UNIT IV
BIOCHEMISTRY OF DIGESTION 1

OBJECTIVE:
1. Define and determine featured involved in the process of Digestion
2. Understand the different factors Affecting Digestion
3. Explain the chemical reactions involved in the process of digestion.
4. Analyze certain basic biochemical processes to explain commonly occurring health-related problems in digestion
5. Discuss the digestion of complex biomolecules in the body;

TOPICS

Unit 4: BIOCHEMISTRY OF DIGESTION 1. Definition and factors affecting Digestion 2. Phases of Digestion a. Salivary Digestion b. Gastric Digestion c. Intestinal Digestion d. Pancreatic Juice e. Intestinal Juice f. Bile	3. Chemical changes in the large intestines and feces a. Fermentation b. Putrefaction c. Deamination d. Decarboxylation e. Detoxification 4. Chemical Composition of Feces

DIGESTION: DEFINITION, FACTORS AFFECTING DIGESTION, PHASES OF DIGESTION
BIOCHEMISTRY OF DIGESTION

People eat to live and have an energy in making their daily task in life. The food we take in are processed by the different organs in our body especially in the process of digestion. Within this process organs play their own rule in processing the food to be used by our body.

I. Definition

Digestion- involves breaking down large food molecules into water-soluble molecules that can be passed into the blood and transported to the body's organ.

Biochemistry- the science in which chemistry is applied to the study of living organism and the atoms and molecules which comprise living organism

II. Factors Affecting Digestion

1. **Chewing.** The more thoroughly food is chewed, the more its surface area is increased. To visualize this, just imagine a chunk of something being broken into two smaller pieces. The total surface area is now equal to that of the original chunk plus the new area exposed by breaking. Not only does prolonged chewing of food increase its surface area and hence its potential for quickly absorbing digestive juices, but chewing food longer also increases the production of saliva and the appropriate digestive enzymes by the stomach. In the words of Herbert Shelton, noted authority on "Natural Hygiene," "Food should be chewed thoroughly because the stomach has no teeth.".

2. **Liquids** Liquids with or following meals dilute digestive enzymes, thus increasing digestion time. Lowering the intake of salt and spices reduces the desire for liquids during and after meals. Cold liquids are the worst because the digestive enzymes become very inefficient at lowered temperatures. Some people purposely drink water around mealtime to fill their stomachs so they will eat less. This erroneous idea implies that hunger is satiated only when the stomach is full. As previously stated, true hunger has nothing to do with the stomach. Flooding ingested food with water may promote a sense of fullness and temporarily relieve the discomfort of irritated stomach walls contacting each other. However, this practice hampers digestion and stretches the stomach, thus further irritating the stomach lining.

3. **Condiments.** Flavorings such as salt, vinegar, pepper, spices, and monosodium glutamate have effects beyond causing thirst after meals. One additional effect is that they prompt us to swallow food after insufficient chewing. Their strong flavors stimulate the sense of taste, giving the false impression that enough of the nutrients in the food have been extracted during the mastication process.
   Many of these flavorings-especially MSG (monosodium glutamate)-act as gastric irritants, resulting in a
   false sensation of hunger, causing overeating.
4. **Frequency of Meals**. If food is eaten before the previous meal has been sufficiently digested, one of two undesirable events occurs:
   (a) The stomach empties prematurely, releasing partly digested food into the intestines. This action results in the absorption of partly digested proteins and burdens the immune system, which must remove them from the blood stream.
   (b) The new, undigested food mixes with the partly digested food. The combined food mass now takes longer to digest, thus allowing increased putrefaction and fermentation of it.
5. **Eating Within Digestive Limitations.** Overeating expands and stretches the stomach, causing irritation and exacerbating prior harm. Moreover, if excessive amounts of a specific nutrient such as protein are eaten, the glands of the stomach cannot secrete sufficient enzymes to fully digest it. The food then remains in the digestive tract longer, and yeast and bacteria have more time to multiply. Not only is it important not to overeat a specific nutrient, but it is important never to totally fill your stomach. You must leave room for the subsequent outpouring of juices required for digestion.
6. **Food Allergies-** Food allergies occur when your immune system triggers cells to release
   antibodies known as immunoglobulin. This is what triggers histamine release that causes
   abdominal pain, diarrhea, nausea, or vomiting.

