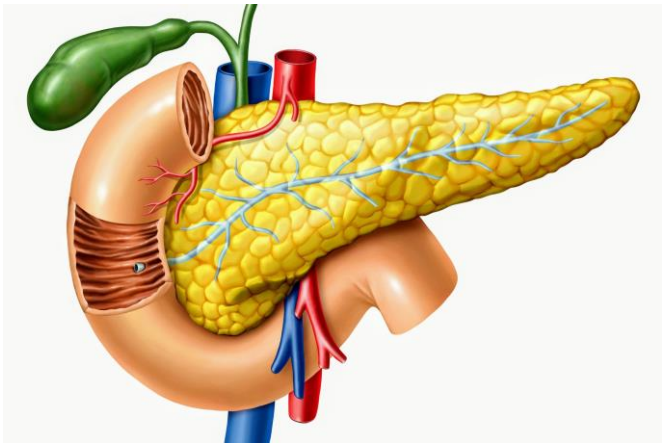
Ashur University
College of Medicine

Grade 2
PHYSIOLOGY OF
GASTROINTESTINAL TRACT
(GIT)
Lec. 7

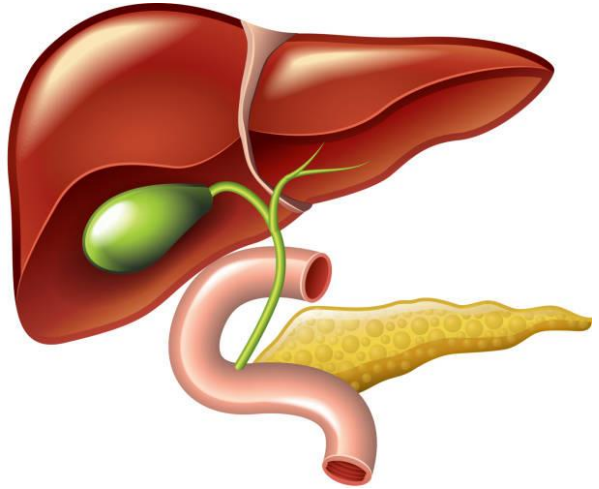
Inhibition of gastric secretion, Pancreas and Biliary secretions



Ass. Professor Internal Medicine

Dr.Qasim Razzaq Radhi

4/2/2025



Objectives:

- Explain the inhibition of gastric secretion.
- Describe the regulation of pancreatic secretion.
- Outline the phases of pancreatic secretion.
- Explain the importance of secretin mechanism and CCK.
- Describe biliary secretions

Inhibition of gastric secretion

The **inhibition of gastric secretion** can be brought about in **2 ways:**

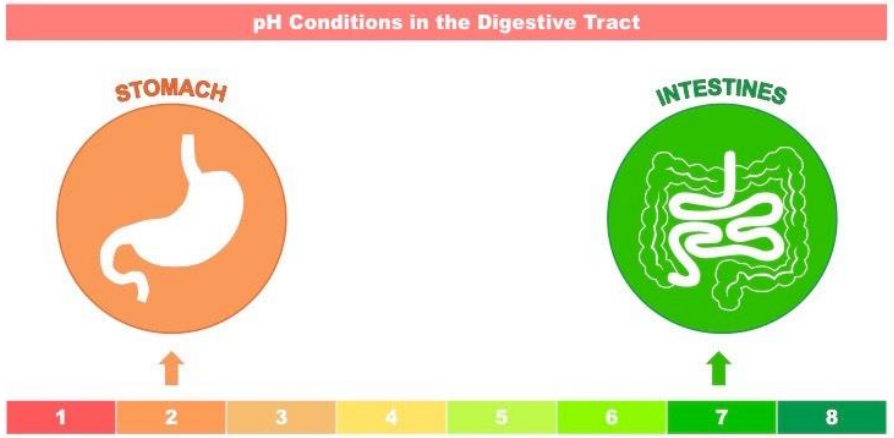
1- Enterogastric reflex:

Reflex nervous signals are transmitted from the duodenum back to the stomach to cause inhibition of gastric secretion and gastric emptying.

This reflex is stimulated by many factors for e.g.

(a) Distending the small bowel.

(b) Acid in the duodenum. PH in the duodenum falls to 3.5 or 4 this will stimulate this reflex to inhibit gastric secretion and thus protects the duodenal mucosa from high acidity.



2- Inhibitory hormones:

The presence of acids, fat, protein breakdown products, hypo/hyper osmotic fluids, etc.. causes the release of several intestinal hormones that are:

-Secretin.

-Gastric inhibitory peptide (GIP).

-Vasoactive intestinal polypeptide (VIP).

-Somatostatin.

-Peptide YY

Enterogastrone: also called gastric inhibitory peptide(GIP) Inhibitory hormones produced by the duodenal mucosa. As the name suggests, it inhibits the production of gastric juice, and motility. **It counters the function of gastrin**.

Peptide YY functions as an Enterogastrone. Fat causes its release from the jejunum and it is an effective inhibitor of gastrin-stimulated acid secretion.

Gastric secretion is increased following the removal of a large part of the small intestine, due to the removal of the source of these inhibitory hormones.

The purpose of intestinal factors that inhibit gastric secretion is presumably to **slow passage of chyme** from the stomach when the small intestine is already filled or already overactive.

Secretion of the stomach during the interdigestive period

The stomach secretes a few milliliters of gastric juice each hour during the "interdigestive period," when little or no digestion is occurring anywhere in the gut. **The secretion is usually almost entirely of the nonoxyntic type, composed mainly of mucus but little pepsin and almost no acid.**

Emotional stimuli may increase interdigestive gastric secretion (which is highly peptic and acidic) to 50 ml or more per hour, in the same way that the cephalic phase of a meal. This increase of secretion in response to emotional stimuli may contribute to the development of peptic ulcers.

Pancreas

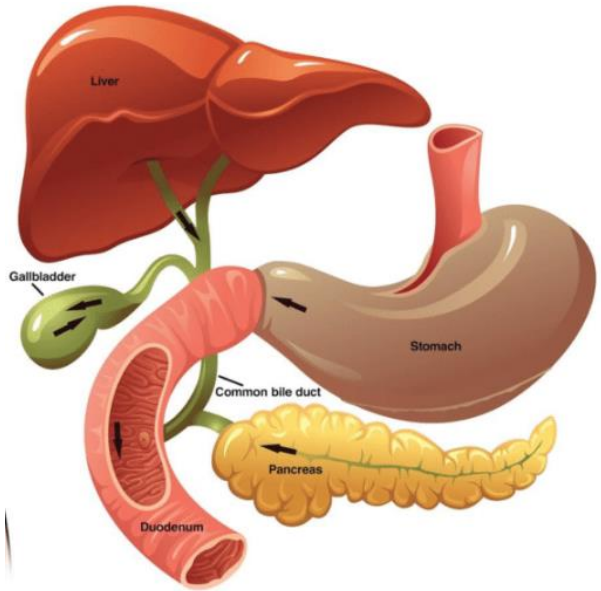
The pancreas is an organ of the **digestive system** and **endocrine system**. It is located just behind the stomach. **It produce enzymes and sodium bicarbonate** that flows through a long pancreatic duct that normally joins the hepatic duct immediately before it empties into the duodenum through the

