

# COMPARATIVE ACCOUNT OF ALIMENTARY CANAL AND DIGESTIVE GLANDS IN VERTEBRATES(SALIVARY GLAND, LIVER AND PANCREAS)

## ALIMENTARY CANAL

The term alimentary canal/ Digestive tract in vertebrates refer to an internal tube, seldom straight and often coiled , running from an anterior mouth opening in head to a posterior anal or cloacae aperture at the base of the tail.

It is designed for ingestion, digestion and absorption of food stuffs and egestion of undigested waste.

Major parts of Alimentary canal are: -

- 1) Oral Cavity
- 2) Pharynx
- 3) Oesophagus
- 4) Stomach
- 5) Small and Large Intestine

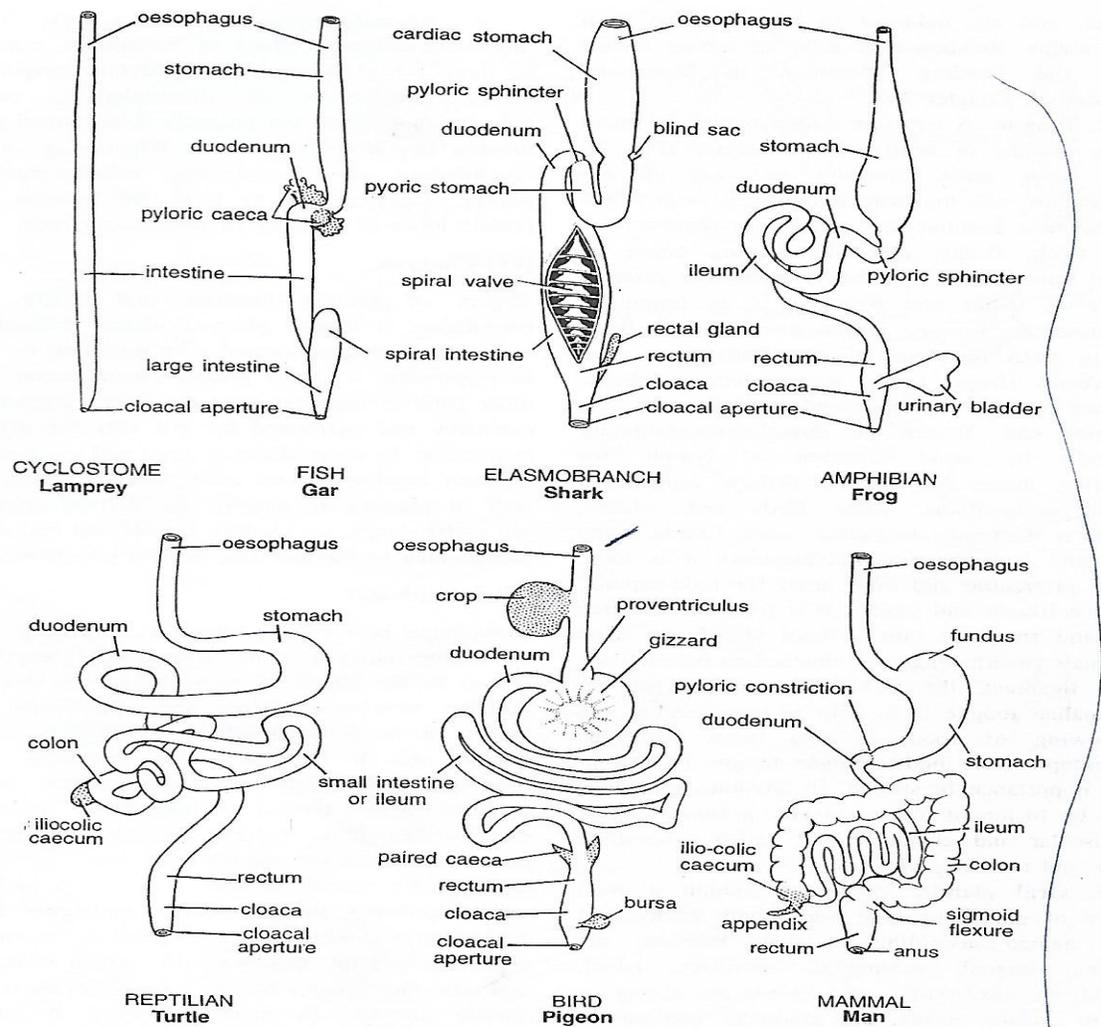


Fig. 4. Digestive tracts of some vertebrates.