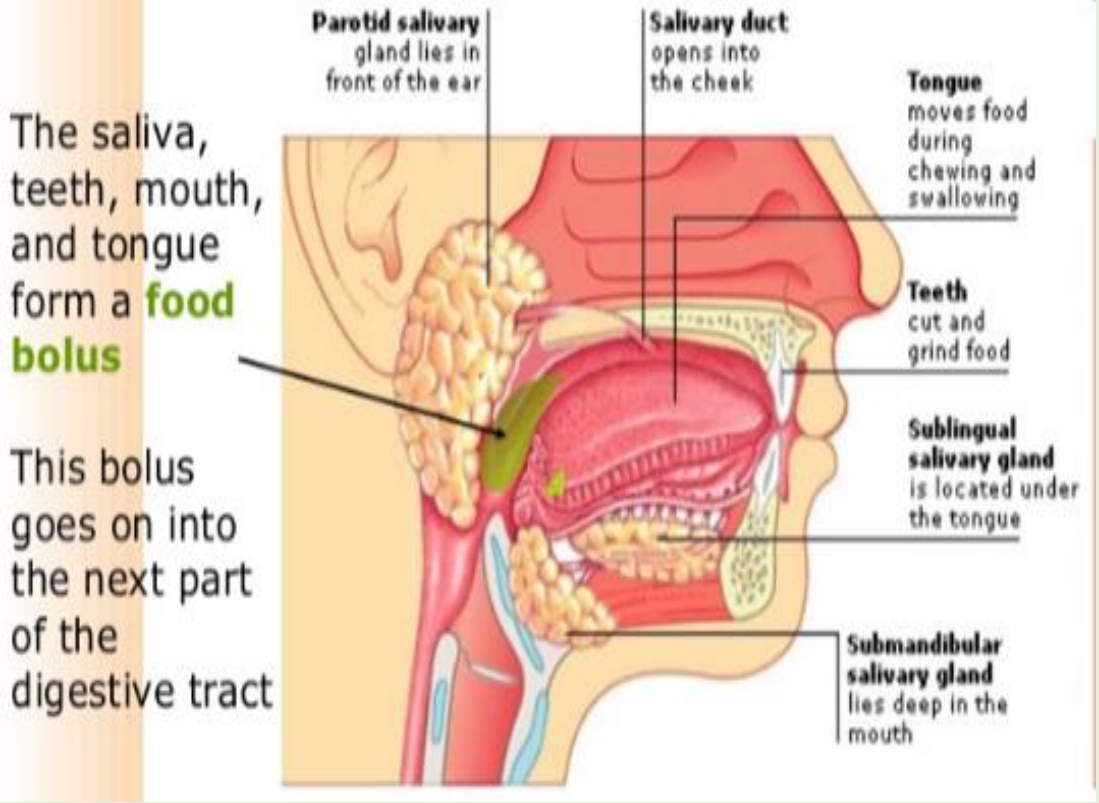
I. Phases of Digestion

1. Salivary Digestion

Digestion of the food occurs within the mouth, even before food reaches the stomach. During the salivary digestion the presence of saliva is important. Saliva is the watery and usually substance produced by mouth that is responsible in moistening food, and helping to create a food bolus, so it can be swallowed easily. Saliva contains amylase that is readily inactive at Ph

4.0 or less, so that digestive on food in the mouth will cease as soon as the acid environment of the stomach has penetrated the stomach particle.
Saliva amylase- The which begin the process of starch digestion in the mouth. Saliva also contains substances such as lysozyme and antibodies that inhibit bacteria.