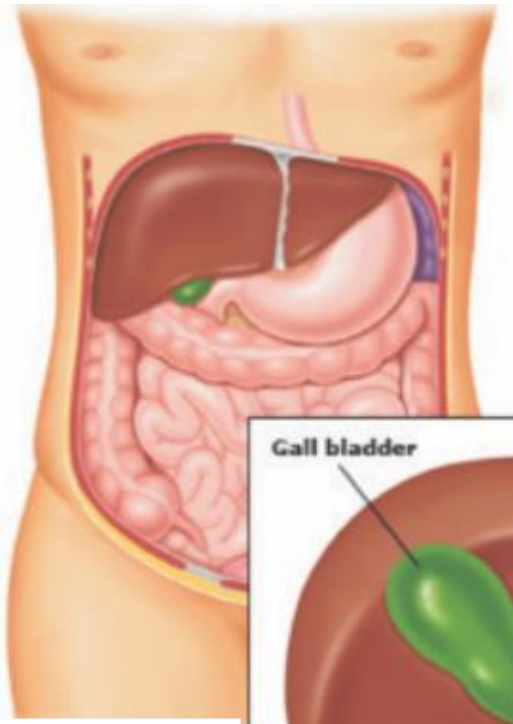
papilla of Vater

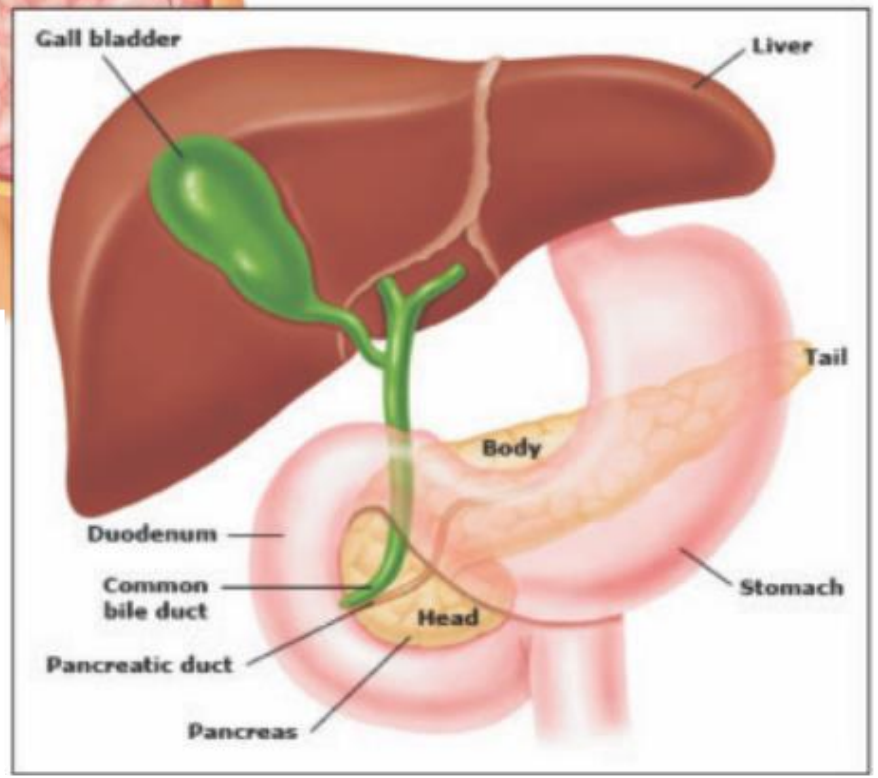
(Ampulla of Vater)

surrounded by the

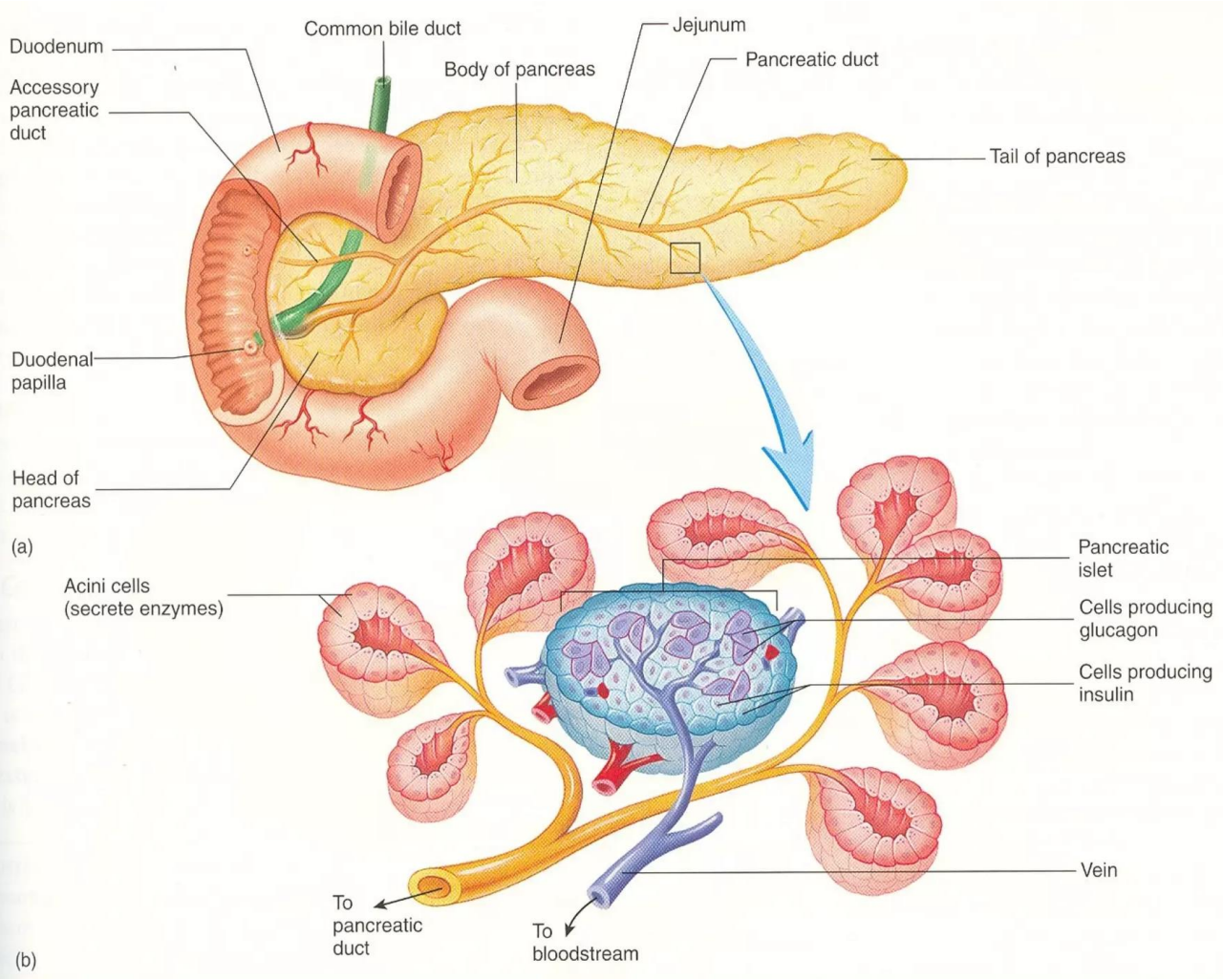
sphincter of Oddi.

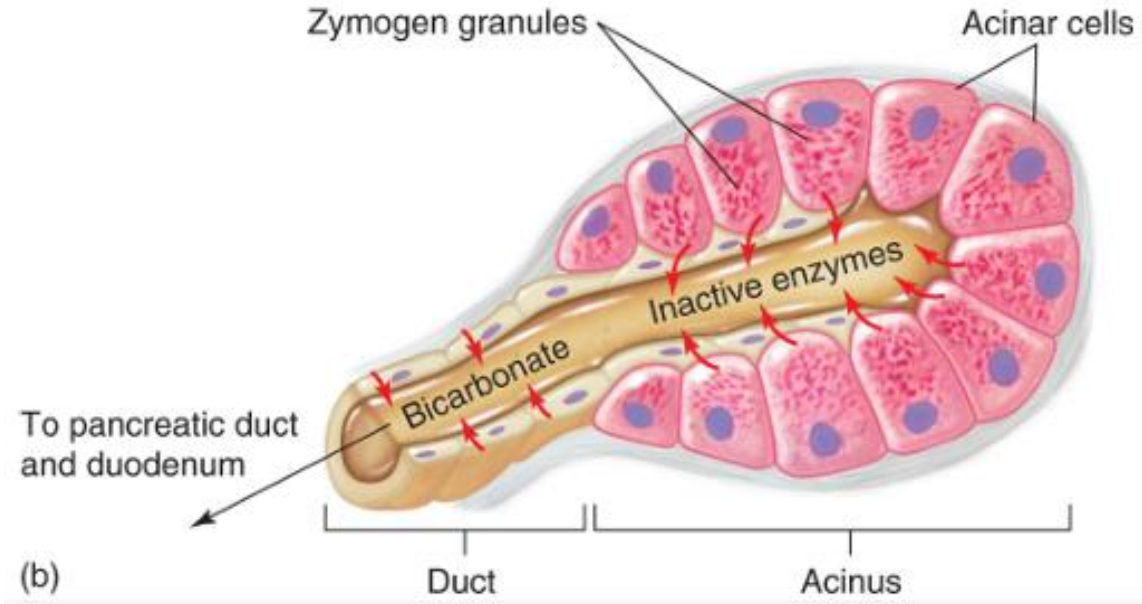






Pancreas secrete an electrolyte solution that contains large amounts of **water and bicarbonate ions** which is important in neutralizing the acid chyme emptied by the stomach.

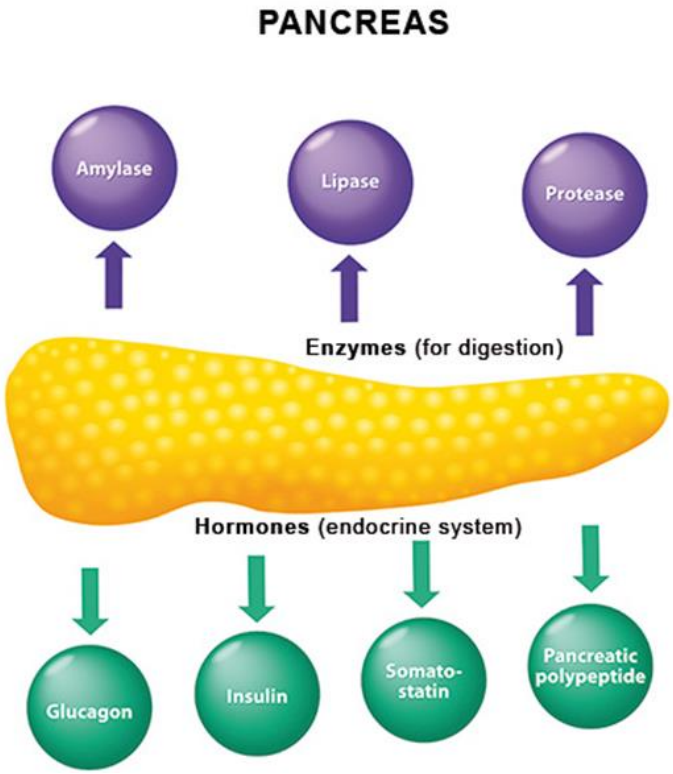




The pancreas has two components :

Endocrine pancreas : produces **insulin** and other hormones (e.g. **glucagon**)from the **islets of Langerhan.**

Exocrine pancreas produces several **digestive enzymes** that help in the digestion of protein, fat and carbohydrates (CHO). The enzymes are secreted by the **acini of the pancreas**.