Chief accessory organs associated with the alimentary canal are:-

- 1) Tongue
- 2) Teeth
- 3) Oral glands
- 4) Pancreas
- 5) Liver
- 6) Gall Bladder

## I. MOUTH

Mouth is an anterior opening leading into the oral cavity and is subject to a great deal of variation .

In **amphioxus** , true mouth is located at the end of the vestibule perforating the **velum**.

In **cyclostomes** ( lamprey) it is circular opening at the vertex of buccal funnel .

In **gnathostomes** , mouth is terminal .

True fleshy and muscular lips occur only in **mammals**.

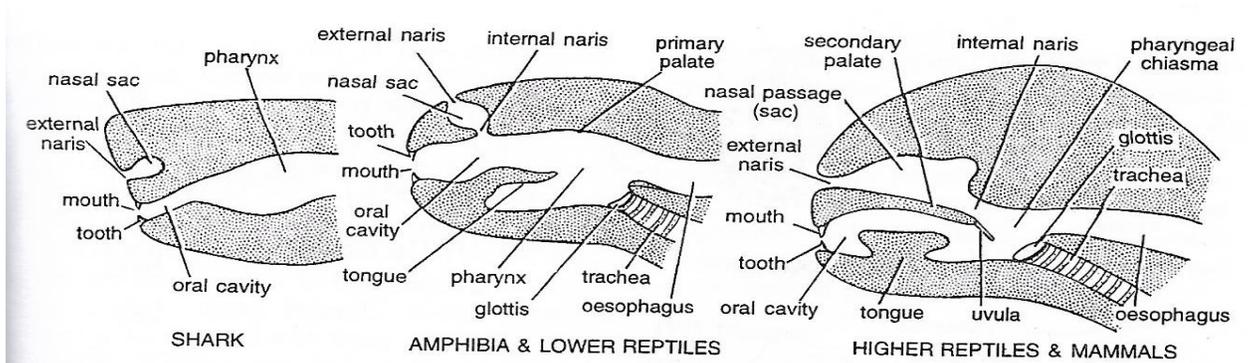
In **fishes** , **amphibians** and most **reptiles** mouth is surrounded by unmodified cornified skin forming immovable lips.

## II. ORAL CAVITY / BUCCAL CAVITY

The **oral cavity** is the space between jaws and pharynx . Oral cavity begins at the mouth and merges with pharynx without a definite line of demarcation . Basically it acts as passage for food but in fishes it also acts as passage for water circulations.

In amphibians buccal cavity is lined by ciliated epithelium which participates in respiration.

In Mammals it is best developed.



## III. DERIVATIVES OF ACCESSORY ORGANS OF ORAL CAVITY.

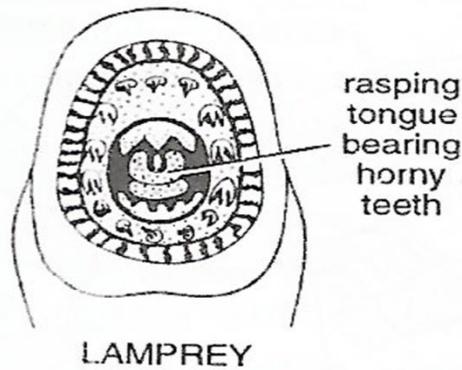
These are mainly:-

- A) Tongue
- B) Teeth
- C) Oral Glands
- D) Anterior and middle lobes of pituitary glands.