Significance	Normal Process	Abnormal Process
-Saliva: moisten the food for easier ingestion of food	**-** food is taken through mouth and broken down by teeth and saliva and digestive enzymes.	**-** the food being ingested is dry - you would need to drink water whenever you will eat to moisten your food



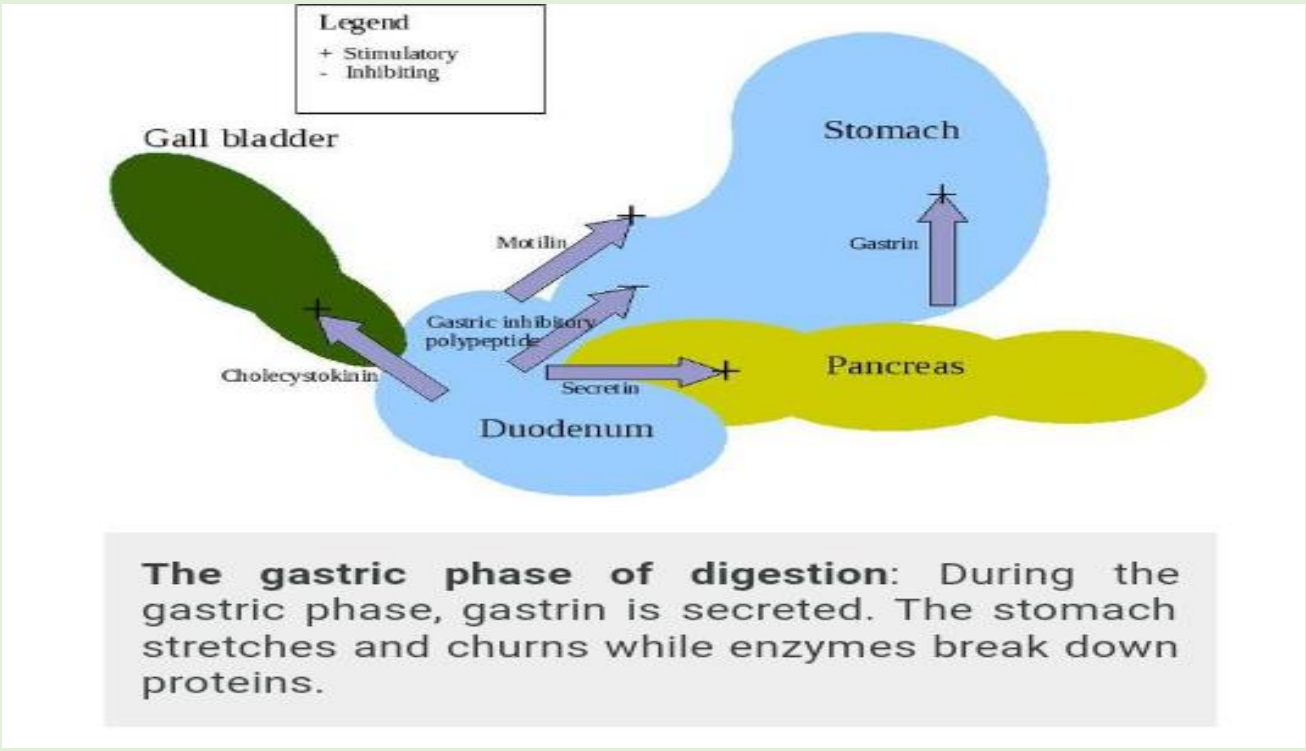
2. Gastric Digestion- Digestion by the action of gastric juice. The gastric phase accounts for about two-third of gastric secretions.

Ingested food stimulates gastric activity by stretching the stomach and raising the pH of its contents; this causes a cascade of events that leads to the release of hydrochloric acid by the parietal cells that lower the pH and break apart the food.

Gastric secretion is stimulated chiefly by three chemicals: acetylcholine, histamine, and gastrin.

The gastric phase is a period in which swallowed food and semi-digested protein (peptides and amino acids) activate gastric activity. About two-thirds of gastric secretion occurs during this phase.

Ingested food stimulates gastric activity in two ways: by stretching the stomach and by raising the pH of its content.



The gastric phase of digestion: During the gastric phase, gastrin is secreted. The stomach stretches and churns while enzymes break down proteins.

Gastric juice- regulated by both neural and hormonal factor, the sight, smell, and taste of food stimulate parasympathetic nervous system reflexes, which increase the secretion of gastric juice by the stomach glands. In addition, the presence of food and falling pH in the stomach stimulate the stomach cell to release the hormone gastrin.

