

CHAPTER - 9

DIGESTIVE SYSTEM

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9.4.1 Digestion of food in alimentary canal

9.4.2 Absorption of food in the alimentary canal

DIGESTIVE SYSTEM

9.1 INTRODUCTION

- The digestive system consists of gastrointestinal tract (alimentary canal) and its glands. The functions of gastrointestinal tract are ingestion, digestion and absorption of food and excretion of waste products.
- The organs that cause mechanical splitting of food include teeth, tongue and muscles that help in mastication and peristaltic movement in the gastrointestinal tract.
- Thus, the organs involved in and constituting the digestive system are placed into two groups
 - i. The alimentary canal;** a long tube starting from mouth extending up to the anus.
 - ii. Accessory organs,** i.e. teeth, tongue, salivary glands, liver and pancreas.

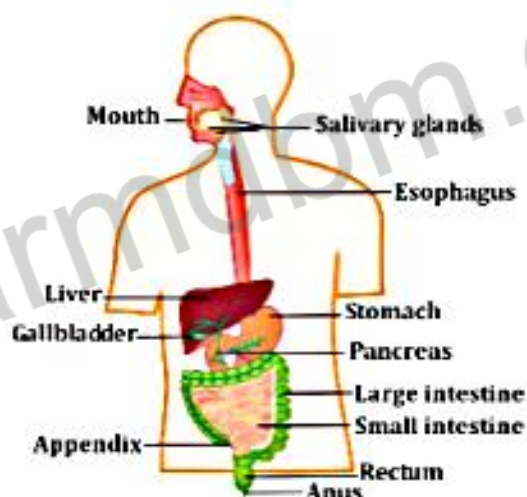


Fig.9.1: Digestive System

9.2 THE ALIMENTARY CANAL

The alimentary canal (also called the digestive tract). This long tube of organs makes a pathway for food to travel through the body. It runs from the mouth to the anus (where poop comes out) and includes the oesophagus, stomach, and intestines. An adult's digestive tract is about 30 feet (about 9 meters) long.

On the basis of structural peculiarities, the alimentary canal comprises:

1. Mouth
2. Pharynx

3. Oesophagus
4. Stomach
5. Small intestine
6. Large intestine
7. Rectum and Anus

9.2.1 Mouth (buccal cavity)

- The alimentary canal begins at mouth. The mouth or oral cavity extends from lips to oropharynx.
- The roof of the mouth cavity is formed by a hard anterior bone palate; it is soft on the posterior. From the posterior margin of soft palate, a small muscular flap hangs down called as uvula.
- The soft palate is attached to the tongue by the gloss palatine arches and to the wall of oropharynx by the pharyngopalatine arches.
- It is the upper expanded portion which forms the beginning of alimentary canal. It can be divided into two parts –
 1. **Vestibule** - It is a space between the lips and cheeks externally and inside by the gums and teeth.
 2. **Oral Cavity** - An inner part. it is bounded by teeth and mastoid bone at the sides, palate above and tongue below.

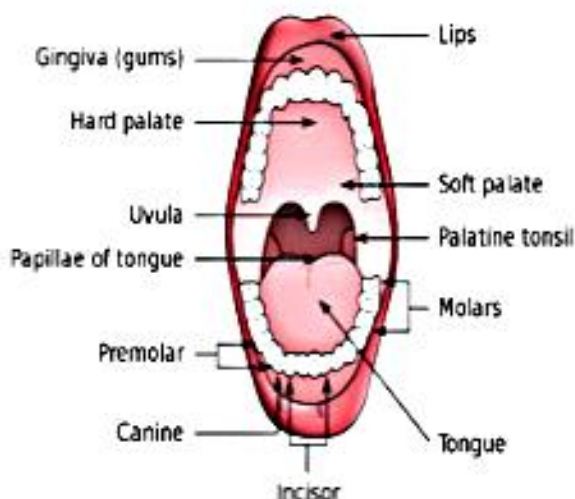
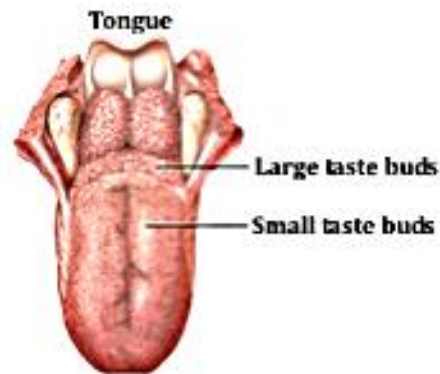


Fig.9.2: Mouth (Oral Cavity)

(a) Tongue

- It lies in the floor of the mouth and it is attached to hyoid bone and by a fold of its mucous membrane covering, called the frenulum,
- The upper surface of the tongue consists of various projection known as papillae.



- All these papillae contain sensory receptors in them known as the test buds.
- Test buds for sweet, salty, sour, bitter taste in different area of tongue.