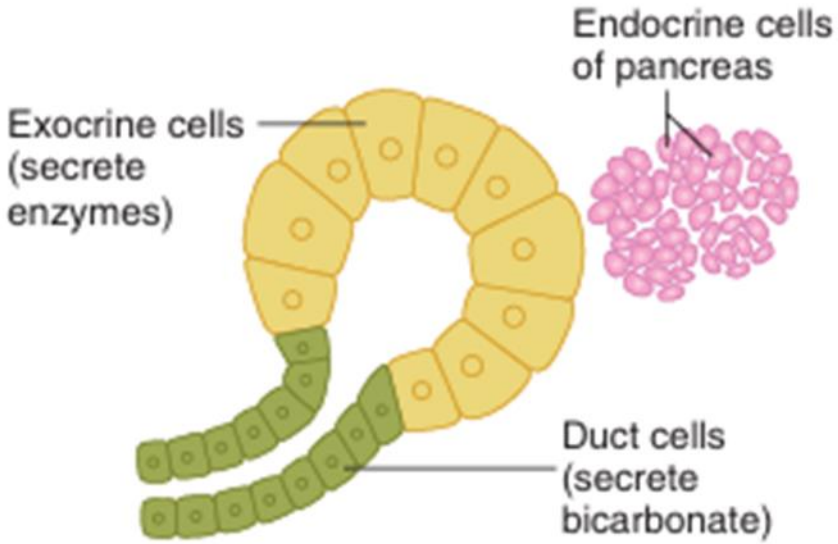


FIGURE: Structure of the pancreas →

Composition of the pancreatic juice:

The pancreas secretes approximately

1- 1.5 liters /day.

PH approximately 8.0

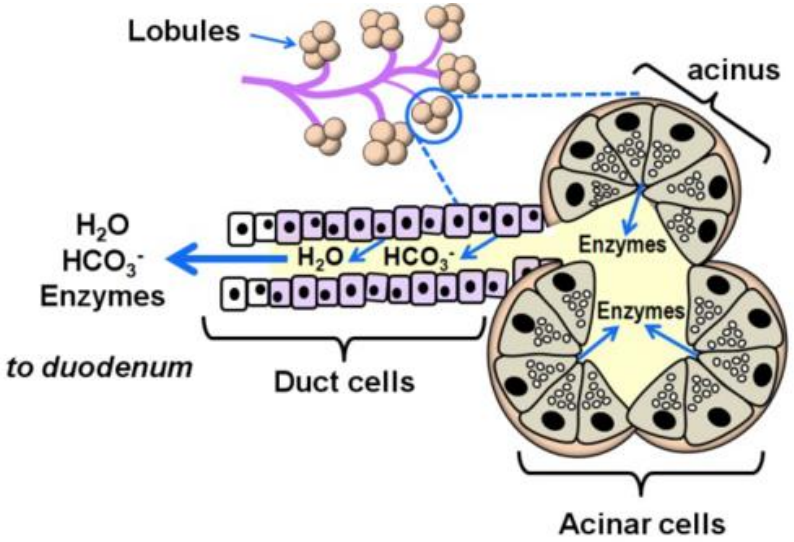
water and different electrolytes:

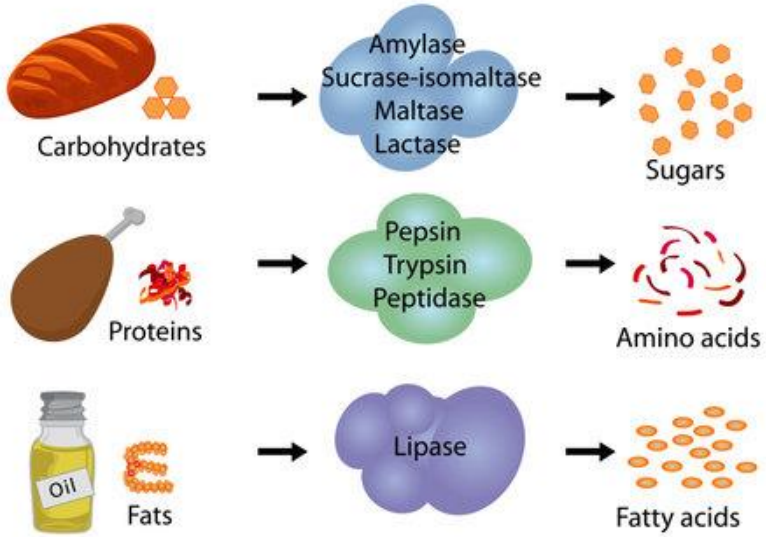
Cations: Na+, K+, Ca2+, Mg2+

Anions: HCO3 –, Cl–, SO4 2–, HPO4 2–

The organic constituents : Digestive enzymes.

The enzymes, **trypsin**, **lipase**, and **amylase** are essential for digestion of most of the **protein**, **fat**, and **carbohydrate.**

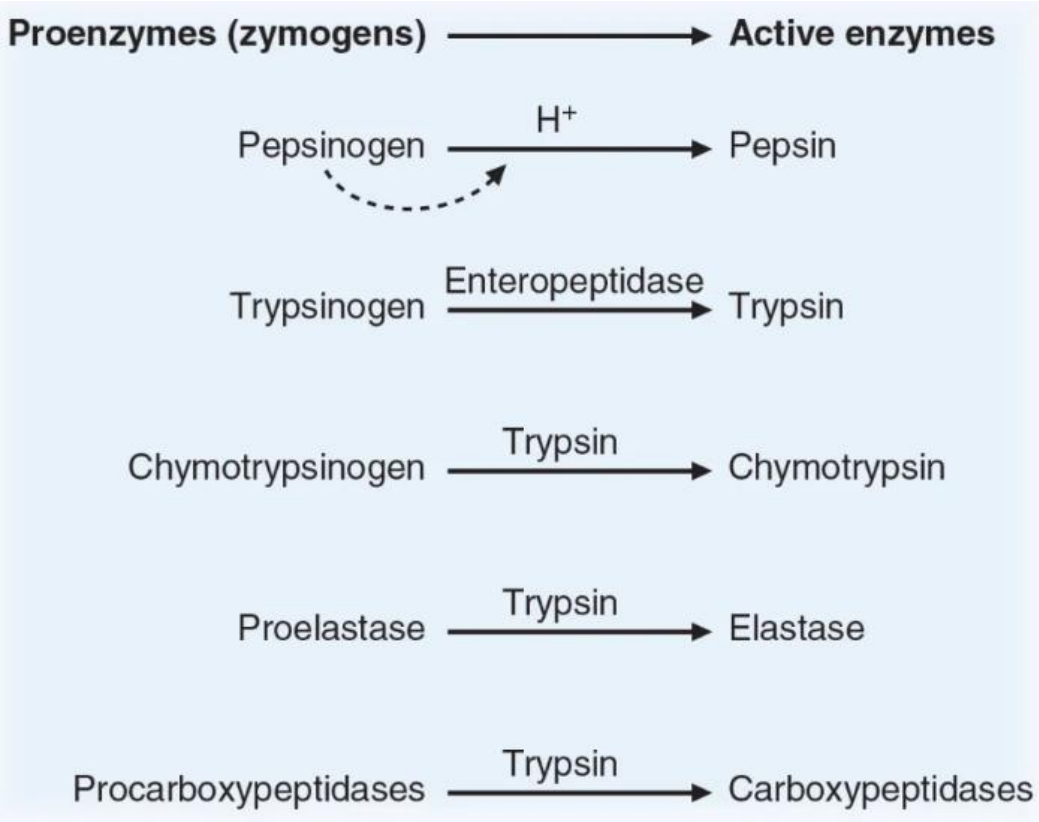




Protein digesting enzymes:

1. **Trypsin.**
2. **Chymotrypsin.**
3. **Elastase.**
4. **Carboxypeptidase**

These enzymes will become **activated only after they are secreted into the intestinal tract** and not while they are present in the pancreas.



Enzymes for the digestion of carbohydrates:

α-amylase: the pancreas secrets an α-amylase similar to that of salivary secretion. It splits starches and glycogen into disaccharides such as maltose and isomaltose.