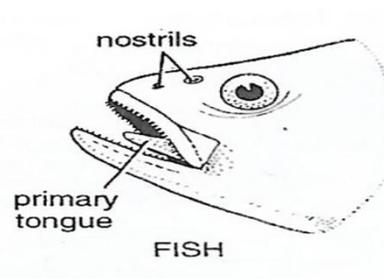
### A) TONGUE

A fleshy structure may be muscular or non muscular present in the buccal cavity of the all vertebrates, is known as tongue.

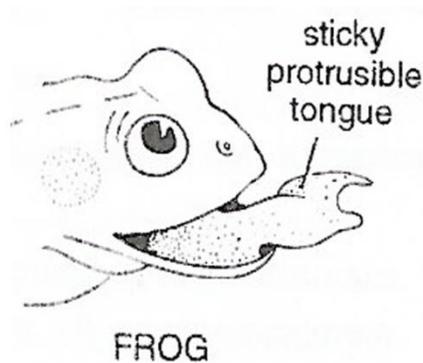
In **cyclostomes** it is thick fleshy extensile structure lying on the floor of buccal cavity acts as rasping organ.



**Fishes:-** The tongue of fishes is called primary tongue is nearly fleshy fold.

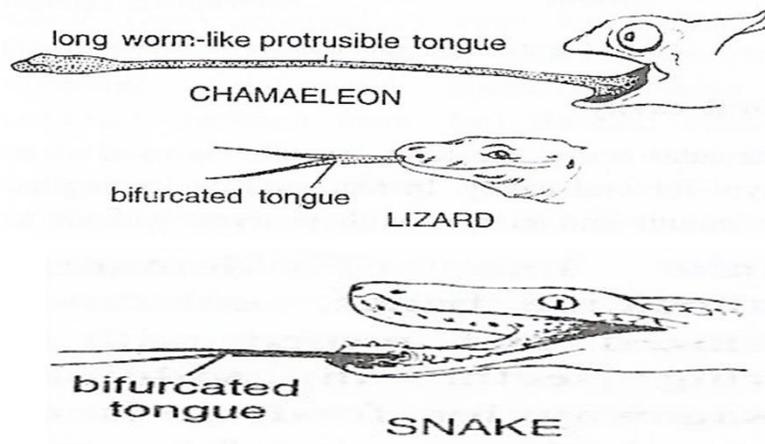


**Amphibians :-** In anurans the tongue is absent. They have a protrusible tongue having basal portion homologous to that a fishes.

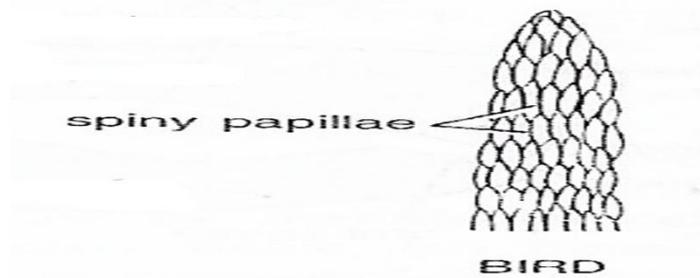


**Reptiles:-** The crocodiles and turtles have non protrusible tongue. Snakes and Lizards have well developed protrusible tongue and of chamaelon is prehensile organ used for capture of prey.

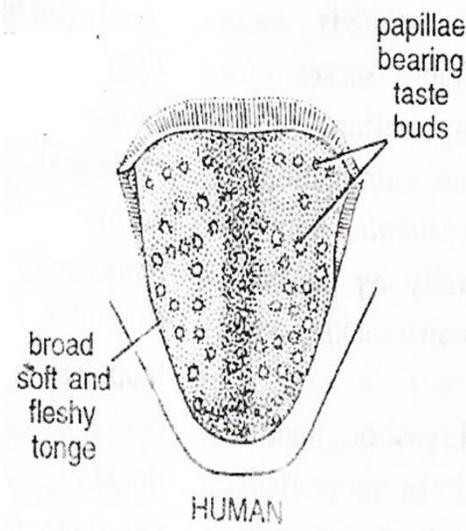
In some **lizards and snakes** the tongue is bifurcated at its anterior end and places the blind pouch of jacobsons organ.