➤ **Function of tongue**

- Mastication (chewing)
- Deglutition (swallowing)
- Speech
- Taste

(b) Teeth

- These are hard structures present in mouth on both the jaws (upper and lower jaw).
- Depending on the age at which they arise, teeth can be classified into two type-
 - ✓ **Temporary teeth (deciduous)** - There are 20 of them, with 10 teeth in each jaw in Children.
Incisors -2, Canines -1, Molars - 2
 - ✓ **Permanent teeth** - There are 32 of them, with 16 teeth in each jaw in adults.
Incisors -2, Canines -1, Premolar - 2, Molars - 3

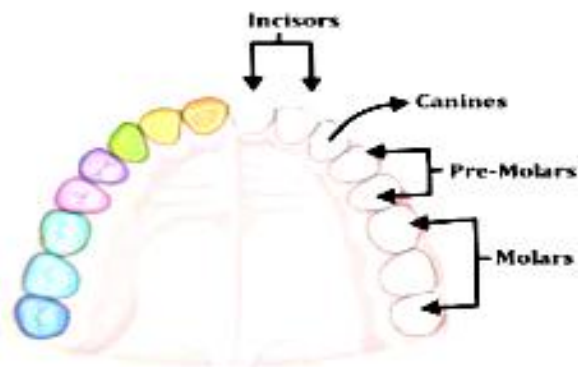


Fig. 9.3: Deciduous and Permanent Teeth



Fig. 9.4: A Section of Tooth

➤ Functions of teeth

- Breaking down the food.
- Acquiring the chewing food.
- Protecting the oral cavity.
- Functioning in communication.
- Aiding the digestive system in breaking down food.

(c) Salivary glands

- The salivary glands are exocrine glands that release saliva into ducts, which lead into the mouth. Pairs of Salivary glands.

1. Parotid glands

- They are the largest salivary glands and located just in front of the ears.
- Stinson's duct is a duct in each gland which opens on the inner side of cheek opposite to the second upper molar tooth.

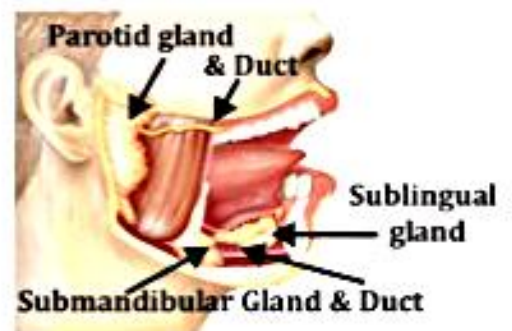


Fig. 9.5: Salivary Glands

2. Submandibular glands

- They are smaller than parotid glands
- Each gland lies under the angle of jaw
- They have duct called Wharton's duct and it opens near the midline under the tongue.

3. Sublingual glands

- They are the smallest salivary glands and lies under the tongue.

- They have several small openings through which they pour the secretions directly.

➤ **Function of salivary gland**

- It converts cooked starch into a soluble sugar called maltose.
- The salivary glands produce saliva, which keeps the mouth and other parts of the digestive system moist.
- It acts as a solvent for food and helps in its swallowing.
- It also helps break down carbohydrates (with salivary amylase, formerly known as ptyalin) and lubricates the passage of food down from the oropharynx to the oesophagus to the stomach.

9.2.2 Pharynx

- The pharynx is a muscular, funnel-shaped internal organ that connects the oral cavity and the nasal cavity to the oesophagus, trachea and larynx region.
- About 13 cm long in humans, it lies in the front of the spinal column.
- The pharynx is divided for descriptive purpose into three parts

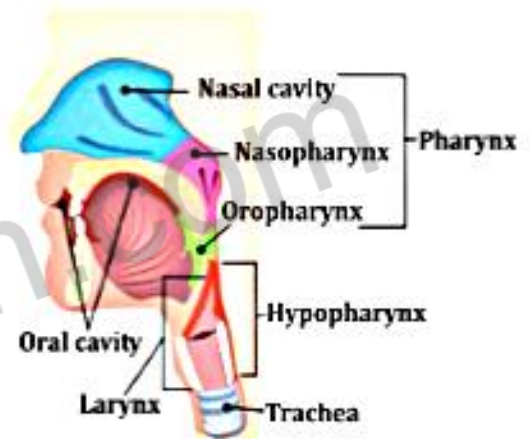


Fig. 9.6: Pharynx

- Nasopharynx-** The part of pharynx behind nasal cavity and into which the nasal cavity opens is known as nasopharynx. It extends from base of skull to the level of soft palate.
- Oropharynx-** It stretches from the soft palate above to the upper aperture of the larynx below, behind the mouth.
- Laryngopharynx-** It is the lowest part and lies behind the larynx. The laryngopharynx extends from oropharynx above to the larynx and oesophagus below

➤ **Function of Pharynx**

- Deglutition, Respiration and Vocal resonance.
- Secretion of mucus by mucous membrane to lubricate the pharynx.

- Provides drainage to nose, oral cavity and middle ear.
- Acts as a pathway for air and food.
- Pharynx helps to provide immunity and formation of antibodies.
- Acts as a warning to the body against infectious agents in air and food.

9.2.3 Oesophagus

- It is situated behind trachea and passes through mediastinum of the thorax.
- It is a muscular tube which extends between pharynx above and cardiac orifice of stomach below.
- It lies between trachea in front and vertebral column at the back. From the thorax, it enters the abdomen through the oesophageal opening of diaphragm.
- Oesophagus contains sphincters at its upper and lower ends.
- These sphincters relax during swallowing.