Fat splitting enzymes:

1.Lipase.

2.Bile salts-activated lipase.

3. Procolipase (colipase): it is secreted from the pancreas as procolipase (inactive form) and activated into active form by trypsin.

4. Cholesterol ester hydrolase.

5. Phospholipase A2 secreted as inactive form (prophospholipase A2) and activated by trypsin into phospholipase A2

Trypsin inhibitor:

Secretion of Trypsin inhibitor prevent digestion of pancreas itself.

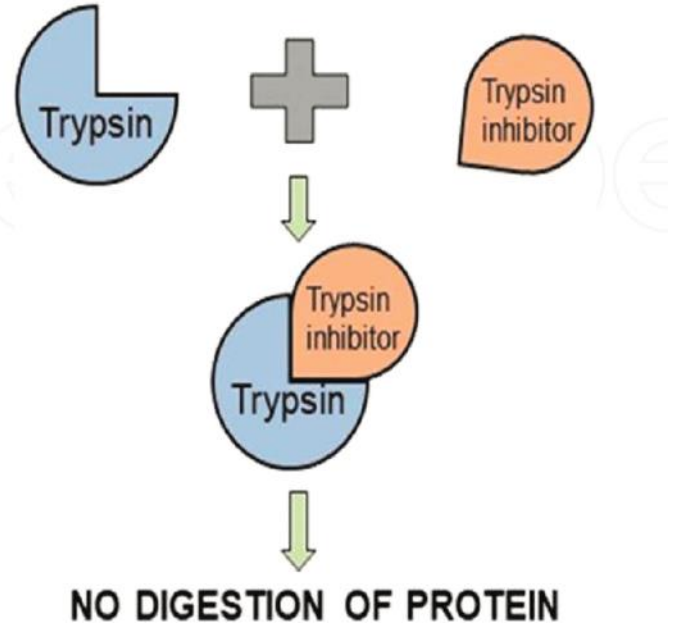
Proteolytic enzymes of the pancreatic juice do not become activated until after they have been secreted into the intestine because the trypsin and the other enzymes would digest the pancreas itself.

The same cells that secrete proteolytic enzymes into the acini of the pancreas secrete another substance called **trypsin inhibitor**.

Trypsin inhibitor prevents activation of trypsin

both inside the secretory cells and in

the acini and ducts of the pancreas.



CLINICAL APPLICATION

Pancreatitis (inflammation of the pancreas)

may result when conditions such as

Alcoholism,

Gallstones,

Traumatic injury,

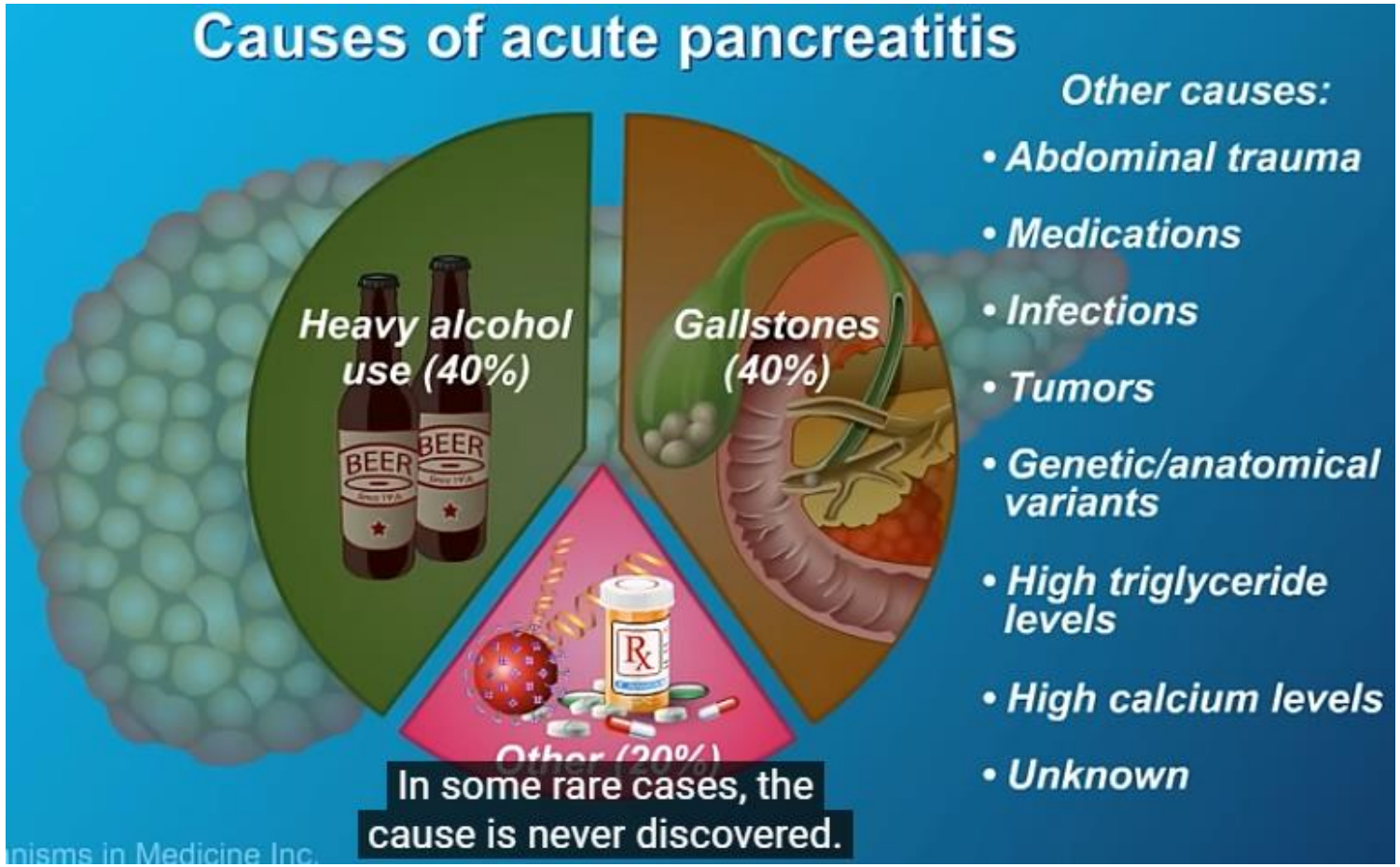
Infections, or

Toxicosis from various drugs

provoke activation of digestive enzymes within the pancreas.



Healthy pancreas Inflamed pancreas



REGULATION OF PANCREATIC SECRETION

1- Nervous by the

vagus and other cholinergic

nerve in the

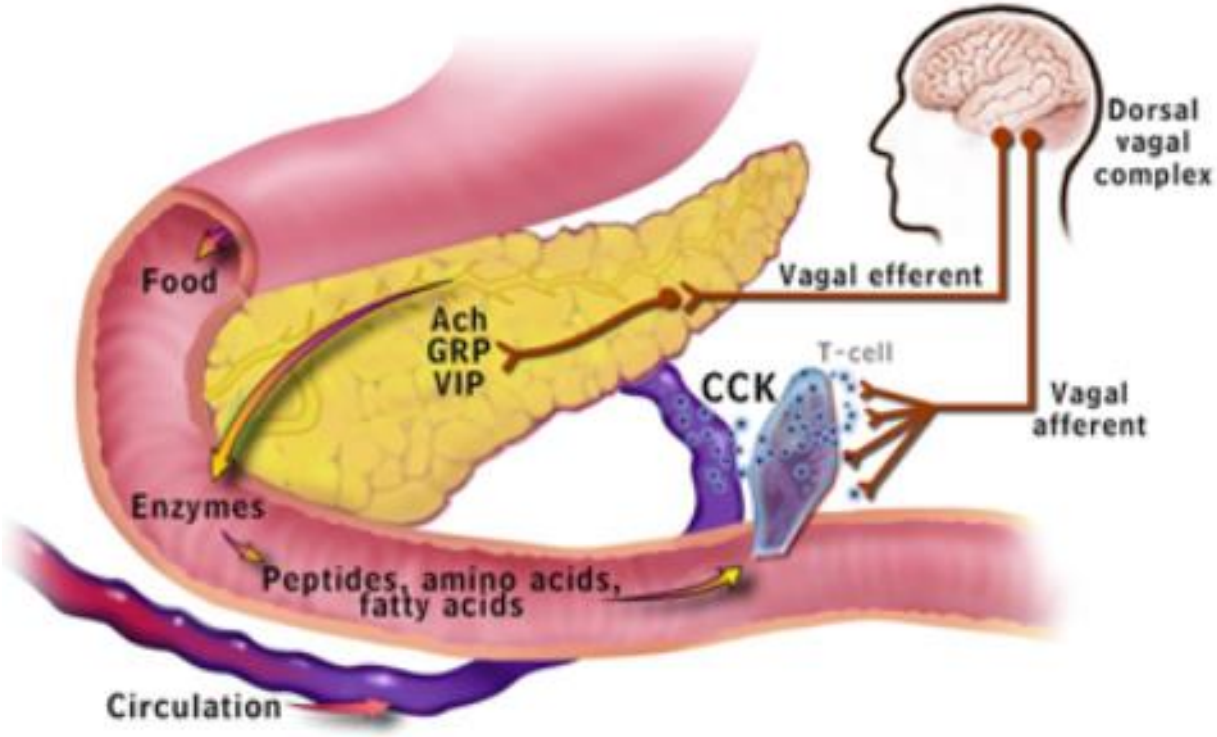
enteric nervous system.