Gastrin prods the stomach glands to produce still more of the protein- digesting enzyme, mucus and hydrochloric acid.

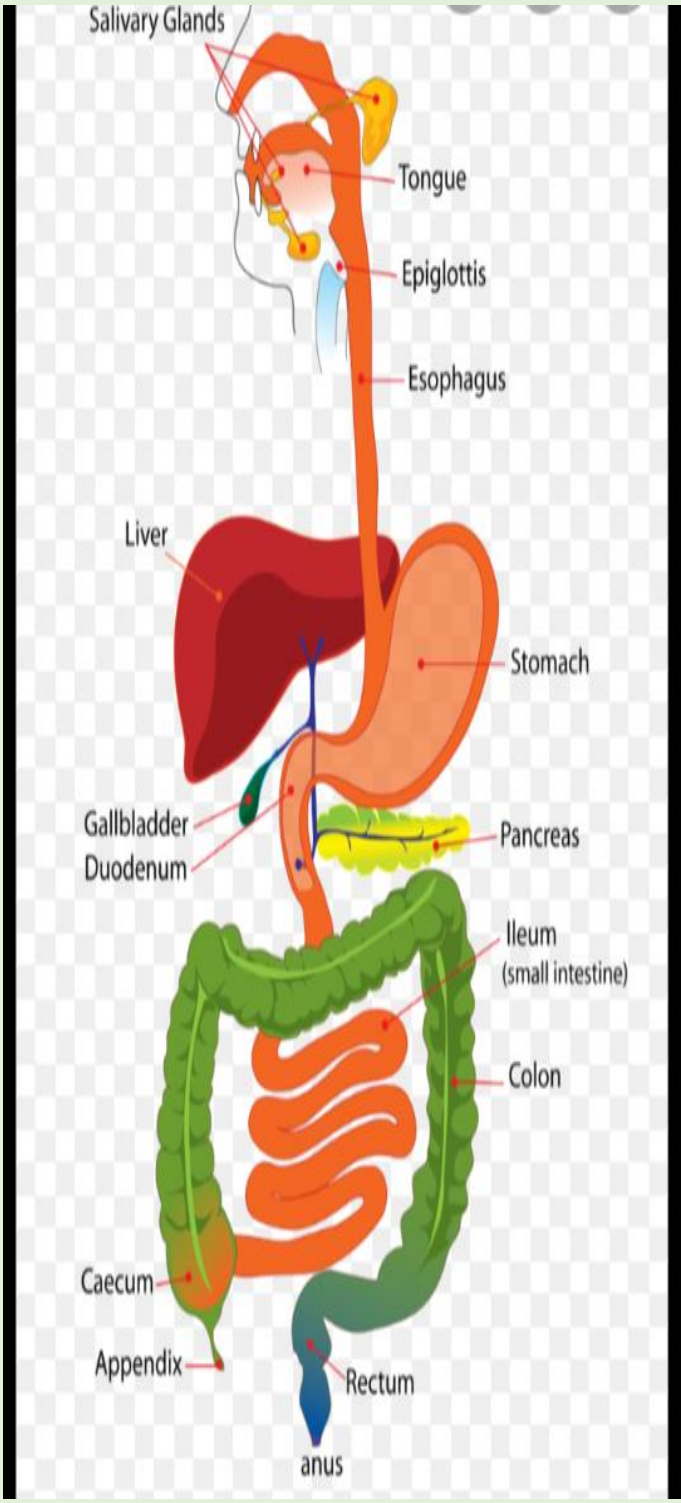
Significance	**Normal Process**	**Abnormal Process**
- gastric juice: break down proteins into polypeptides during digestion.	**-** gastrin is secreted and the stomach stretches and churns while enzymes break down proteins.	**-Ulcer:** hydrochloric acid makes the stomach contents very acid that is dangerous both hydrochloric acid and the protein-digesting enzymes have the ability to digest the stomach

3. Intestinal Digestion

The intestinal phase occurs in the duodenum as a response to the arriving chyme, and it moderates gastric activity via hormones and nervous reflexes.