There are three distinct sections that make up the Oesophagus:

1. **Cervical part** (4 cm)
2. **Thoracic part** (20 cm)
3. **Abdominal part** (1-2 cm)

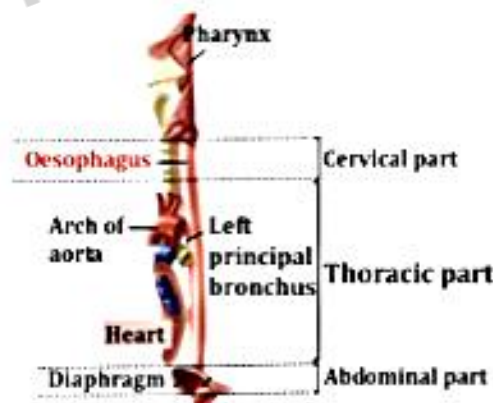


Fig. 9.7: Oesophagus

➤ **Functions of Oesophagus**

- Transporting food.
- Help swallowing.
- Protection against reflux.
- Coordination with other digestive organs.
- Afferent impulses in the glossopharyngeal vagal reflex.

9.2.4 Stomach

- Stomach is the dilated portion of alimentary canal and it receives food from oesophagus. It lies in the upper part of abdominal cavity below the left half of diaphragm.
- The stomach is a J-shaped organ that are Located on the left side of the body just below the diaphragm.
- The stomach varies from 15 to 25 cm in length, and the pH is acidic (1.5 to 3.5).
- It is covered by mucous layer.
- Stomach is the dilated portion of alimentary canal.
- It receives food from oesophagus.

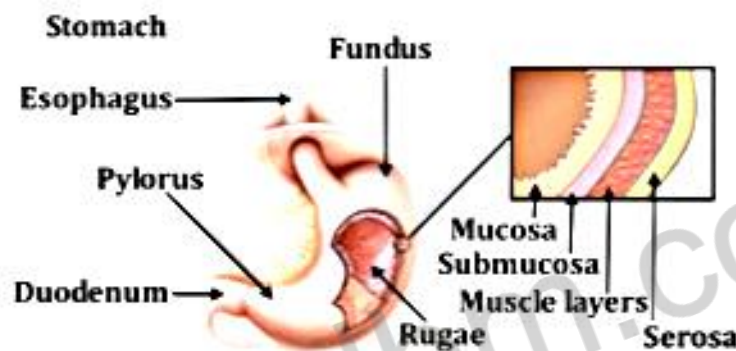


Fig. 9.8: Stomach

- **The stomach has four main anatomical divisions:**
 - a. Cardia-** Surrounds the superior opening of the stomach at the T11 level.
 - b. Fundus-** The rounded, often gas filled portion superior to and left of the cardia.
 - c. Body-** The large central portion inferior to the fundus.
 - d. Pylorus** – This area connects the stomach to the duodenum. It is divided into the pyloric antrum, pyloric canal and pyloric sphincter. The pyloric sphincter demarcates the transpyloric plane.
- **Structure – It consists of the following four coats:**
 - (a) Peritoneal coat-** Made of serous covering.
 - (b) Muscular coat-** Made of longitudinal, circular and oblique fibers.

(c) **Submucous coat**- Made of areolar tissue.

(d) **Mucous coat**- Made of mucous membrane.

➤ Secretions of stomach

The mucous membranes of stomach contain glands which secrete gastric juice continuously.

The secretion of gastric juice occurs due to

- A reflex mechanism through vagus nerve.
- Gastrin, a hormone secreted by the action of food stuffs on gastric mucous membrane.
- Psychological effects produced by taste or smell of food.

➤ Gastric juice contains

Table 9.1: Secretory Products of Gastric Juice

CELL	SECRETORY PRODUCTS
Chief cells	Pepsinogen, Rennin, Lipase, Gelatinase, Urease
Parietal cell	Hydrochloric acid, Intrinsic factor of castle
Mucus neck cells	Mucin
G cells	Gastrin
Enterochromaffin cells (EC)	Serotonin
Enterochromaffin like cells (ECL)	Histamine

(a) Pepsin

- It is an enzyme produced by glands present in the fundus and body of stomach.
- In presence of hydrochloric acid, pepsin converts protein into peptone.

(b) Rennin

- It is the enzyme which curdles milk.
- It involves the conversion of caseinogen, the soluble protein of milk into insoluble casein.

(c) Hydrochloric acid

- It is released by the parietal cells of the stomach glands, and gastric juice contains around 0.4% of its concentration.

✓ Functions of hydrochloric acid are

- Neutralization of saliva and acidification of food.
- Helping the action of pepsin in converting into peptone
- Antiseptic action by killing bacteria.

(d) Intrinsic factor

- It is a content of gastric juice which is necessary for the absorption of Vitamin B12.
- This vitamin is necessary for the development of red blood cells.

(e) Chyme

- It is the product of digested food in the stomach.
- It is in a semi-liquid form and it is passed on to duodenum.

