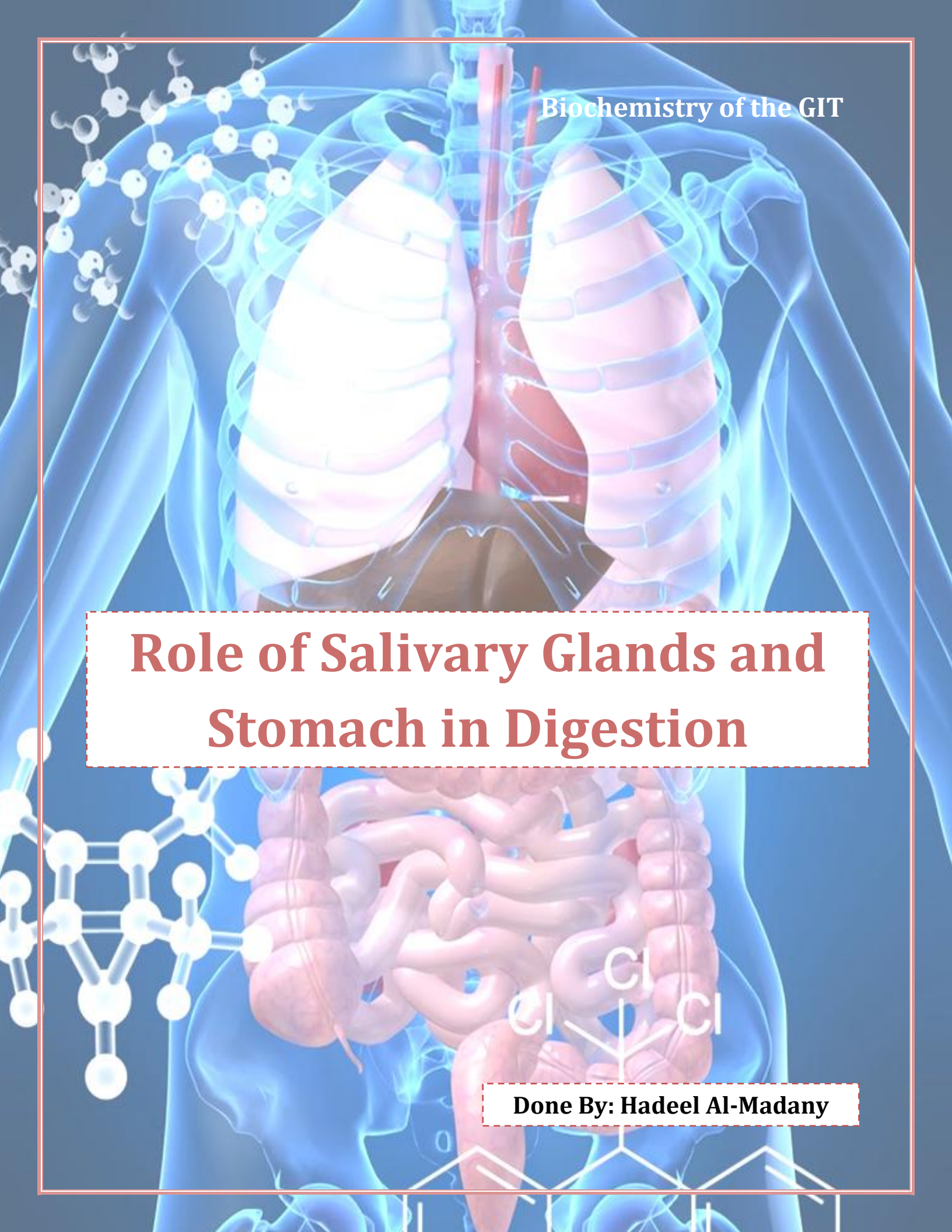


Biochemistry of the GIT

Role of Salivary Glands and Stomach in Digestion

Done By: Hadeel Al-Madany

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: it consists of 2 mechanisms:

- Mechanical effects:

  e.g., mastication (in the mouth)

- Enzymatic effects:

  Digestive enzymes "hydrolases" (in the GI)

End products of digestion:

- Carbohydrates → Mnosaccharides e.g: glucose
- Triacylglycerols (TAG) → Fatty acids & monoacylglycerols. 95% of the fat in the diet are TAGs, that's why fats are presented as TAGs
- Proteins → Amino acids

Role of Salivary Glands in Digestion

- They secrete saliva
- Saliva:
  - Acts as lubricant
  - Contains salivary α-amylase to digest carbohydrates
  - Contains lingual lipase to digest lipids

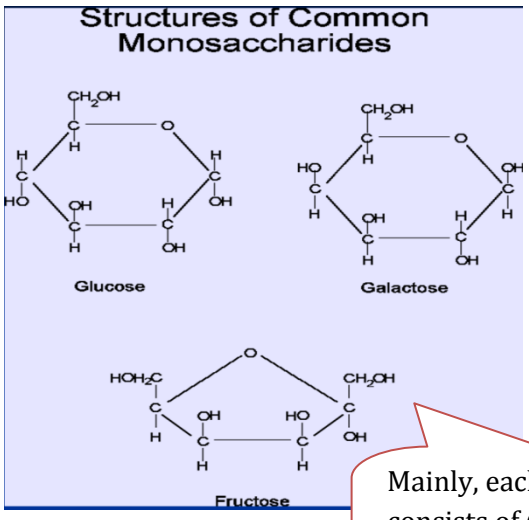
Salivary α-Amylase "it is called salivary α-Amylase because there is another type which is the pancreatic"

- ✓ Secreted by: Parotid glands
- ✓ Optimum pH: 6.6 – 6.8 (not acid stable, it gets inactivated in the stomach)
- ✓ Substrate: Starch from plants and glycogen from animals
- ✓ Hydrolyzes: α(1,4) glycosidic bonds
- ✓ Produces: Short oligosaccharides

Classification of fatty acids according to their length:

- Short (2-4) carbon atoms
- Medium (12 –12) sometimes to 14
- Long (14 -20)
- Very long above 20

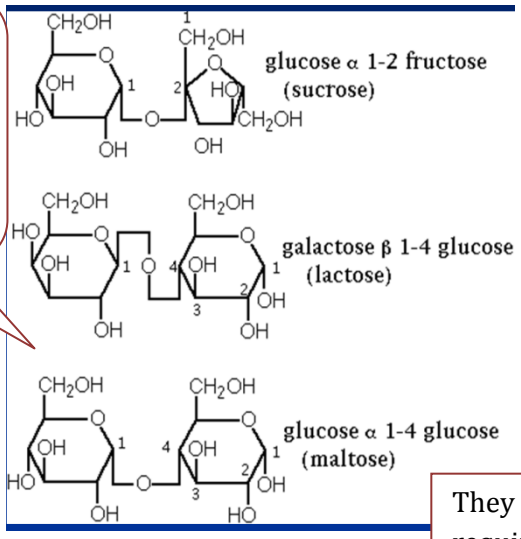
Simple sugars:



Mainly, each monosaccharide consists of 6 carbons. Alpha amylase cleaves the 1-4 bonds between the carbon atoms

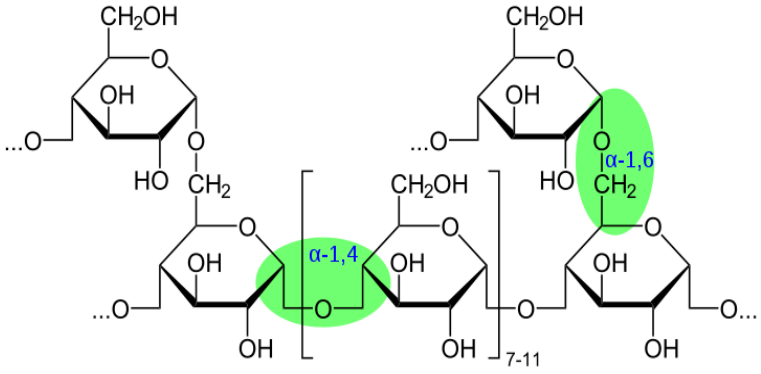
Disaccharides:

Alpha amylase cannot work on disaccharides; they require certain enzymes to cleave them