Stretching of the duodenum (the first segment of the small intestine) enhances gastric function via the vagal nerve, as the chime cause the secretion of gastrin, which stimulates the stomach.
The acid and semi-digested fats in the duodenum trigger the enterogastric reflex: the duodenum sends inhibitory signals to the stomach by the way of the centric nervous system. The newly arrived chyme also stimulates enteroendocrine cell of the intestine to release compounds that stimulate the pancreas and gall bladder, while also suppressing gastric secretion and motility to allow the duodenum to process the chyme before receiving more from the stomach.
Chyme: The thick, semifluid mass of partly digested food that is passed from the stomach to the duodenum.

In small intestine food is still partially digested. The process of chemical food digestion is accelerated as the food now takes a rather wild 3-6 hours' journey through the looping coils and twist of the small intestine. The time the food reaches the end of the small intestine digestion is complete and nearly all food absorption has occurred.



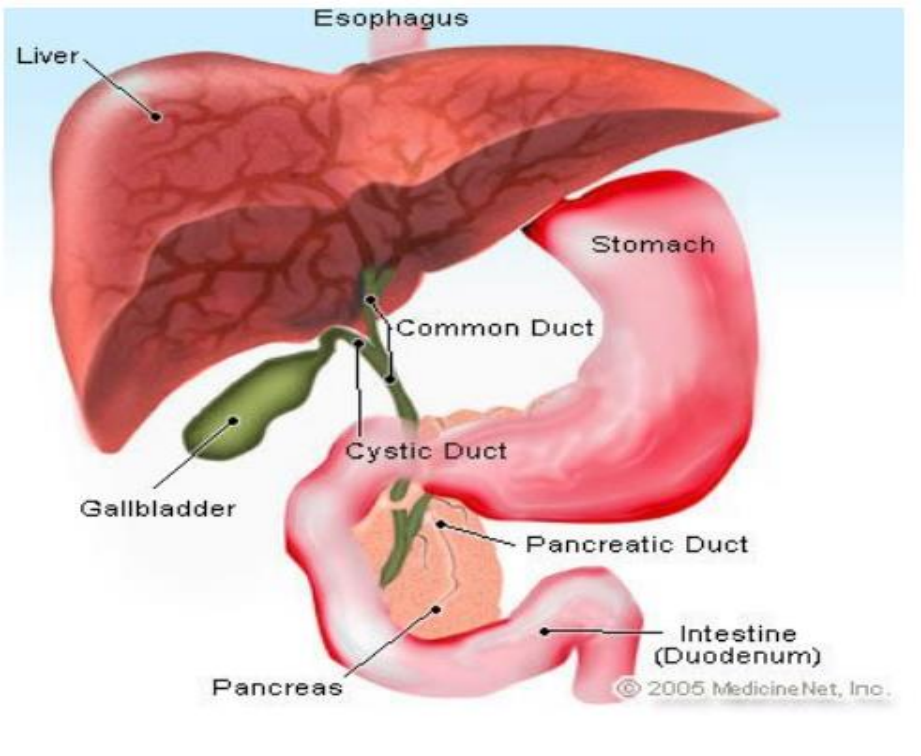
Significance	Normal Process	Abnormal Process
intestines: where digestion takes place	**small intestine** partially digest food while **Large intestine** dry out the indigestible food residue by absorbing water, and eliminate it from the body	**- Diarrhea**: watery stool result from any condition that rushes food residue through the large intestine before the organ has had sufficient time to absorb the water. And other bowel disorder affects how your body digest and absorb food

4. Pancreatic Juice

- Fluids made by the pancreas that contain digestive enzymes**.**

The pancreas is a spongy, tube-shaped organ about 6 inches long. It is located at back of the abdomen. It is connected to the duodenum, the upper end of the small intestine.

Pancreas makes pancreatic juices and hormones. The pancreatic juices contain enzymes that help digest food in small intestine.



Insulin: is among the hormones made by the pancreas. It controls amount of sugar in the blood. Both enzymes and hormones are needed to keep the body working right

As pancreatic juices are made, they flow into the main pancreatic duct. This duct joins the common bile duct, which connects the pancreas to the liver and the gall bladder. The common bile duct, which carries bile, connects to the small intestine by an opening called ampulla in the duodenum near the stomach.