➤ Functions of the stomach

- Temporary storage gives pepsins, the digesting enzymes, time to work.
- Pepsins chemically break down proteins into polypeptides.
- Nonspecific defence against microbes.
- Creation and release of intrinsic factors required for vitamin B₁₂ absorption.

9.2.5 Small intestine

- It is the most convoluted portion of the digestive tract. It is about 05 metres in length and lies in the abdominal cavity, surrounded by the large intestine.
- It has three regions which are continuous with each other.
- The small intestine comprises three main sections continuous with each other-
 - a. **Duodenum** (25 cm, Shortest and wider part)
 - b. **Jejunum** (2.5 metres, Long, Thicker and vascular)

c. Ileum (3 metres, Thinner than jejunum and less vascular)

➤ **Digestion in small intestine**

- The acidic chyme from the stomach enters into the duodenum. Then, it mixes with

- a. Alkaline intestinal juice called succus entericus.
- b. Alkaline secretions from liver and pancreas.



➤ **Enzymes responsible for the digestion**

- a. **Enterokinase** - it converts trypsinogen of pancreatic juice into trypsin..
- b. **Erepsin** - it converts polypeptides into amino acids.
- c. **Sucrase, maltase and lactase**- it converts the corresponding disaccharides into monosaccharides

Fig.9.9: Small Intestine

➤ **Absorption in small intestine**

- a. **Mucosal folds** - Inner surface of small intestine thrown into circular fold.
- b. **Villi** - The inner mucosa layer of small intestine covered with columnar epithelial cells. A central lymphatic vessel called "Lacteal".
- c. **Microvilli** - Numerous microscopic projections of microvilli are produced by the cell lining the villi. And gives brush-border appearance and enormously increase the surface area of the intestine.

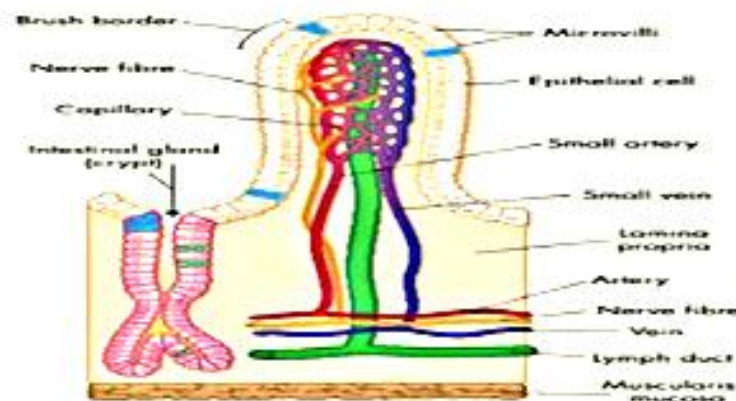


Fig.9.10: Microvilli and Villi

➤ Function of small intestine

- Secretion of intestinal juice.
- Absorption of nutrients.
- Secretion of the hormones cholecystokinin (CCK) and secretin.
- Onward movement of its contents which is produced by peristalsis.
- Completion of chemical digestion of carbohydrates, protein and fats in the enterocytes of the villi.
- Protection against infection by microbes.

1. Large intestine

- Large intestine (colon) extends from the end of ileum to rectum.
- The large intestine is about five feet (or 1.5 meters) long.
- The large intestine is much broader than the small intestine and takes a much straighter path through belly, or abdomen.

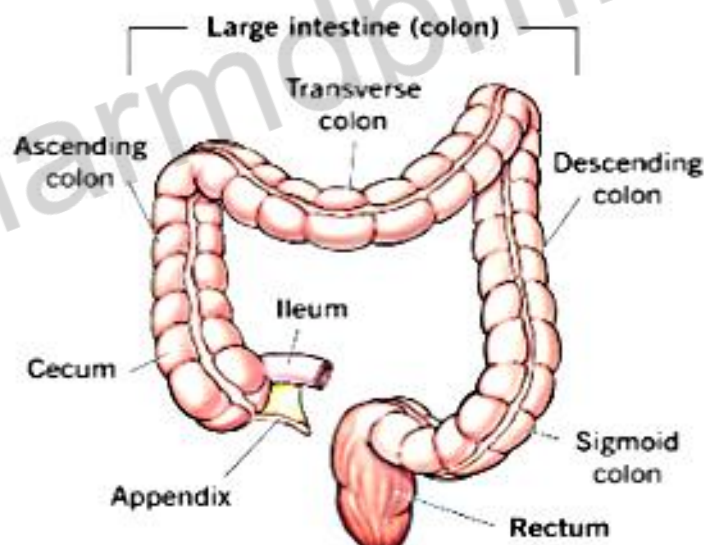


Fig. 9.11: Large Intestine

✓ The large intestine is made up of the following parts:

- A. Cecum**- This first section of large intestine looks like a pouch, about 2 inches long. It takes in digested liquid from the ileum and passes it on to the colon.
- B. Appendix** - It springs out from the caecum at about an inch from the ileocecal junction. It is present in the right iliac fossa. The lumen of

appendix communicates with that of caecum. The appendix is composed of the same four coats as intestine but the submucous coat contains lymphoid tissue.