2- Hormonal:

a- Cholecystokinin (CCK)

(formerly called pancreozymin)

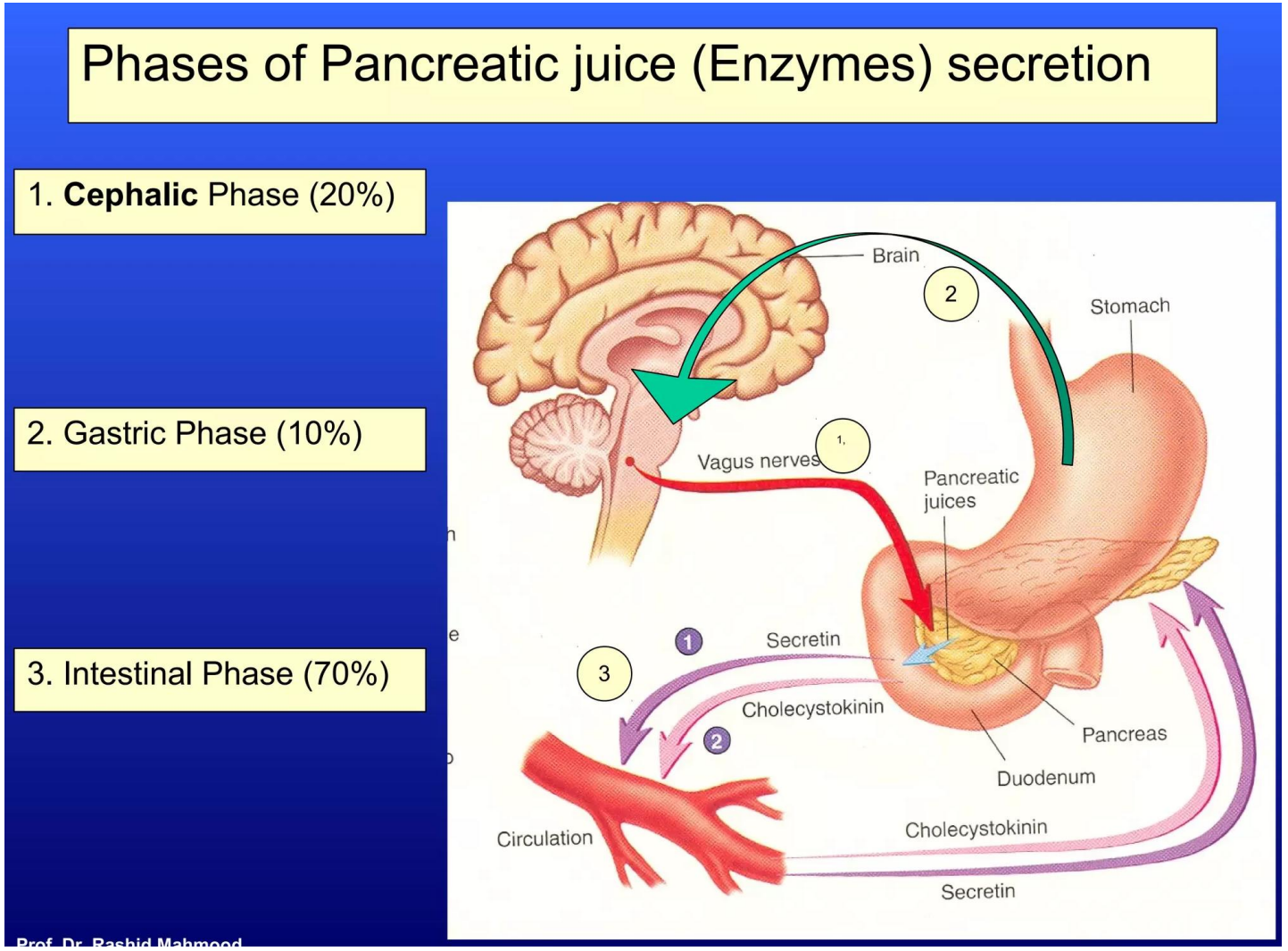
b- Secretin



PHASES OF PANCREATIC SECRETION

Cephalic and Gastric phase:

The same nervous signals that cause the secretion in the stomach also cause **acetylcholine release** by the vagal nerve endings in the pancreas. It will cause moderate amount of enzymes to be secreted into the pancreatic acini and ducts, so the **pancreatic juice secreted is rich in enzymes and poor in water and bicarbonate.**



As the amount of water secreted is little then the pancreatic secretion to the intestine is small because there is no fluid medium to transport the enzymes to the intestine. So most of the enzymes are temporarily stored in the pancreas itself. **This phase accounts for 20% of the total secretion of pancreatic enzymes after a meal.**

Phases Of Pancreatic Secretion

- Pancreatic secretion is under neural and hormonal control.
- It normally results from the combined effects of the multiple basic stimuli which potentiate each other.

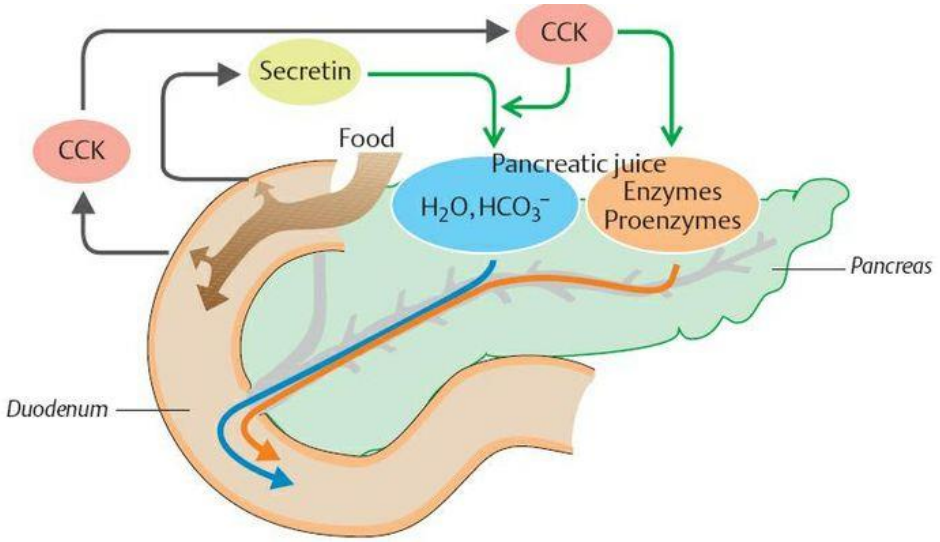
Phase	Cephalic (20%)	Gastric (5-10%)	Intestinal (70-75%)
Stimulus	Smell, taste, chewing and swallowing	Protein, gastric distention	Amino acid and fatty acids in chyme
Mediator	Through Vagus nerve	Through Vagus nerve	Through hormonal stimulation (Secretin, CCK) and enteropancreatic reflexes.[3]

Intestinal phase:

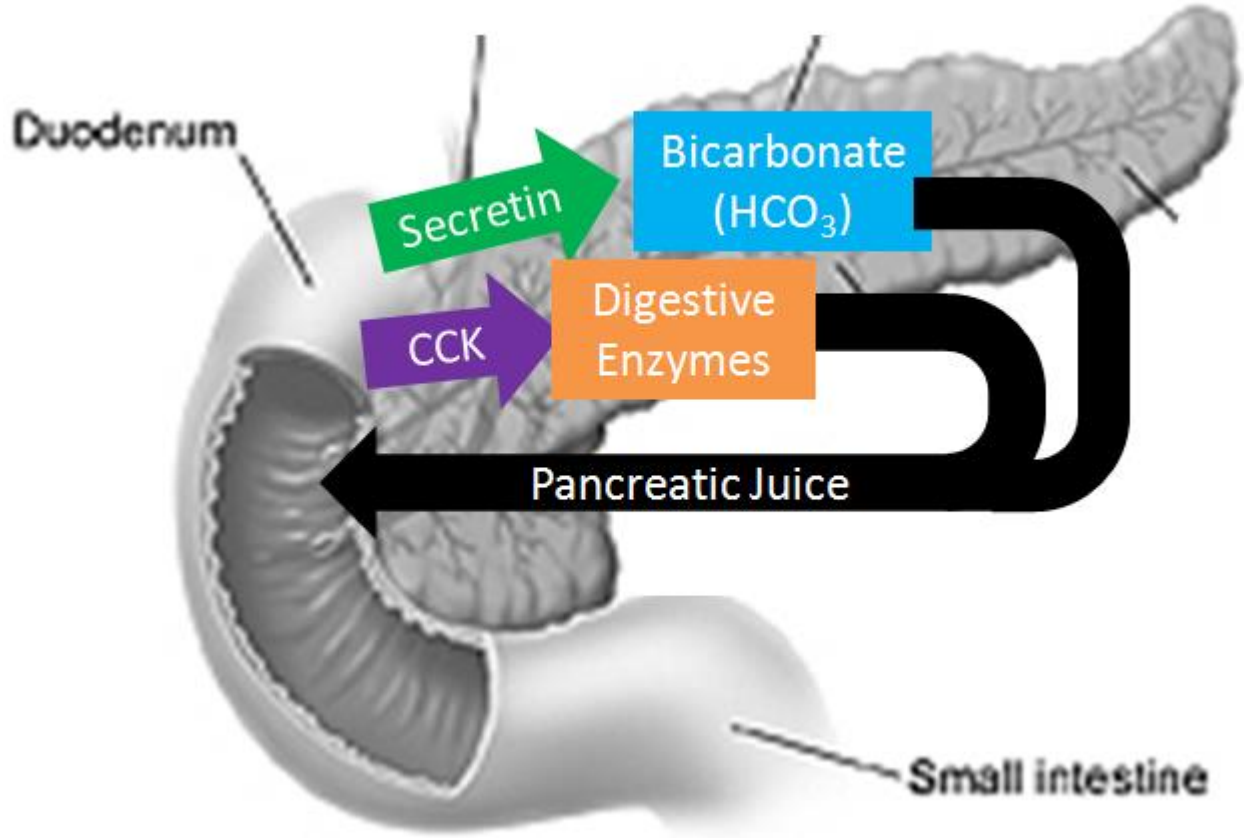
- After the chyme enters the small intestine, it will cause copious secretion mainly in response to secretin.

Also **CCK causes more increase in the secretion of enzymes.**

- **Secretin** : Secretin is present in the mucosa of the upper small intestine and it is secreted when chyme enters the intestine. The most important factor in chyme that causes the release of secretin is:
  - **Acid** → hydrochloric acid → causes release of secretin → absorbed by blood → to the pancreas.



Secretin causes copious secretion of pancreatic juice that contains little enzymes and chloride ions. **Secretin acts on the epithelial cells lining of the small ducts and not on the acinar cells** (that secrete the enzymes) and the duct cells will **secrete water and bicarbonate ions** thus the response of the pancreas to secretin is a watery, alkaline juice poor in enzymes and chloride.

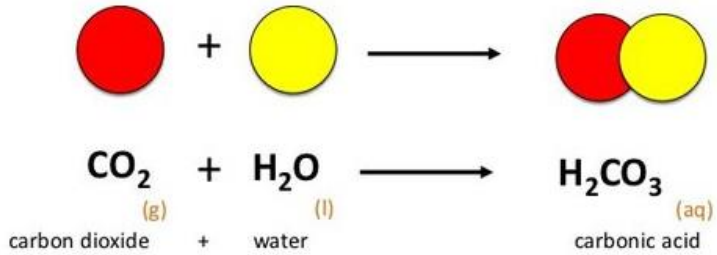


Importance of the secretin mechanism:

1-Secretin is released in large quantities from the mucosa of the small intestine **whenever the PH of the duodenal contents falls below 4.5-5**. This will cause the secretion of large amounts of **watery-alkaline pancreatic juice which will neutralize the acid in the duodenum.**

HCL + NaHCO3→ NaCl + H2CO3

(Carbonic acid) H2CO3 → CO2 + H2O



The carbonic acid will then dissociate into CO2 + H2O and

CO2 will be absorbed by blood and expired through the lungs leaving a neutral solution of NaCl in the duodenum.

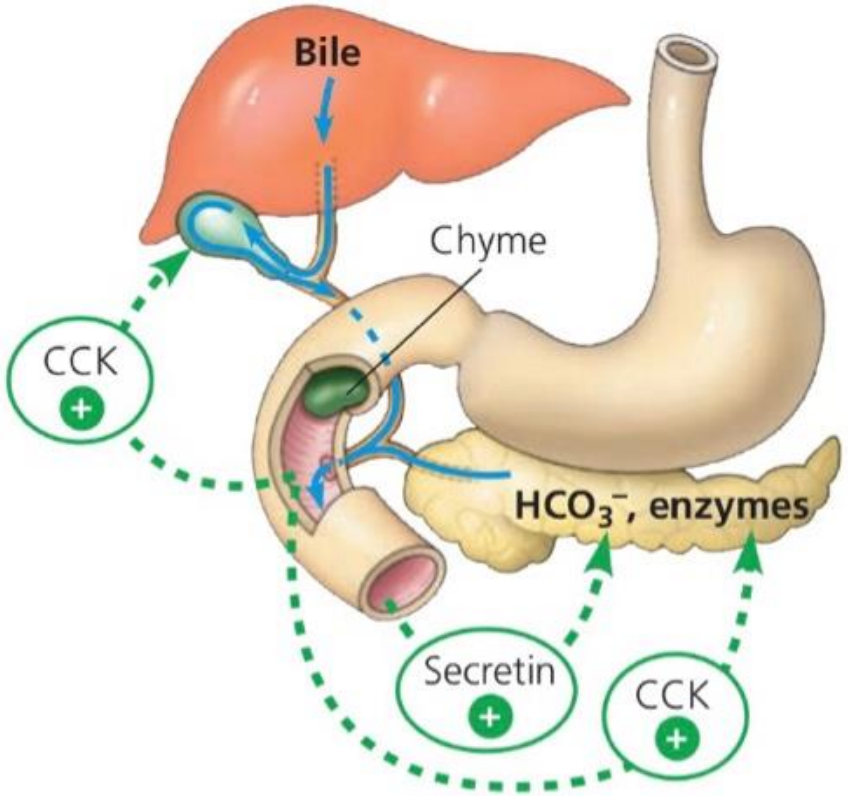
Thus:

a-Excessive acidity is neutralized.

b-Peptic activity of gastric juice is stopped. This is a protective mechanism against the development of peptic ulcer in the duodenum.

2-The bicarbonate ions will provide a suitable PH for the action of the pancreatic enzymes, since all these enzymes act optimally in a slightly alkaline or neutral medium at a PH of 7-8

3- Secretin will also provide the fluid medium to wash out the enzymes that are secreted into the acini without large accompanying osmotic equivalent of water.



2 Chyme—an acidic mixture of partially digested food—eventually passes from the stomach to the duodenum. The duodenum responds by releasing the digestive hormones cholecystokinin and secretin. *Cholecystokinin (CCK)* stimulates the release of digestive enzymes from the pancreas and of bile from the gallbladder. *Secretin* stimulates the pancreas to release bicarbonate (HCO_3^-), which neutralizes chyme.

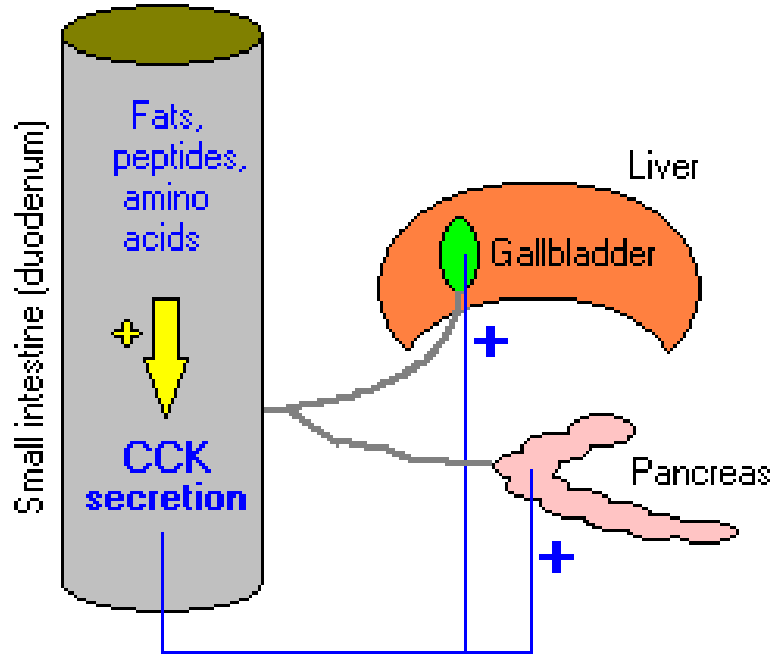
CHOLECYSTOKININ-PANCREOZYMIN (CCK)

- **This hormone is released from the mucosa of the upper small intestine** in protein digestion response to fat and partial byproducts of such as proteoses and peptones and also to a lesser extent in response to acid (HCL).
- CCK when released will be absorbed by the blood and then will go to the pancreas to **cause the secretion of pancreatic juice rich in enzymes but poor in water and bicarbonate.**
- **CCK accounts for about 70-80%**

of the total secretion of pancreatic

digestive enzymes after a meal.