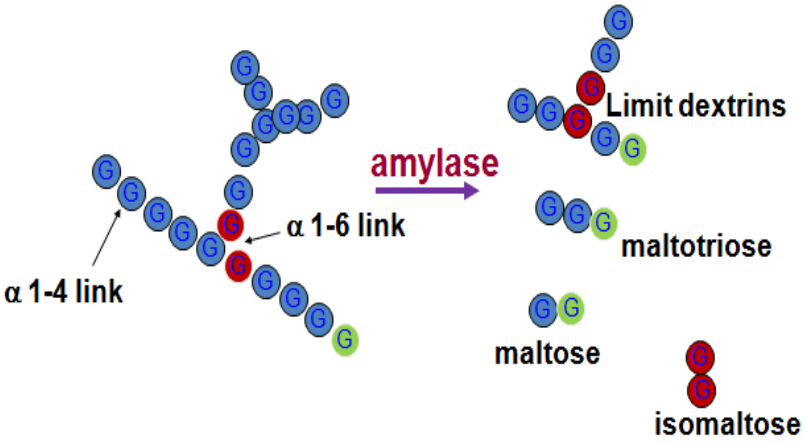
They require
sucrase
Lactase
maltase

Types of bonds:



Digestion

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



Note: alpha amylase cannot cleave cellulose because it contains beta 1-4 bonds

Key- We must breakdown these very large oligosaccharides into monosaccharides in order to absorb them. Alpha amylase. – Cannot attack a1-4 linkase close to 1-6 branch points.

Why do we get:

- Maltose? Because maltose is a disaccharide which we can't cleave by alpha amylase.
- Isomaltos? Because it is linked by alpha 1-6 bonds
- Maltotriose? Because it can't work on periphery to cleave (the green atom)

Hydrolysis of α(1,4) Glycosidic Bonds

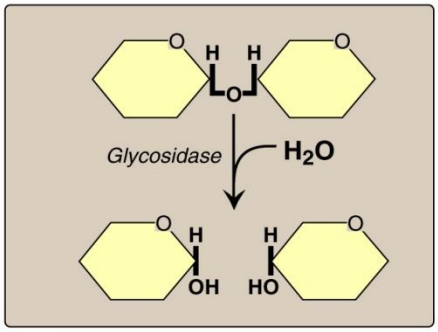
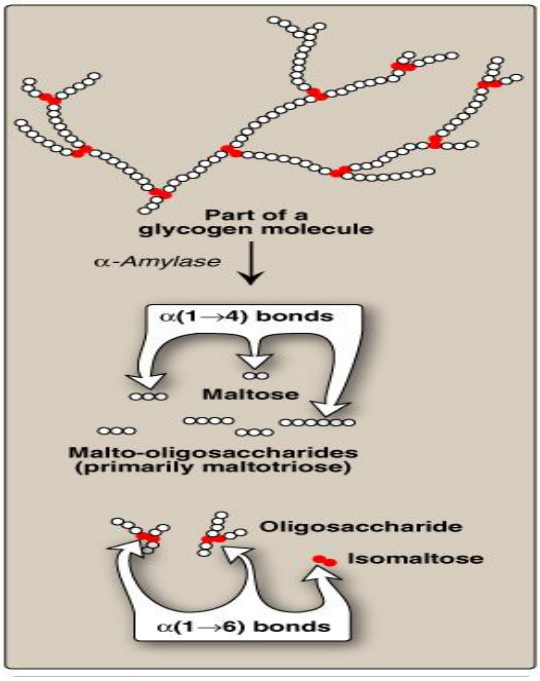


Figure 7.8
Hydrolysis of a glycosidic bond.

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

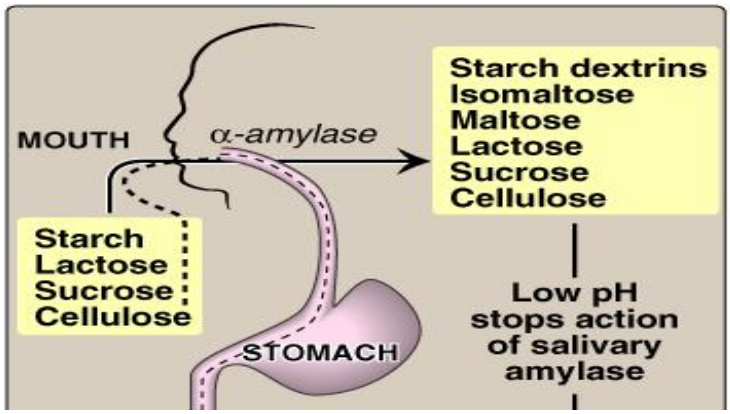
- Its digestive action on the polysaccharides is of little significance because of the short time during which the enzyme can act on the food in the mouth
- Salivary amylase is inactivated by the acidity of stomach (The enzyme is inactivated at pH 4.0 or less)