**Birds:-** In birds , the tongue is immobile as it lacks intrinsic muscles and is covered by horny material.



**MAMMALS :-** The tongue of mammals is best developed among vertebrates. It is moveable as it contains well developed intrinsic muscles.



## b) TEETH

Teeth are hard and pointed structures attached to jawbones , that aid in food getting.

Two types of teeth occur in vertebrates.

1. **Epidermal teeth** ( horny projections of stratum corneum ) e.g  
Cyclostomes  
Other examples are conical projections from lips of tadpole of some species of frogs.

2. **True teeth** ( occur in all vertebrates except agnathans, sometoades, modern birds etc.)

Its comparative account are as follows:-

**Cyclostomes** :- True teeth are absent. The epidermal teeth are present on the lining of buccal funnel .

**Fishes** :- Dentation in fishes is of Acrodont, Polyphyodont and Homodont.

**Amphibians** :- The larval anurans have epidermal teeth whereas adult amphibians have true teeth.

The dentation in amphibians is of acrodont, polyphyodont and homodont type.

**Reptiles** :- Homodont and polyphyodont type of dentation.

**Lizards** have acrodont and Crocodiles have thecodont dentations.

The poison fang of snakes are modified maxillary teeth bearing of poison duct.

**Birds** :-Modern birds lacks teeth

**Mammals** :- Thecodont type of dentitions is rule in mammals.

**Whales and Sirenians** have monophyodont condition .

**Echidna** has no teeth at any stage of life.

## **B) ORAL GLANDS**

Vertebrates exhibit a great variety of glands opening into mouth cavity and named according to position.

**Oral glands** are absent in aquatic forms .

**Fish and Amphibians** have only simple mucous glands.

**Poisonous snakes** have large poison glands .

The largest oral glands are enzymes secreting **salivary glands** of mammals secrete enzyme **ptylin**.

## **C) Adenohypophysis**

**Pituitary** , the most important endocrine gland of vertebrates.

## **IV. PHARYNX**

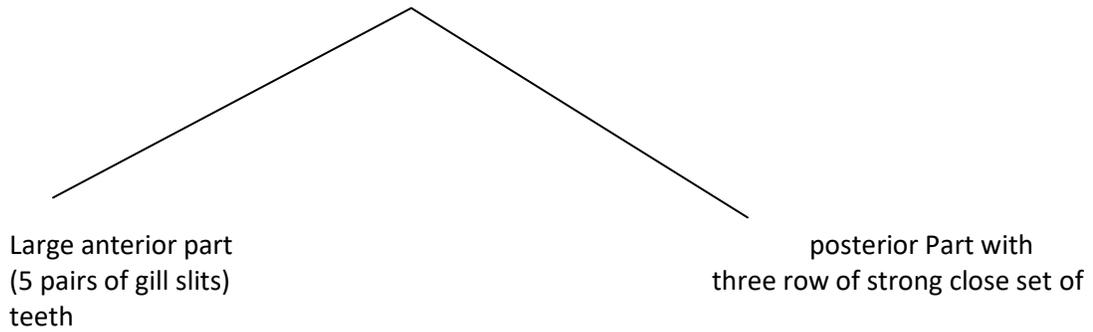
Region of foregut between oral cavity and oesophagus is termed as pharynx lined by endoderm. It is a part of foregut behind the buccal cavity.

Its Comparative account are as follows:-

**Cyclostomes**:- In lampreys , the pharynx lies below oesophagus as separate blind pouch communicating with gills.

**Fishes** :- In fishes, pharynx plays an important role in respiration. In cartilaginous fishes pharyngeal lateral wall has internal gill clefts.