C. Colon- This is the major section of the large intestine. The cecum opens into colon, which is further divided into four main parts-

- i. Ascending colon-** It ascends upwards from caecum and in front of right kidney. It turns to the left below the liver and forms the transverse colon.
- ii. Transverse colon-** It is the loop of large intestine which extends between the lower surfaces of liver and spleen. At the lower surface of spleen, it turns downwards to form descending colon.
- iii. Descending colon-** It extends from the lower surface of spleen to brim of pelvis. It lies in the left lumbar region.
- iv. Sigmoid colon-** it is the continuation of descending colon and it continues below with rectum

➤ **Functions of Large Intestine**

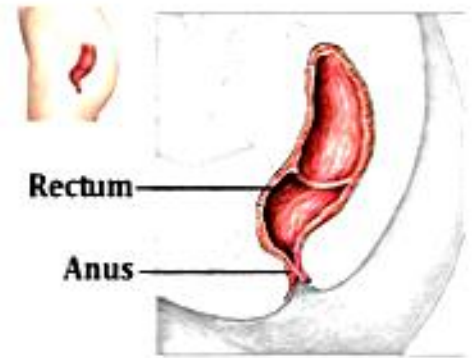
- **Absorption-** All carbohydrates, proteins and fat are already adsorbed in small intestine. Only water and glucose are absorbed in the colon.
- **Digestion-** This is carried out by microorganism of colon. They act on the undigested and unabsorbed residue from small intestine.
- **Secretion-** Mucin is the only secretion. It lubricates the colon and facilitates the passage of faecal matter.
- **Excretion-** Iron and some purgatives are excreted in large intestine.
- Reabsorption of water and other substances such as bile salts, vitamins, toxins of bacteria.

1. Rectum and Anus

➤ **Rectum**

- It occupies the lower posterior part of pelvis and extends between sigmoid colon and anus.
- The lower part of rectum is dilated and it is called rectal ampulla.

It occupies the lower posterior part of pelvis and extends between sigmoid colon and anus.



- The lower part of rectum is dilated and it is called rectal ampulla.

➤ **Anus**

- The anus is the last part of the digestive tract
- It is a small canal measuring about one inch in length.
- The opening of anus is guarded by a sphincter called anal sphincter. This sphincter is under voluntary control.
- It's at the end of the rectum. It's where stool comes out of the body.

9.3 ANATOMY AND FUNCTIONS OF ACCESSORY GLANDS

- There are four accessory organs that aid the process of digestion which are located outside the alimentary canal.
 1. **Pancreas**
 2. **Liver**
 3. **Bile ducts**
 4. **Gall bladder**

9.3.1 Pancreas

- The pancreas is located behind the stomach in the upper left abdomen. It is surrounded by other organs including the small intestine, liver, and spleen.
- It is a yellowish gray coloured gland situated in the epigastric and left hypochondriac regions of abdominal cavity at the level of first and second lumbar vertebrae.
- It is about 12-15 cm long with a broad head situated in the curve of duodenum, the middle part of the body situated behind the stomach and a tapering tail reaching to the spleen on the left side.
- It has both "Exocrine" and "Endocrine" function.
- Pancreas consists of a head, body and tail.

- Head lies in the “C” shaped curve of duodenum.
- Body lies in the front of the bodies of lumbar vertebrae.
- Tail lies in contact with the hilum of spleen.

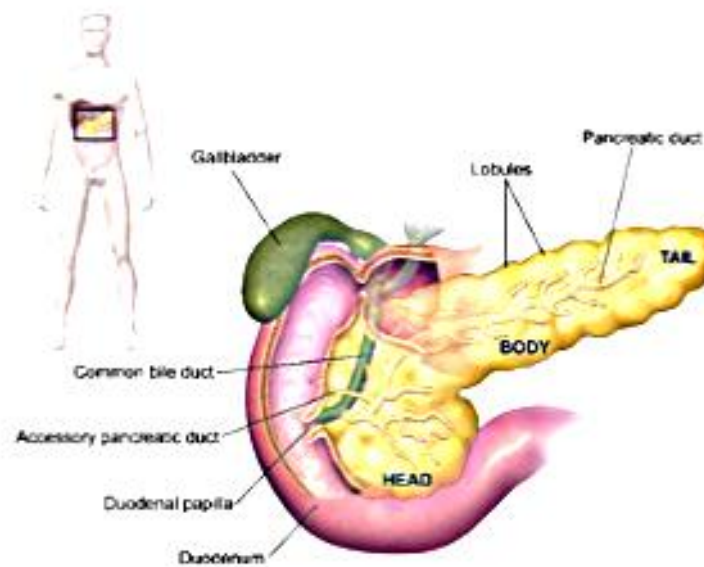


Fig. 9.12: Pancreas

➤ Structure of pancreas

- Substance of pancreas contains a number of lobules of secretory cells called “Acini”.
- In between the acini there are groups of endocrine cells called Islets of Langerhans.
- Small ducts emerge from these lobules.
- These ducts unite and reunite to form the “Pancreatic duct”.
- This duct begins at the tail and emerges from the head of pancreas.
- It enters the duodenum along with common bile duct.