<u>Salivary α-amylase does not hydrolyze:</u>

- α(1,6) glycosidic bonds (The branch points of starch and glycogen). Pancreatic lipase hydrolyzes it
- cannot act on: β(1,4) glycosidic bonds of cellulose. Celluslose is helpful in constipation
- does not hydrolyze disaccharides

Digestion of Carbohydrates in the Mouth

Carbohydrates are the only micronutrients that their digestion starts at the mouth



Lingual Lipase "it is called lingual lipase because there is another type which is the pancreatic"

- Secreted by the dorsal surface of the tongue (Ebner's glands)
- Acts in the stomach for the digestion of TAG (it's acid stable)
- 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

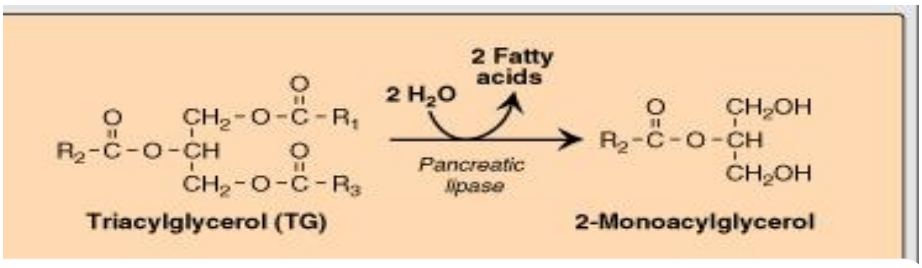
Lingual and Gastric Lipases (Acid-Stable Lipases)

- 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

  (Lack of lipid emulsification that occurs in duodenum)

Lingual and Gastric Lipases



Target substrate for acid-stable lipases is TAG containing:

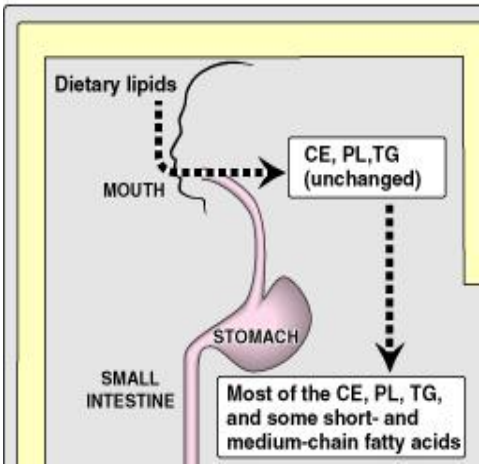
R1 – C – O and R3 – C – O as short- or medium-chain fatty acids

Lingual and Gastric Lipases

- 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. To compensate the loss

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



Emulsification: is the process by which the bile salt converts big droplets of fats into small droplets, this process will help the enzymes to work easier

Pepsin

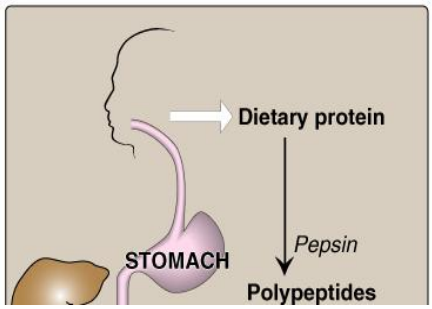
- Secreted by chief cells of stomach as inactive proenzyme, pepsinogen
- Activated by HCl and autocatalytically by pepsin
- Acid-stable, endopeptidase
- Substrate: denatured dietary proteins (by HCl)
- End product: Smaller polypeptides

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 into short, branched oligosaccharides
- 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