Significance of pancreatic juices	**Normal Process**	**Abnormal Process**
- helps neutralize the acidic gastric juice from the stomach - produce the hormone insulin and secretes it into the bloodstream, where it regulates the body glucose or sugar	**-** pancreatic juices contain enzymes that help digest food in the small intestine.	Absence of pancreatic juices: essentially no fat digestion and absorption goes on, and fatty bulky stools are the result.

5. Intestinal Juices

- a fluid that is secreted in small quantities in the small intestine, is highly variable in constitution, and contains especially various enzymes (as lipase, lactace, enterokinase, and amylase) and mucus.

- it is part of the larger digestive system. It is an integral part of digestion and is excreted into the small and large intestine when the body detects that there is food in the area. The intestinal juices contain much mucus and some digestive enzymes, which assist with digestion.

Purposes:

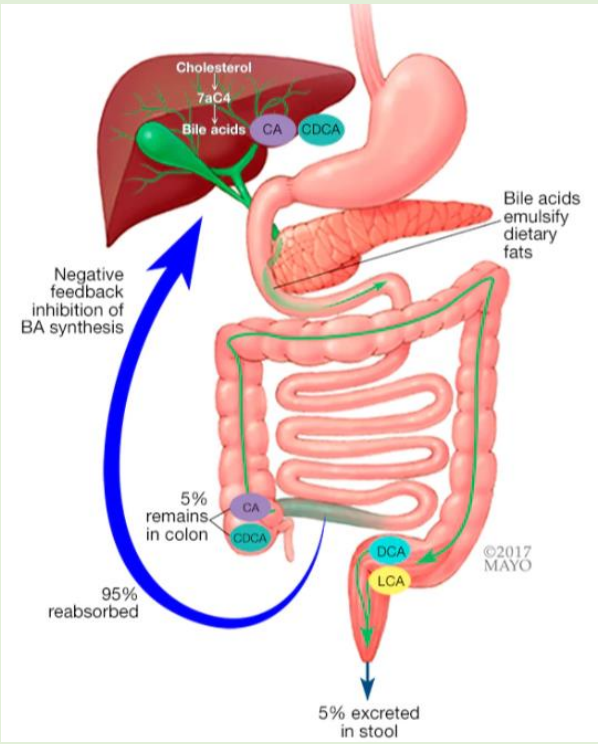
-helps to neutralize the acid coming in from the stomach

- protects the small and large intestine from becoming irritated.

Significance	Normal Process	Abnormal Process
Lipase – helps your body digest fat	-breaks down dietary fats into smaller molecules called fatty acid and glycerol	**- Pancreatitis:** high level of lipase which causes inflammation of the pancreas
Lactase: complete digestion of whole milk; it breaks down lactose, a sugar which gives milk its sweetness	Human body is able to take and digest lactase	Not enough lactase produce in the small intestine causes a person to have Lactose intolerance.

6. Bile

Bile is concentrated and stored in the gall bladder, which lies just beneath the liver. It doesn't contain digestive enzymes but does contain bile salt, which transform lipids(fats) into microscopic particles in a process known as emulsification. The resultant small particles provide a large total surface area of fats so that the pancreatic lipases can digest them more easily.



Properties of bile:

a. Emulsification: Helps emulsify fats in the intestine to dissolve fatty acids. The presence of bile in the intestine is an important adjunct to accomplish the digestion and absorption of fats as well as the absorption of the fat-soluble vitamins A, D, E, and K.
b. Neutralization of acid: neutralize the acid chyme from the stomach and prepares it for digestion in the intestine.
c. Excretion: Bile is an important vehicle for bile acid and cholesterol excretion, but it also moves many drugs, toxins, bile pigments, and various inorganic substances such as copper, zinc, and mercury.

Significance	Normal Process	Abnormal Process
- waste products, including bilirubin are elimination from the body by secretion into the bile and elimination of feces	**-** contains bile acid that are critically for digestion and absorption of fats and fat soluble vitamins in small intestine.	**- gallstone:** if bile is stored in the gallbladder for too long or too much water is removed.