➤ Secretion of pancreas

The secretions of pancreas can be classified into-

- Exocrine secretion
- Endocrine secretion

a. Exocrine secretion

- It is pancreatic juice which is digestive in function.
- It is an alkaline fluid with a pH of around 8.

- Daily about 1200-1500 ml. of pancreatic juice is secreted.
- It is conveyed to duodenum through the pancreatic duct.
- Pancreatic juice contains 97-98% water along with the following digestive enzymes.

1. **Lipase**- It converts fats into fatty acids and glycerol.
2. **Amylase**- It converts starch into maltose.
3. **Trypsin**- It converts peptones into amino acids. Other enzymes are trypsinogen, chymotrypsin, nuclease and carboxypeptidase.

b. Endocrine secretion

- It is secreted by Islets of Langerhans and directly poured into circulation.
- This secretion contains two different hormones which are secreted by the two different cells of islets of Langerhans.
 1. **Glucagon**- Secreted by alpha cells.
 2. **Insulin**- Secreted by beta cells.

➤ **Function of the pancreatic juice**

- It acts on proteins, fats and carbohydrates.
- Trypsinogen is converted into trypsin. Trypsin acts on proteins and convert them into proteoses and peptides. Peptones are converted into amino acids.
- Chymotrypsinogen is converted into chymotrypsin. It acts on casein.
- Amylase acts on starch and converts it into maltose.
- Lipase acts on fats in the presence of bile salts. Bile salts convert fat into fatty acids and glycerol.
- Large amount of sodium bicarbonate is present in the pancreatic juice. This sodium bicarbonate reacts with gastric hydrochloric acid.

9.3.2 Liver

- Liver is the largest abdominal organ.
- It lies in the upper part of abdominal cavity below the diaphragm and under the cover of lower ribs.

- The human liver normally weighs approximately 1.5 kilograms (3.3 pounds) and dark reddish-brown, wedge-shaped organ with two lobes of unequal size and shape.

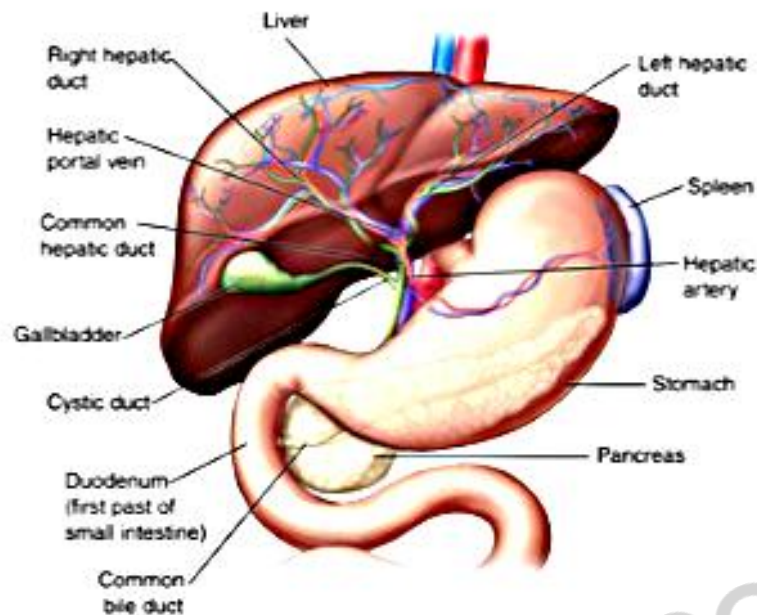


Fig. 9.13: Human Liver

➤ Anatomy

1. External features

- Liver is covered by “Glisson’s capsule”. Externally, the liver contains two lobes and four surface.
 - a) Lobes - They are (1) Right lobe (2) Left lobe
 - b) Surfaces- They are
 1. **Superior surface** which is in contact with the under surface of diaphragm.
 2. **Inferior surface** which is facing the abdominal viscera. The hilum or portal fissure is present in the inferior surface. The blood vessels of liver and bile duct pass through the hilum.
 3. **Anterior surface** which is separated from ribs and costal cartilages by the diaphragm.
 4. **Posterior surface** which lies in front of vertebral column, aorta, inferior vena cava and lower end of oesophagus.

