Digestive System

INTRODUCTION

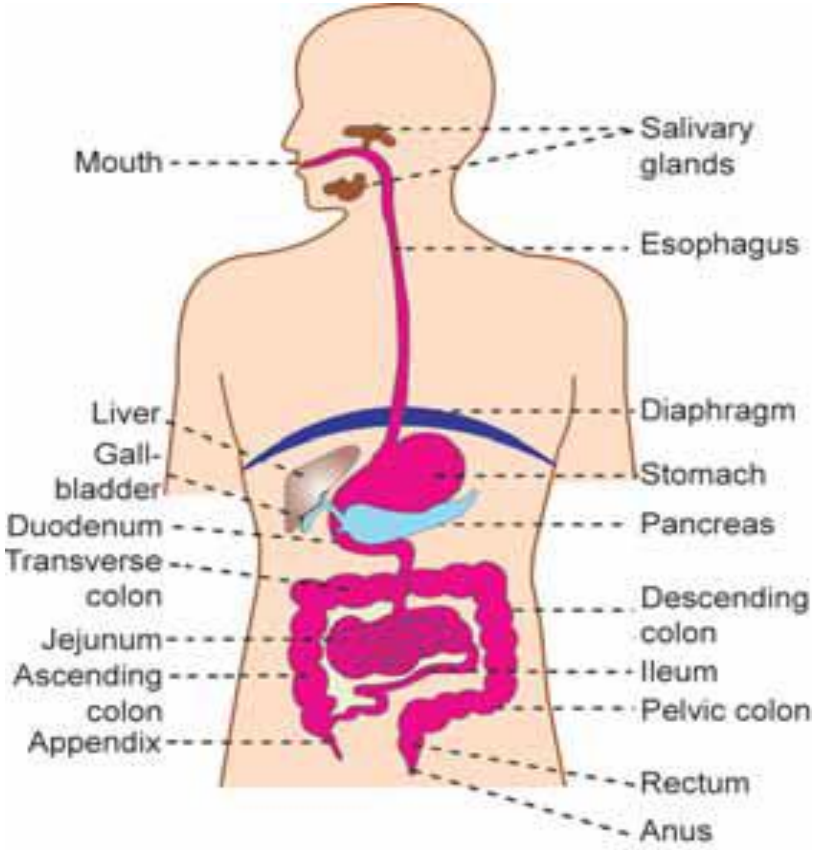
- Digestion is defined as the process by which food is broken down into simple chemical substances

that can be absorbed and used as nutrients by the body. Most of the substances in the diet cannot be utilized as such.

These substances must be broken into smaller particles.

- Then only these substances can be absorbed into blood and distributed to various parts of the body for utilization.

- The digestive system is responsible for these functions.



FUNCTIONAL ANATOMY OF THE DIGESTIVE SYSTEM

Digestive system is made up of

- Gastrointestinal tract (GI tract) or alimentary canal and
- Accessory organs, which help in the process of digestion and absorption
- GI tract : is a tubular structure extending from the mouth up to anus with a length of about 30 feet.
- It opens to the external environment on both ends.

GI tract is formed by two types of organs:

1. Primary digestive organs
2. Accessory digestive organs.

1. *Primary Digestive Organs*

- Primary digestive organs are the organs where actual digestion takes place.
- These organs are:

1. Mouth
2. Pharynx
3. Esophagus
4. Stomach
5. Small intestine
6. Large intestine.

2. Accessory Digestive Organs

Accessory digestive organs are the organs which help the primary digestive organs in the process of digestion. These organs are:

- 1. Teeth
- 2. Tongue
- 3. Salivary glands
- 4. Exocrine part of pancreas
- 5. Liver
- 6. Gallbladder.

WALL OF GASTROINTESTINAL TRACT

- In general, the wall of the GI tract is formed by four layers which are from inside out:
- 1. Mucus layer
- 2. Submucous layer
- 3. Muscular layer
- 4. Serous or fibrous layer.