CCK cause emptying of the gall bladder.



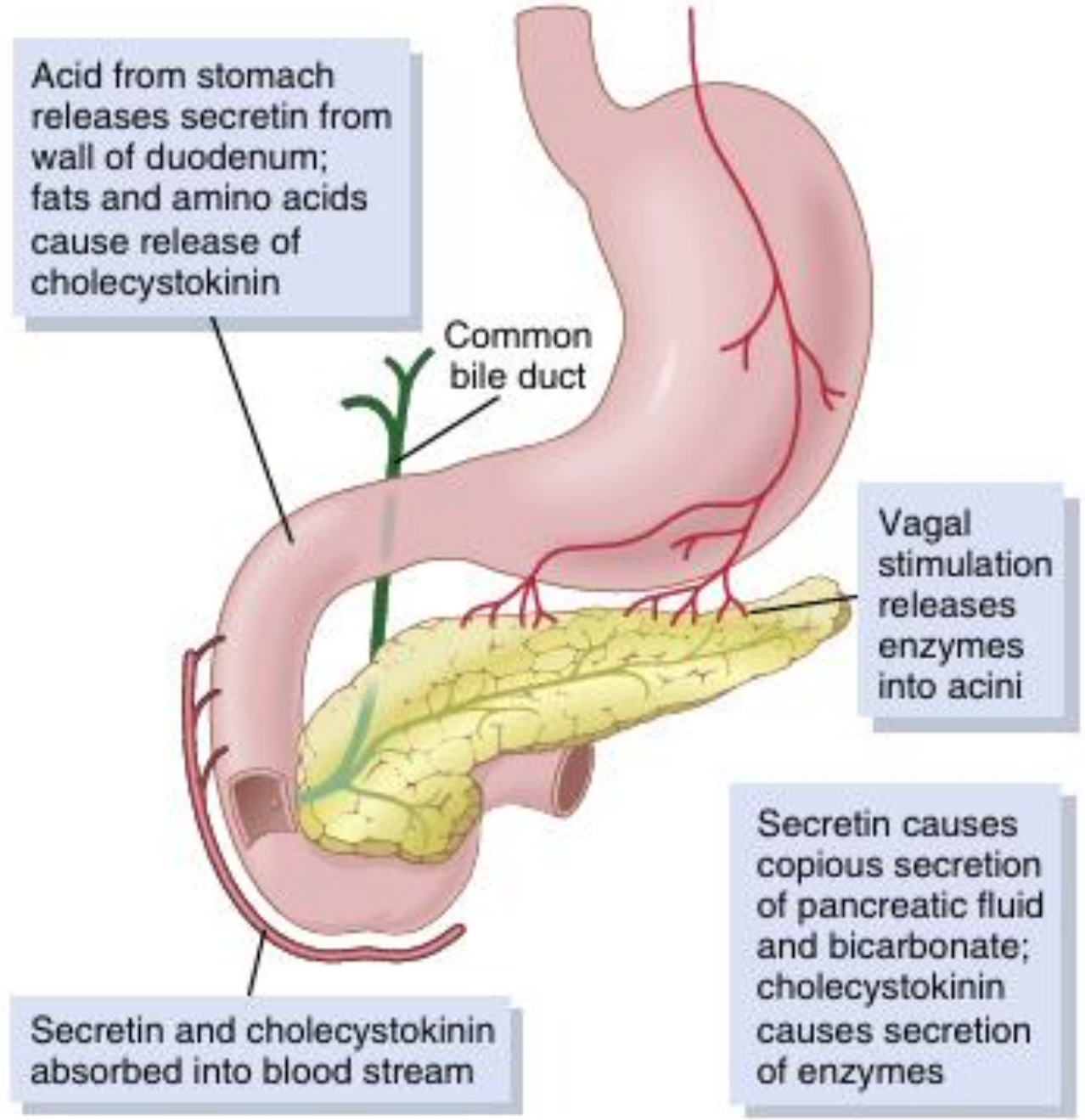


Figure :

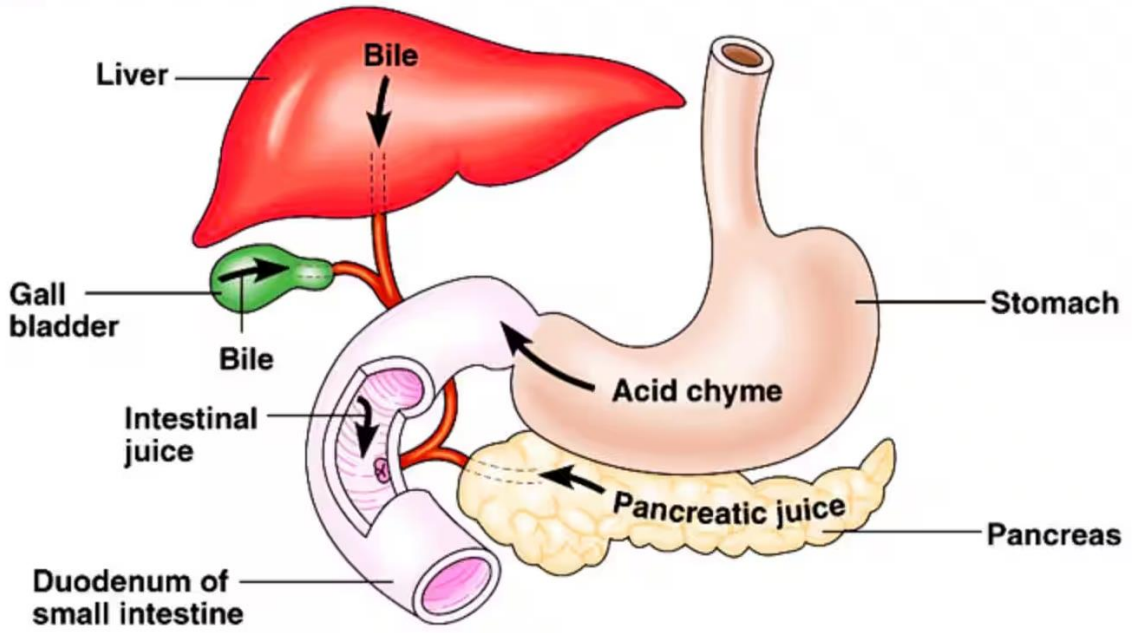
Regulation of pancreatic secretion.

SECRETION OF BILE

Bile serves two important functions:

1. Very important for the digestion and absorption of fat although it does not contain any digestive enzymes.

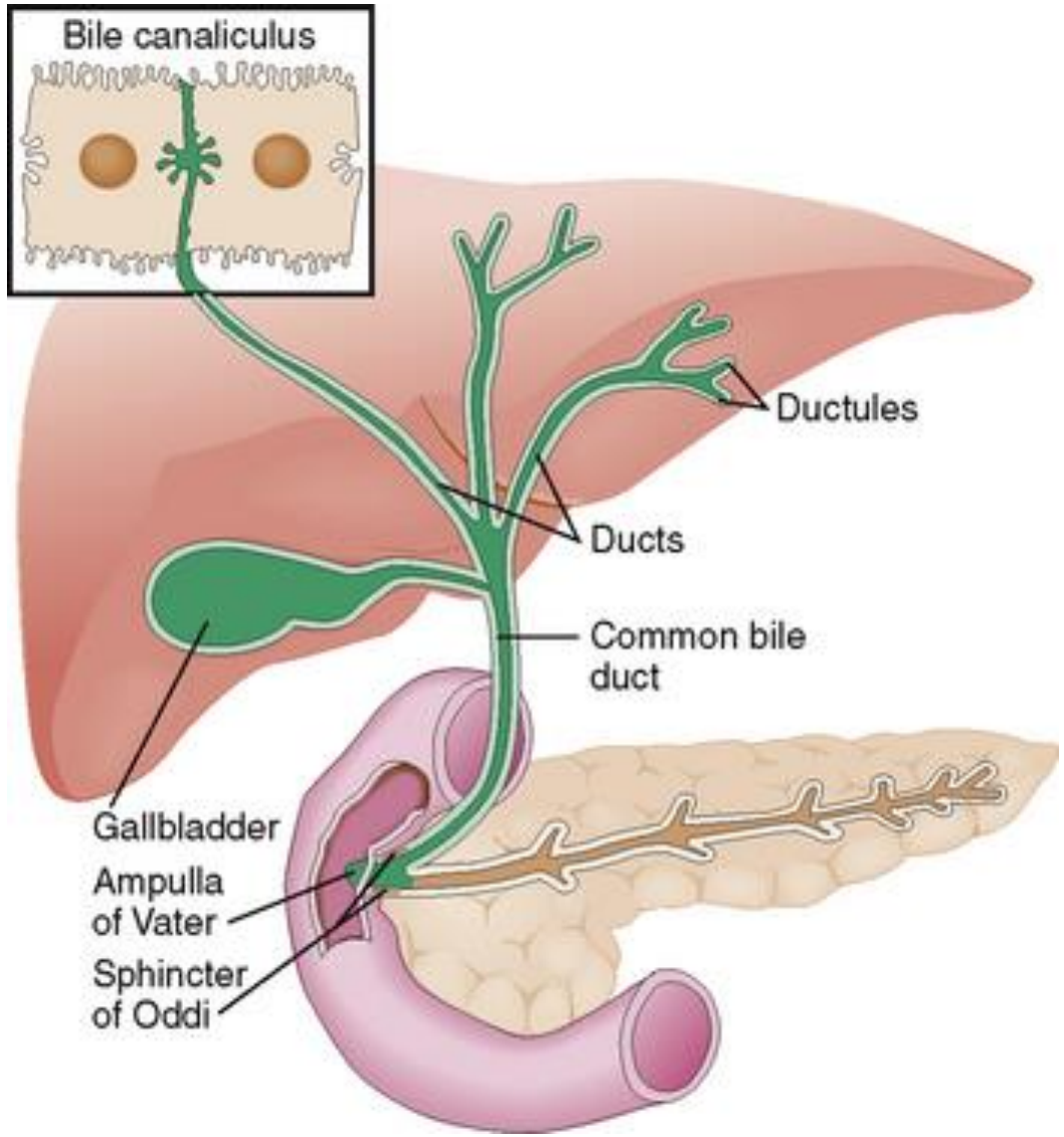
2. Bile serves as a mean for excretion of several waste products from blood e.g. bilirubin (end product of haemoglobin destruction) and excess of cholesterol.