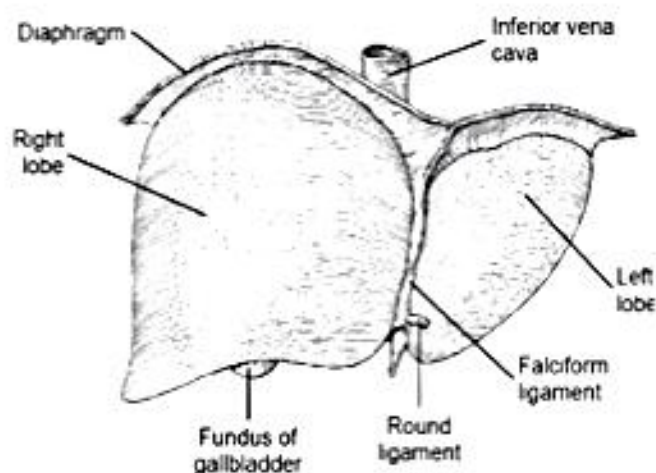


Fig.9.14: Anterior View of Liver

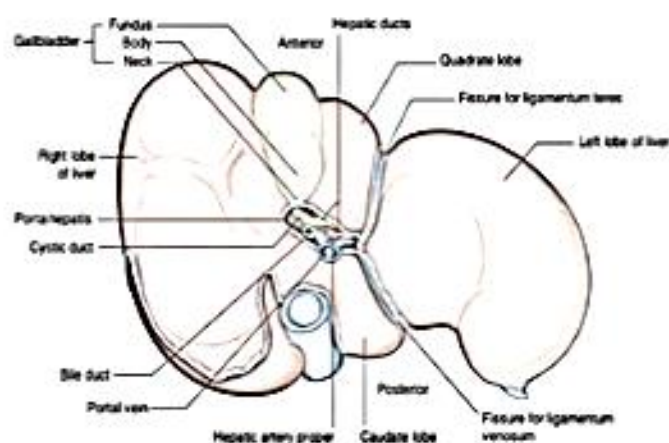


Fig. 9.15: Posterior View of Liver

2. Microscopic structure

- The liver consists of a large number of liver cells called Lobules.
- Each lobule has a Central vein or Intralobular vein.
- The connective tissue lying in between the lobules contains the branches of:

- A. Portal vein
- B. Hepatic artery
- C. Bile duct

➤ **Blood supply** - Blood is brought to liver by-

1. Hepatic artery:

- It supplies oxygenated blood to liver.
- It is a branch of coeliac plexus which arises from abdominal aorta.

2. Portal vein:

- Portal vein also brings blood to liver. It carries blood from stomach, spleen and intestine to the liver.
- It divides into interlobular veins which lie in between the lobules of liver.
- They subdivide and ultimately form central veins.

3. Hepatic veins:

- They carry the impure blood of liver and drain into inferior vena cava.

- The central veins of each lobule join to form sub lobular veins.
- The sub lobular veins unit to form several hepatic veins.
- The hepatic veins join with inferior vena cava.

➤ **Function of liver**

1. Secretion of bile

- Bile salts are helpful in digestion and absorption of fats. They reduce surface tension of fats and help in their emulsification.

2. Glycogenic functions

- The hepatic cells, by the action of enzymes, convert glucose into glycogen and it is then stored in liver.

3. Formation of urea

- The enzymatic activity of hepatic cells results in the deamination of amino acids, liberating the amino group, which subsequently combines to form urea.

4. Denaturation of fats

- The digested fats in the form of the fatty acids and glycerol are absorbed in the central lacteal duct. The fatty acids and glycerol again unite to form fats.

5. Maintenance of body temperature

- The liver undergoes numerous chemical reactions, producing heat that contributes to the regulation of body temperature.

6. Excretion of toxic substances

- The liver plays a crucial role in neutralizing toxic substances introduced into the body via the alimentary canal, such as alcohol and certain drugs.

9.3.3 Bile duct

- The secretion of liver (bile) is carried through bile ducts which are formed by the union of biliary canaliculi.
- The "Biliary canaliculi" are small biliary channels present in between the lobules of liver.

- The bile ducts from the right and left lobes of liver unite to form common hepatic duct.
- The hepatic duct unites with cystic duct of gall bladder to form the "Common bile duct".
- Later, the common bile duct unites with pancreatic duct in the duodenum at a papilla called "Ampulla of Vater".

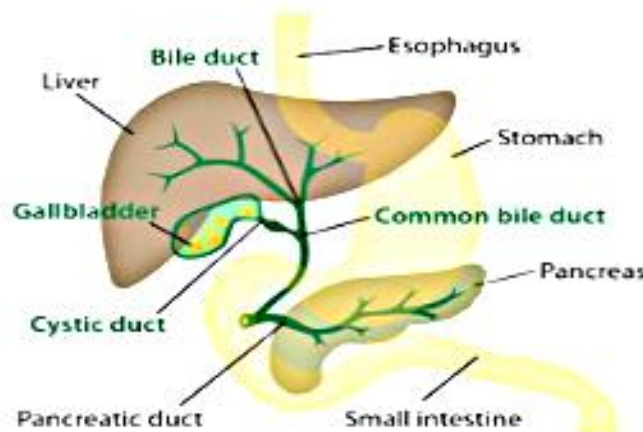
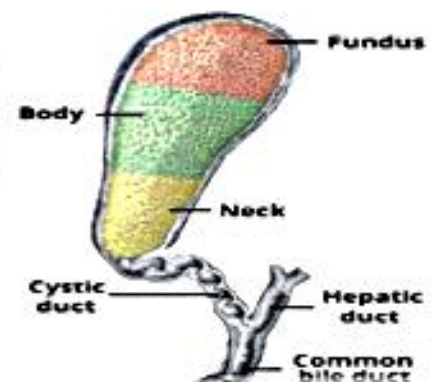


Fig.9.16: Bile Duct

9.3.4 Gall bladder

- Gall bladder is a slate coloured, pear-shaped, storage sac for bile.
- It is situated in the under surface of the right lobe of liver.
- It is divided into three regions:
 - a) Fundus
 - b) Body
 - c) Neck



➤ Layers of the gallbladder - Three layers

1. **Outer serous or peritoneal coat** (which is continuous with the peritoneum covering the liver).
2. **Middle muscular coat** (made of non-striated muscles).
3. **Inner mucous** (which is continuous with the lining of bile ducts).