NERVE SUPPLY TO GASTROINTESTINAL TRACT

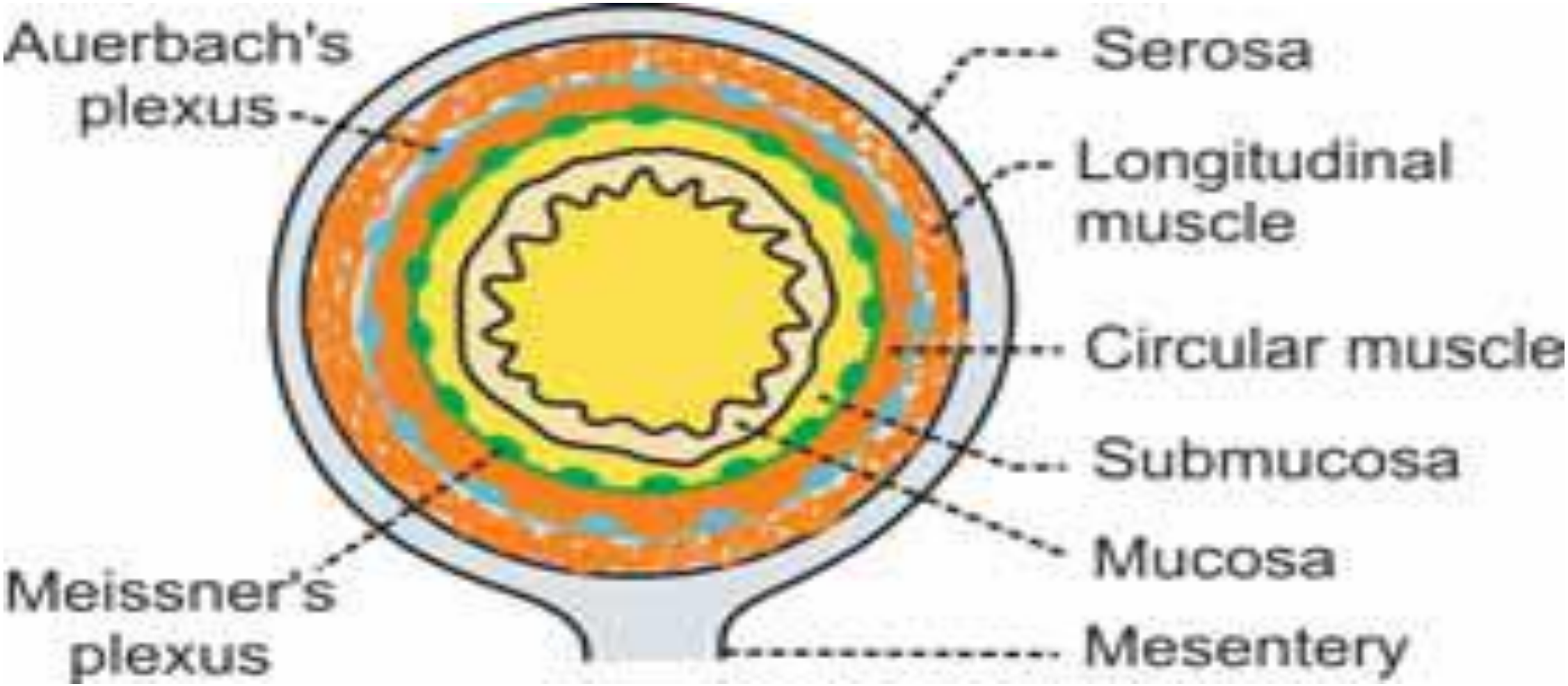
- GI tract has two types of nerve supply:
- I. Intrinsic nerve supply
- II. Extrinsic nerve supply.