The daily secretion of bile from the liver is 500-1000 ml. However the gall bladder has the capacity of 40-50 mills only so the hepatic bile is concentrated in the gall bladder by the absorption of water and electrolytes. So we have two types of bile:

Hepatic bile → secreted by the liver.

Gall bladder bile → which is the hepatic bile that has been stored and concentrated by bladder.

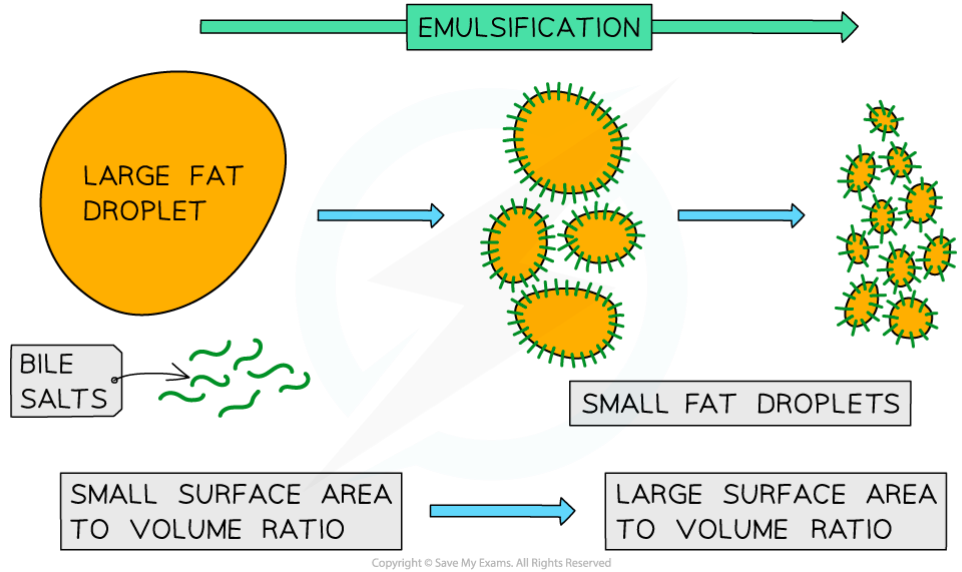


Main functions of bile salts in the intestinal tract:

1-Detergent function (emulsification).

2-Formation of micelles.

3-Activate lipases in the intestine.



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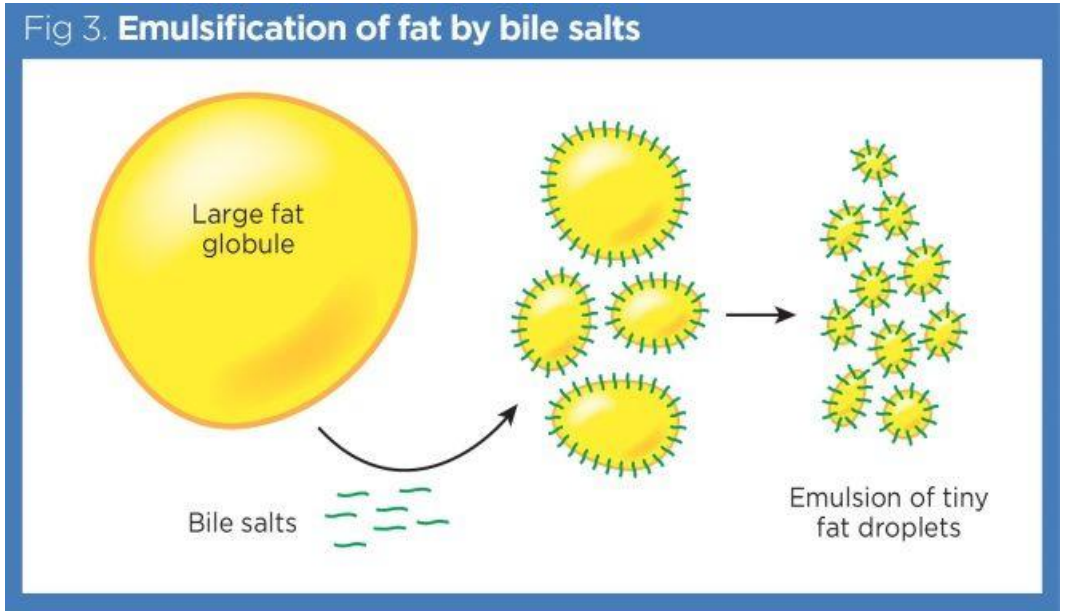
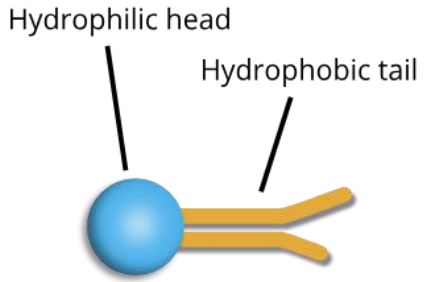
Detergent function (emulsification):

Bile salts through their detergent effect will decrease the surface tension of fat particles in the food and allow the agitation in the intestine to **break the fat globules into smaller sizes** thus it will increase the total surface area of fat particles exposed to the action of the digestive enzymes, this emulsification function is very important for the digestion of fat.

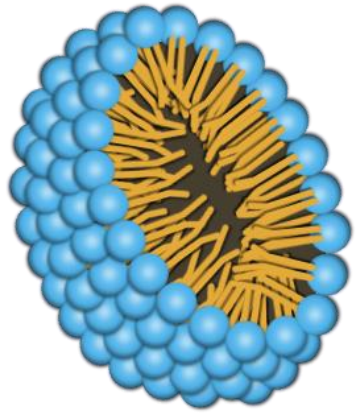


Formation of micelles :

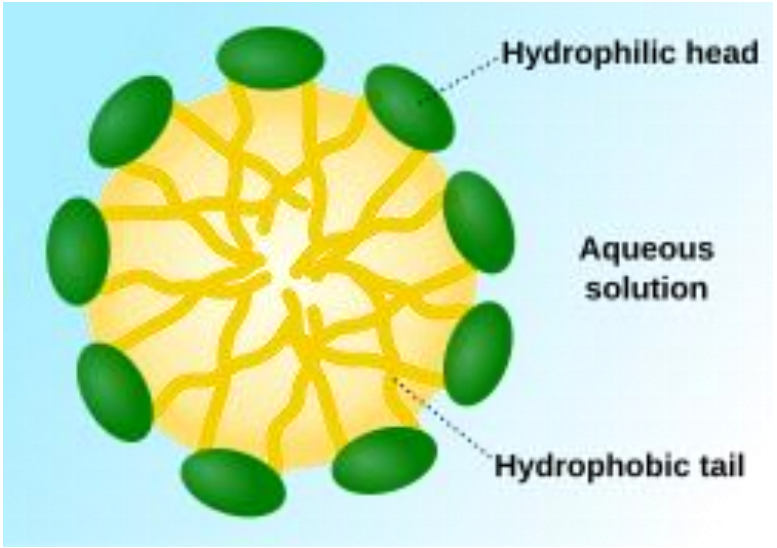
This is a very important effect by which bile salts help in the absorption of fatty acids, monoglycerides, cholesterol and other lipids from the intestinal tract. **Bile salts will form small complexes with lipids particles called micelles**; they are highly soluble in the water of the digestive fluid. The lipids are then ferried (transported) to the mucosa to be absorbed. Without the presence of bile salts 40-50% of lipids are lost in the stool, and there is important loss of **fat soluble vitamins** such as **vitamin A, D, E, and K.** **(DEAK)**



Amphiphilic molecule



Micelle

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