➤ Duct of gallbladder

- The duct through which gall bladder opens is called Cystic duct. It arises at the neck of gall bladder.

- The cystic duct unites with the common hepatic duct to form the common bile duct.
- The common bile duct joins with pancreatic duct and opens into the duodenum.
- A sphincter present in the bile duct at this termination in the duodenum is called as "Sphincter of Oddi".

➤ **Function of gallbladder**

1. The gall bladder stores the bile that is secreted in liver.
2. It also concentrates the bile stored in it.
3. It secretes mucus into the bile.
4. It reduces alkalinity of the bile.
5. It excretes cholesterol into the bile through the mucous membrane.

✓ **Bile**

- Bile is an alkaline fluid secreted by the liver and stored in gall bladder.
- It is a mixture of water, bile salts, bile pigments, electrolytes, cholesterol, phospholipids and triglycerides.
- Liver produces 500 ml to 1000ml of bile per day. But the capacity of gall bladder is only 30ml, so it is concentrated in gallbladder.

✓ **Bile salts**

- Bile salts are Sodium taurocholate and Sodium glycocholate.
- The bile salts increase the digestive activity of lipase, a pancreatic enzyme.
- They also help in absorption of fats (like glycerol, fatty acids and cholesterol) and fat-soluble vitamins (A, D and K).

✓ **Bile pigments**

- Two important bile pigments are bilirubin and biliverdin.
- They are formed from haemoglobin which is released in the destruction of worn-out red blood cells in the spleen.

9.4 PHYSIOLOGY OF DIGESTION AND ABSORPTION

9.4.1 Digestion of food in alimentary canal

Food contains carbohydrate, proteins and fats. All these constituents of food are digested in the alimentary canal as follows:

- 1. Carbohydrate** - Ptyalin (salivary amylase) present in the saliva converts cooked starches in the food into a sugar called "Maltose". This conversion occurs in the mouth. All sugars are converted to simple monosaccharides like glucose by the action of enzymes (sucrase, maltase and lactase) in the small intestine. Glucose is absorbed through the capillaries of villi in the small intestine. It is then carried to the liver by portal vein where it is stored as glycogen.
- 2. Proteins**- The digestive enzymes (pepsin of stomach, trypsin and Erepsin of small intestine) convert proteins into peptones, polypeptides and finally into amino acids. The amino acids are absorbed through villi of small intestine and carried to the liver.
- 3. Fats** - Lipase, an enzyme of pancreas which is poured into small intestine converts fats into fatty acids and glycerol. These two products are absorbed through the lacteals of villi. They are carried to the thoracic duct through "Cysterna chyli". From the thoracic duct, they enter into blood through the left brachiocephalic vein.

Table 9.2: Digestion of food in alimentary canal

S.N O	DIGESTIVE GLANDS & JUICE	ENZYME	pH	SUBSTANCE ACTED UPON	END PRODUCT
1.	SALIVARY GLANDS	Salivary amylase or ptyalin	Neutral 7.0	Starch	Maltose
2.	GASTRIC GLANDS	1. Pepsin 1. Rennin 1. lipase	Acidic 1.5 to 3.5	• Proteins • Caseinogen of milk • Fat	• Peptones and peptides • Paracasein and casein • Fatty acid & glycerol
3.	LIVER (BILE JUICE)	No digestive enzymes	Alkaline 7 to 8.6	Fat	Emulsified fats: Chylomicrons

4.	PANCREAS (PANCREATIC JUICE)	1. Trypsin 2. Chymotrypsin 3. Carboxypeptidase 4. Pancreatic Amylase 5. Pancreatic Lipase	7.5-8.0	<ul style="list-style-type: none"> • Proteins • Polypeptides • Proteases • Peptones • Starch, glycogen • Fat 	<ul style="list-style-type: none"> • Peptides • Polypeptide, • Dipeptides • Maltose • Fatty acid and glycerol
5.	INTESTINAL GLANDS	1. Peptidase 2. Enteric lipase 3. Sucrose 4. Maltase 5. Lactase 6. Enterokinase	7.6	<ul style="list-style-type: none"> • Polypeptides • Fats • Sucrose • Maltose • Lactose • Trypsinogen 	<ul style="list-style-type: none"> • Amino acids • Fatty acids & glycerol • Glucose & fructose • Glucose • Glucose and galactose • Trypsin

9.4.2 Absorption of food in the alimentary canal

➤ Absorption in the mouth

- Absorption of food does not take place in mouth however some chemicals like nitro-glycerine and some vitamins can be absorbed.

➤ Absorption in the Stomach

- There is little absorption in stomach as the food is not digested completely.
- Water, alcohol and lipid soluble drugs are absorbed in the stomach.

➤ Absorption in the Small intestine

- Absorption of products of carbohydrate digestion like glucose and other simple sugar occurs through capillaries of villi cells.

➤ Absorption in large intestine

- Water, glucose and certain salts are absorbed through the mucous membrane of the large intestine.