INTRINSIC NERVE SUPPLY - ENTERIC NERVOUS SYSTEM

- The enteric nervous system is present within the wall of GI tract from esophagus to anus.
- The nerve fibers of this system are interconnected and form two major networks called

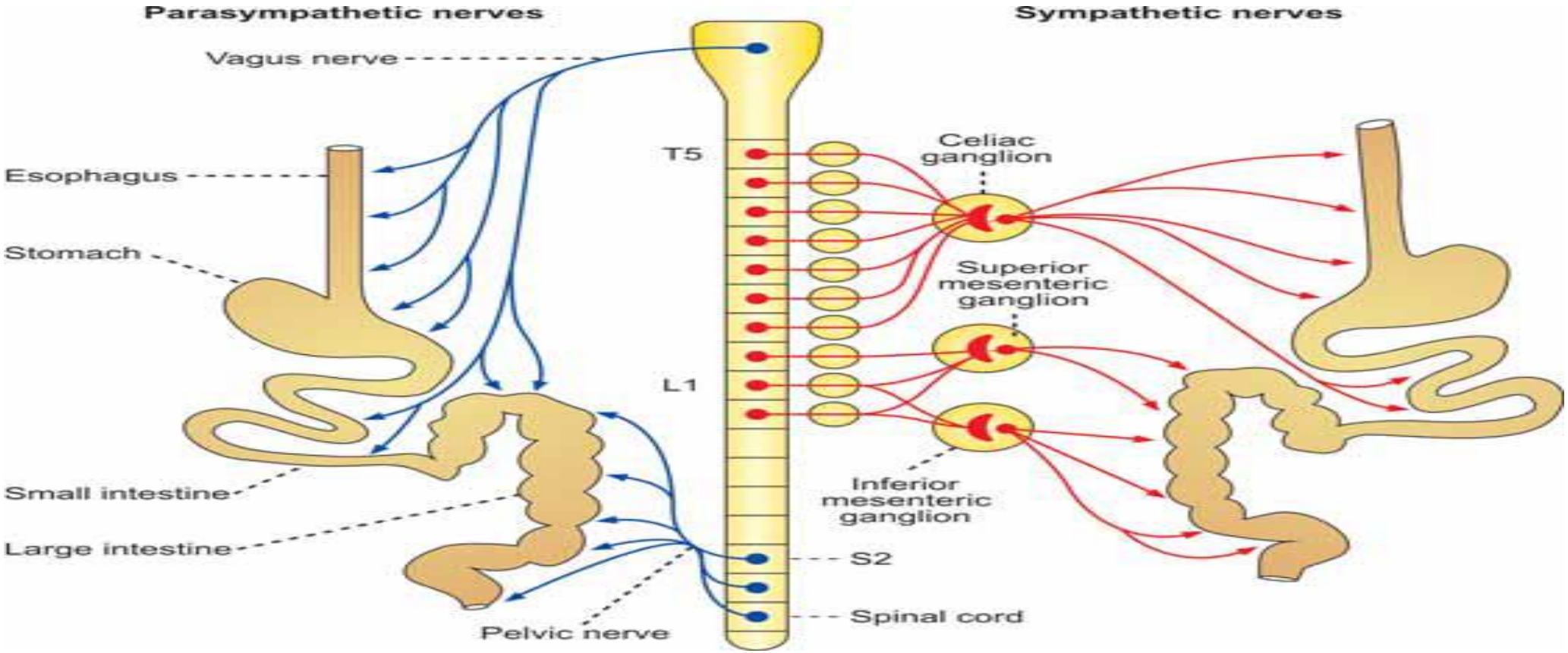
1. Auerbach's plexus myenteric nerve plexus……Movement
2. Meissner's plexus…….Secretion

Structure of intestinal wall with intrinsic nerve plexus



EXTRINSIC NERVE SUPPLY

- The extrinsic nerves that control the enteric nervous system are from autonomic nervous system. Both sympathetic and parasympathetic divisions of autonomic nervous system innervate the GI tract



Mouth and Salivary Glands

- **FUNCTIONS OF MOUTH**

The primary function of mouth is eating. It has few other important functions also. The functions of the mouth are:

1. Ingestion of food materials.
2. Chewing the food and mixing it with saliva.
3. Appreciation of the taste.
4. Transfer of food (bolus) to the esophagus by swallowing.
5. Role in speech.
6. Social functions such as smiling and other expressions