In bony fishes pharynx has two parts



**Tetrapods:-** In tetrapods pharynx has a median aperture glottis, Gullet and a pair of Eustachian tube. In male Froge, a pair of opening of vocal sac is present.

#### V. OESOPHAGUS:-

Oesophagus is simple, distensible tube connecting pharynx with stomach. Its length is related to the length of the neck.

Comparative account of oesophagus are as follows:

**Cyclostomes:-** In lampreys, Oesophagus starts directly from buccal cavity lined by numerous folds.

**Fishes:-** It is very short in fishes, as neck is absent.

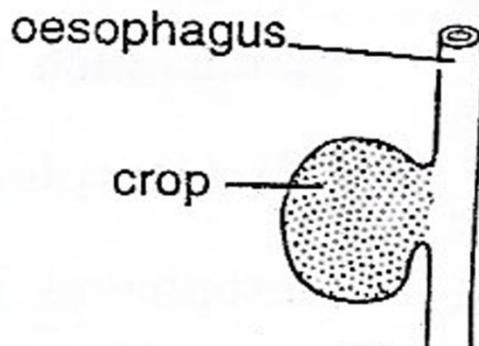
**Amphibians:-** In anurans, esophagus is very short and consists of little more than constricted area of alimentary canal and is ciliated.

**Reptiles:-** The Oesophagus is longer than anamnios.

In snakes the longitudinal folds in the walls permit distension during swallowing of large objects.

**Birds.:-** The oesophagus is very long as neck is very long in birds lined by horny papillae in grain eating birds e.g. Pigeons and birds of prey.

Oesophagus is dilated to form large thin walled sac called crop and in pigeon crop has crop gland and these glands on stimulation secrete Pigeons milk



**Mammals :-**In mammals, the length of oesophagus varies with the neck .

#### VI. Stomach :-

The sack like muscular enlargement of digestive tract between oesophagus and intestine is called stomach. It is the most dilated part of alimentary canal. The primary function of stomach is temporary storage of food.

The shape of the stomach is according to the shape of body. It may be Tubular 'J' shaped, and 'U' shaped or Transverse sac like.

The anterior end of the stomach connected to oesophagus is called **cardiac end** and the part connected to intestine is called **pyloric end**. The main part of stomach is called body.

The comparative account of stomach of vertebrates is as follows:

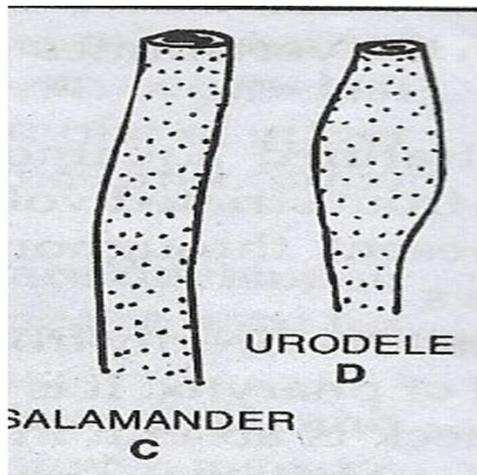
Cyclostomes :- in cyclostomes, Stomach is poorly developed. It is simply enlargement at posterior end of oesophagus.

Fishes:- True stomach first appears in elasmobranch. Here it is "J" shaped.



The pyloric stomach is smaller than cardiac stomach.