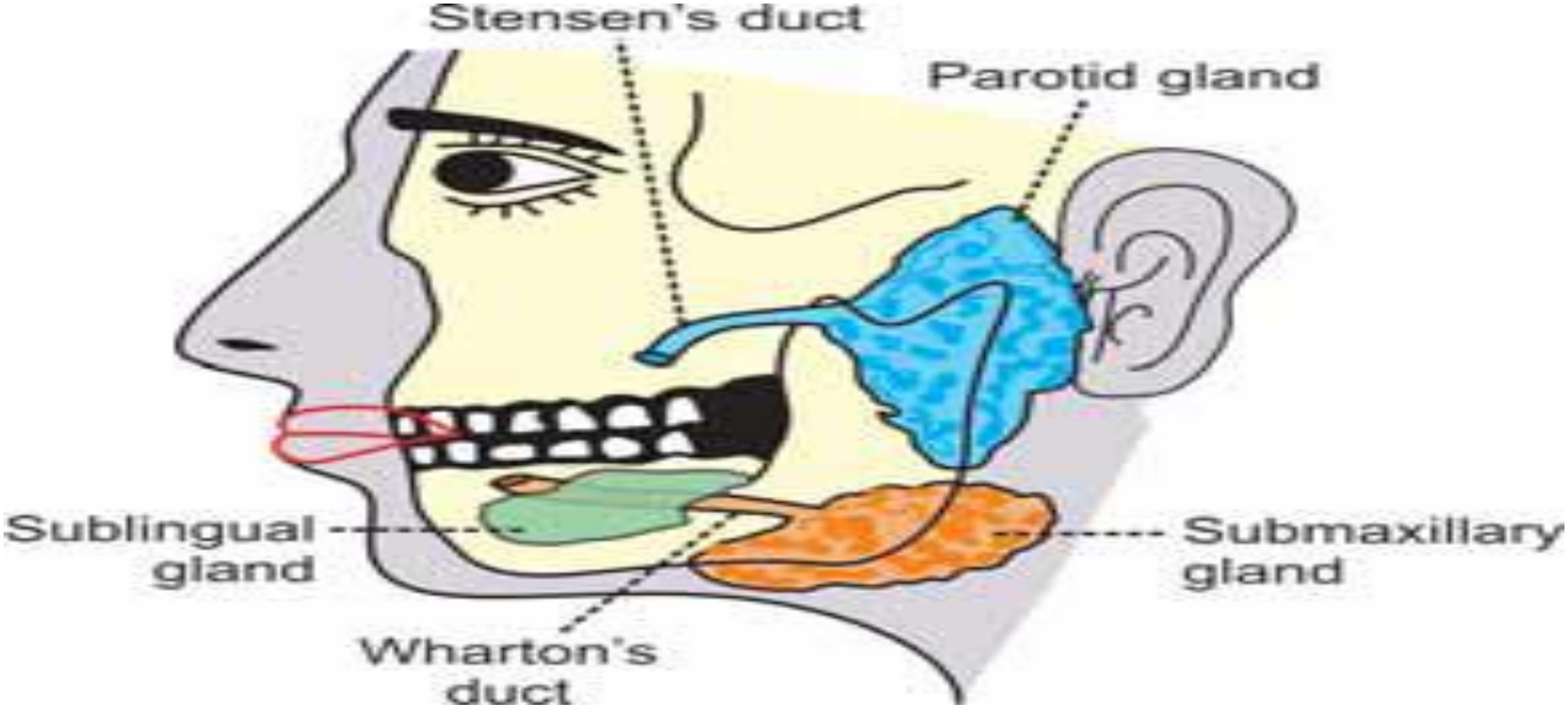
SALIVARY GLANDS

- In humans, the saliva is secreted by three pairs of major (larger) salivary glands and some minor

(small) salivary glands in the oral and pharyngeal mucous membrane. The major glands are:

1. Parotid glands
2. Submaxillary or submandibular glands
3. Sublingual glands

Major salivary glands



Ducts of major salivary glands

Gland	**Duct**
Parotid gland	Stensen’s duct
Submaxillary gland	Wharton’s duct
Sublingual gland	Ducts of Ravinus/Bartholin’s

MINOR SALIVARY GLANDS

- 1. Lingual mucus glands
- 2. Lingual serous glands
- 3. Buccal glands
- 4. Labial glands
- 5. Palatal glands

CLASSIFICATION OF SALIVARY GLANDS

- Salivary glands are classified into three types based on the type of secretion.