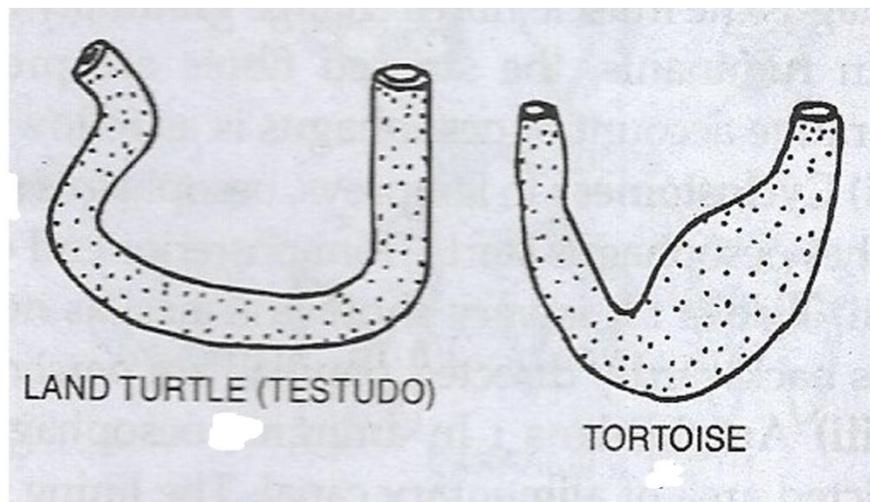
**Amphibians:-** The typical amphibians stomach is called curved, Dilated Part of alimentary canal. It is present on left side of the body.



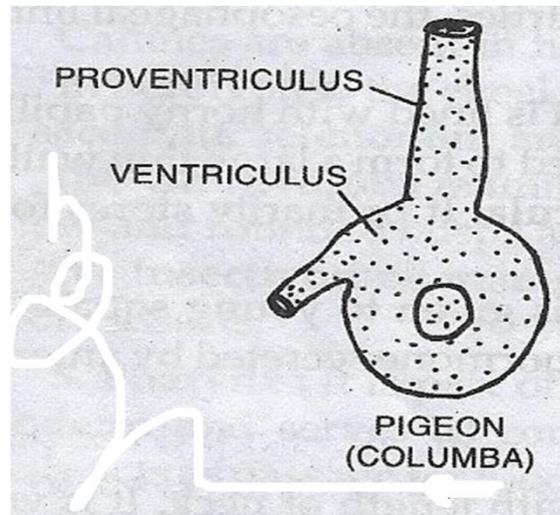
**The anterior** cardiac region is wide and posterior pyloric region is short and narrow. Fundus region is absent.

**In salamanders** the stomach is like a straight tube .

**Reptiles :-** In most of reptiles ( snake and lizard ) long spindle shaped stomach is present. In crocodilians, stomach is similar to that of birds. In tested , stomach is U shaped.

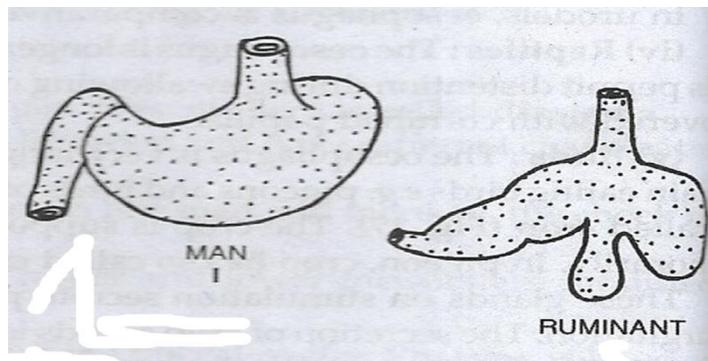


**Birds** :- The stomach of birds is highly specialized to crush the food as teeth are absent in jaws. The stomach is differentiated into two regions:- The anterior proventriculus continuous with oesophagus and posterior highly muscular gizzard or ventriculus.



**Mammals** :- Stomach of mammals show greatest modifications. It may be simple sac or divided into cardiac, fundic and pyloric regions.

**In cud chewing mammals or ruminants stomach has four well defined chambers ( of these the first three chambers rumen, reticulum, omasum are claimed the modifications of oesophagus and serve as reservoirs of food and last chamber abomasum represent true stomach).**



## VII. SMALL

## AND LARGE INTESTINE

The part of digestive tract following stomach is intestine, in which digestion and absorption of food takes place. Hence it is the most important part of digestive tract and undergoes several modifications in vertebrates. It is a long tube-like part between stomach and anus or cloaca.

The length of intestine depends on the feeding habits. It is shorter in carnivores and longer in herbivores.

The intestine usually consists of two parts :

The narrow long and anterior **small intestine** .

The wider shorter and posterior **large intestine**.

The part of small intestine which receives from stomach is called **duodenum**.

Comparative account of small and large intestine is as follows :

**Cyclostomes**: The cyclostomes have straight intestine. There is no demarcation between small and large intestine. The intestine opens into anterior end of cloacal depression .

**Fishes** :- In cartilaginous fishes the small intestine is smaller than stomach and contains a scroll valve .The large intestine is a short passage between small intestine and anus .There is present rectal gland at the junction of small and large intestine.

**Amphibians**:- The intestine of amphibian is comparatively longer and coiled than that of fishes. In anurans the intestine is not differentiated into small and large intestine.

**Reptiles** :- The small intestine is long coiled and of uniform diameter .The large intestine is wide straight and opens into cloaca.

**Birds** :- The birds have comparatively longer small intestine than lower vertebrates due to herbivorous habit in most of the birds .

The large intestine is short and straight and opens out as cloaca.

Ileocolic caeca is present at the junction of small and large intestine .

**Mammals** :- In mammals the intestine is better developed than other vertebrate .The small intestine is differentiated into three regions : Duodenum ,Jejunum, and Ileum.

Large intestine is shorter and wider than small intestine and is differentiated into two regions : colon and rectum .At the junction of Ileum and colon ileocolic valve is present.

Rectum opens out as anus except in monotreme where cloaca is present.In the wall of small intestine there are present large number of villi and glands .

## VIII. DIGESTIVE GLANDS

The digestive glands associated with the alimentary canal secrete several juices which aid in digestion .If the glands are not there alimentary canal will simply act as conducting pipe.Some of the glands are present in alimentary canal are salivary gland whereas some glands like liver and pancreas are appended to alimentary canal..

### **Glands of oral cavity :**

Glands of oral cavity basically secrete secretions which help in ingestion of food .In land vertebrates these glands secrete mucus which moistens the food .

**Cyclostomes**:- A pair of salivary gland lie below the tongue.They secrete an anticoagulant called lampherdin .

**Fishes** :- The only gland present in buccal cavity of fishes are mucous glands.

**Amphibians** :- In aquatic amphibians like urodels only mucous glands are present like fishes .

**Reptiles** :- In reptiles lingual , sublingual and labial glands are present .

In Gila monster modified sublingual glands are poison secreting gland.

In poisonous snakes the modified labial gland of upper jaw is poison gland .

**Birds** :- In birds well developed sublingual gland opens at the floor of buccal cavity.

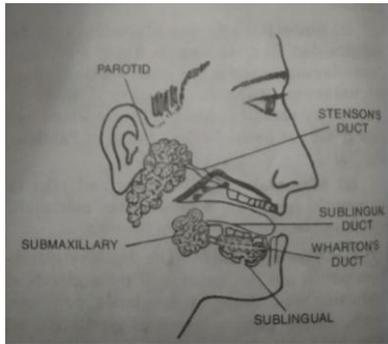
**Mammals** :- Mucous glands minute and numerous are located on palate and tongue of mammals.

In man there are three pairs of the glands namely parotid,submaxillary and sub lingual.

The **parotid gland** lies below external auditory meatus and their secretions are brought by **stensen's duct**.

The **submaxillary gland** lie in the posterior region of lower jaw and their secretions are brought by **Wharton's duct**.

The **sublingual glands** lie under tongue and their secretions are brought by **bartholin's duct**.



## LIVER :-

It is the largest gland of the body .it is present in all vertebrates .it is primarily a digestive gland although it serves many other functions .