1. *Serous Glands*

- This type of gland is predominantly made up of serous cells. These glands secrete thin and watery saliva. Parotid glands and lingual serous glands are serous glands

2. Mucus Glands

- This type of glands is made up of mainly the mucus cells. These glands secrete thick, viscus saliva with high mucin content. Lingual mucus glands, buccal glands and palatal glands belong to this type.

3. *Mixed Glands*

- Mixed glands are made up of both serous and mucus cells. Submandibular, sublingual and

labial glands are the mixed glands.

Properties of Saliva

1. *Volume*: 1000 to 1500 mL of saliva is secreted per day and, it is approximately about 1 mL/ minute.

Contribution by each major salivary gland is:

i. Parotid glands: 25%

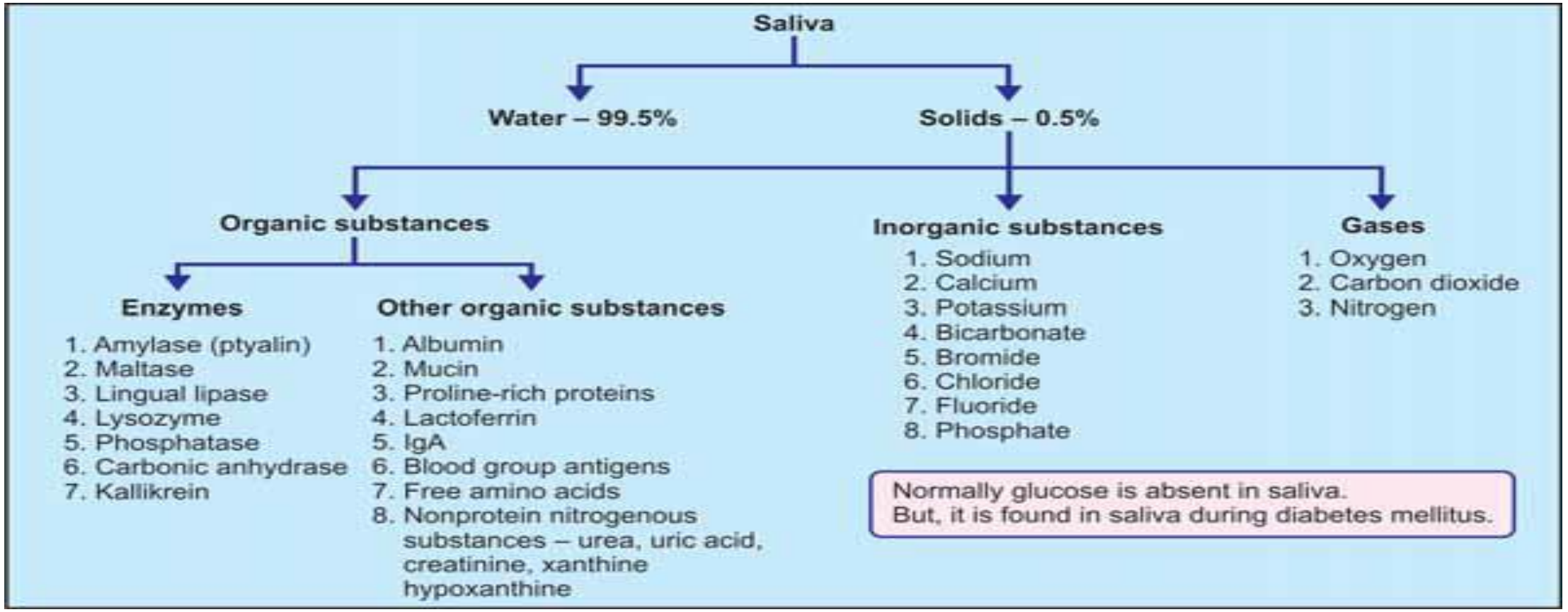
ii. Submaxillary glands: 70%

iii. Sublingual glands: 5%.