**Liver** develops as an outgrowth of the endodermal wall of the **archentron** called as **liver diverticula** differentiates into two parts: anterior part forms large glandular mass of liver and it's bile ducts while posterior part give rise to **gall bladder and cystic duct**.

The comparative anatomy of liver in different vertebrates is as follows :-

**Cyclostomes**:- The liver of cyclostomes is very small .it is bilobed in jagdish and single lobed in lampreys .

**Fishes** :- The liver of fishes is many lobed and large .Gall bladder is generally present except in sharks .

**Amphibians**:- The liver is large in proportions to body size and many lobed .Gall bladder is present.

**Birds** :- Many lobed liver is found in birds .Gall bladder is absent in most of them .

**Mammals** :- In mammals liver is many lobed .Basically two main lobes are further divided into many smaller lobes .In man and rabbit there are five lobes .Gall bladder is lacking in some mammals like rodents .

## PANCREAS :-

It is the second largest digestive gland of the body .It is **heterocrine** gland their secretions form pancreatic juices and contain enzymes .it is the exocrine part formed of acini.

The endocrine part is formed of groups of small cell called Islets of Langerhans .

The comparative anatomy of pancreas in vertebrates is as follows :

**Cyclostomes** :- The hag fish have very small pancreas near bile duct .

In lampreys pancreas is absent.

**Fishes** :- Elasmobranchs have well defined pancreas having dorsal and ventral lobes .

**Amphibians ,Reptiles and Birds** :- A well defined ,compact pancreas is present in the loop between duodenum and the stomach .

**Mammals** :- The pancreas is lying between duodenum and ileum in rabbit and in v fold of duodenum in most of the mammals .There are two pancreatic ducts .The ventral duct joins bile duct near ampulla .The dorsal duct enter duodenum directly .

In few mammals pancreatic bladder is present to store pancreatic juice .

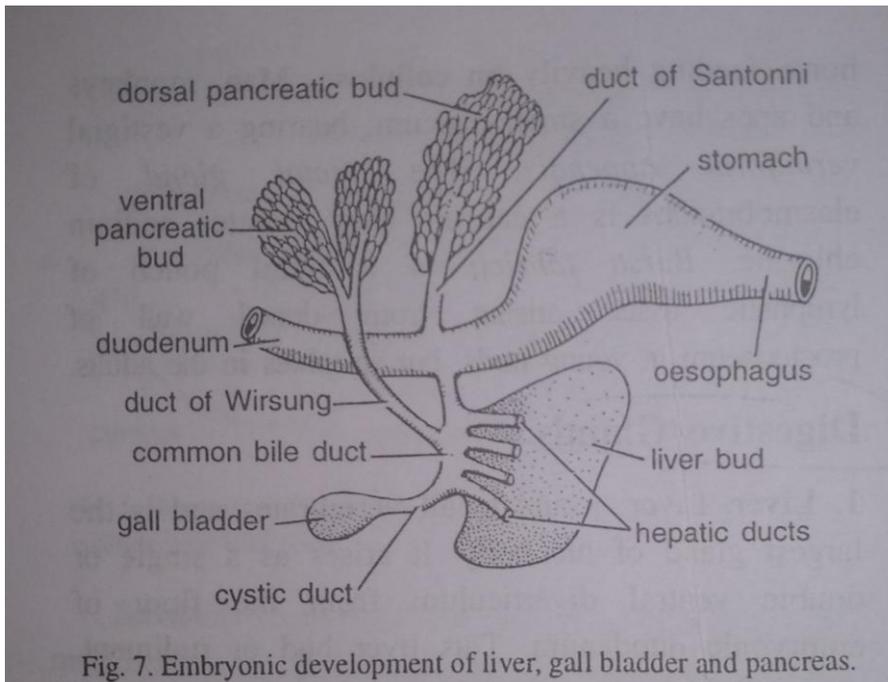


Fig. 7. Embryonic development of liver, gall bladder and pancreas.