2. *Reaction*: Mixed saliva from all the glands is slightly acidic with pH of 6.35 to 6.85.
3. *Specific gravity*: It ranges between 1.002 and 1.012
4. *Tonicity*: Saliva is hypotonic to plasma.

Composition of Saliva

- Mixed saliva contains 99.5% water and 0.5% solids.



FUNCTIONS OF SALIVA

- Saliva is a very essential digestive juice. Since it has many functions, its absence leads to many inconveniences

1. PREPARATION OF FOOD FOR SWALLOWING

2. APPRECIATION OF TASTE

3. DIGESTIVE FUNCTION

Saliva has three digestive enzymes namely, salivary amylase, maltase and lingual lipase

4. CLEANSING AND PROTECTIVE FUNCTIONS

5. ROLE IN SPEECH

6. EXCRETORY FUNCTION

7. REGULATION OF BODY TEMPERATURE

8. REGULATION OF WATER BALANCE

- Salivary glands are controlled by **salivatory nuclei** which are located at the medulla and pons. Salivatory nuclei control saliva production mainly through parasympathetic [7th cranial nerve (Facial N) and 9th crainal nerve (Glossopharyngeal N)] and to less extent by sympathetic nervous signals originates from the superior cervical ganglia and then travels along blood vessels to the salivary glands. *Saliva production is unique in that it is increased by both parasympathetic and sympathetic activity*. Both parasympathetic and sympathetic stimulation increase the rate of saliva secretion. **Parasympathetic stimulation** produces a greater and more sustained increase of a watery saliva rich in enzymes while increased **sympathetic stimulation** produces a smaller volume of thick saliva rich in mucus.

- **Salivatory nuclei are excited or inhibited by:**
- **[A] Signals from the mouth:** Taste (especially the sour taste-excitatory, bitter taste-inhibitory) and tactile stimuli (especially smooth objects-excitatory) from the tongue and other areas of the mouth.
- **[B] Signals from higher centers of CNS:** Salivation can also be stimulated or inhibited by impulses arriving in the salivatory nuclei from higher centers of CNS. For instance, when a person smells or see favorite foods, salivation is greater than when disliked food is smelled or seen.
- **[C] Signals from GIT**: Salivation also occurs in response to reflex originating in the stomach and upper intestine particularly when very irritating foods are swallowed or when a person is nauseated. The swallowed saliva may help to remove the irritating factor in the GIT by diluting or neutralizing the irritant substances.

- Parasympathetic nerve stimulation causes the salivary gland cells to secrete a large volume of watery fluid that is high in electrolytes (K and bicarbonate) but low in proteins. Sympathetic nerve stimulation causes the salivary glands to secrete a small volume of fluid that is low in electrolytes (K and bicarbonate) by containing a high concentration of mucus.
- Saliva production is decreased (via inhibition of the parasympathetic nervous system) by sleep, dehydration, fear, and anticholinergic drugs (such as atropine). Under basal conditions, saliva is almost entirely of the mucus type and is secreted all the time except during sleep when the secretion become very little.

- **Pathophysiological conditions associated with saliva secretion:**
- **Xerostomia** (dry mouth) is associated with chronic ulceration’s of the buccal mucosa and with dental caries. Saliva dissolves and washes out food particles from between teeth.
- **Congenital xerostomia** - absence of saliva.
- **Sjogren's syndrome** - atrophy of the glands and decreased saliva production.In cystic fibrosis, salivary sodium, calcium and protein are elevated. Digitalis drugs cause increased calcium and potassium concentrations in saliva.
- **Addison's disease** - sodium concentrations are increased.
- **Cushing's syndrome** - sodium concentrations are decreased as they are in primary aldosteronism and during pregnancy.
- **Tumors** - Excessive salivation is observed with tumors of the mouth or esophagus and with Parkinson's disease.