S. S. College, Jehanabad

Department: Zoology

Class: M.Sc. Semester IV

Subject: Zoology

Topic: Digestive system and its modification in teleost

Mode of teaching: Google classroom & WhatsApp

Date & Time: 14.09.2020 & 10:30

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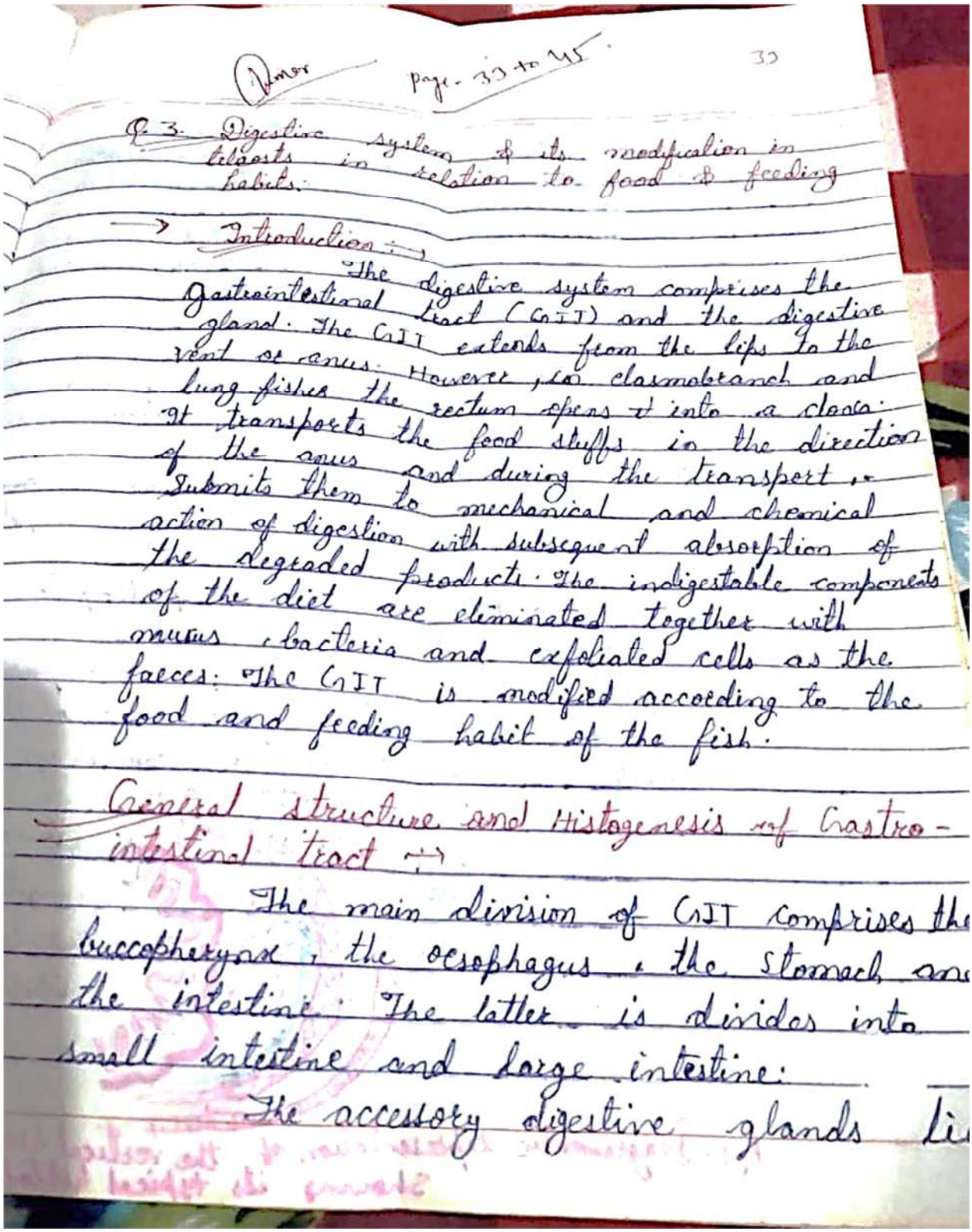
Digestive system and its modification in teleost



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Q 3. Digestive system & its modification in teleosts in relation to food & feeding habits.

→ Introduction :→

The digestive system comprises the gastrointestinal tract (GIT) and the digestive gland. The GIT extends from the lips to the vent or anus. However, in elasmobranch and lung fishes the rectum opens it into a cloaca. It transports the food stuffs in the direction of the anus and during the transport, Submits them to mechanical and chemical action of digestion with subsequent absorption of the degraded products. The indigestable components of the diet are eliminated together with mucus, bacteria and exfoliated cells as the faeces. The GIT is modified according to the food and feeding habit of the fish.

General structure and Histogenesis of Gastro-intestinal tract :→

The main division of GIT comprises the buccopharynx, the oesophagus, the stomach and the intestine. The latter is divides into small intestine and large intestine.

The accessory digestive glands li

entirely outside the wall of the GIT but develop from its epithelial lining. The secretion of these exocrine glands is communicated to the GIT through ducts.

In all segments of the GIT the mucosa consists of an overy innermost epithelial lining and a supportive layer of cell.

The submucosa is a connective tissue layer beneath the mucosa.

The muscularis externa consists of an inner circular and the outer longitudinal muscle layers. It surrounds the Submucosa.

The serosa consists an inner subserosal ~~connecto~~ connective tissue layer & an outer squamous epithelial layer.

All the three germinal layers participate in the development of the GIT. The ectoderm gives rise to parts of mouth, the palate & the lower part of anal canal. The endoderm gives riser to the epithelium & gland derived from it.

Fig: Diagrammatic representation of the vertical section of the GIT showing its typical histological units.

The structure of the buccal cavity, pharynx and the gut of teleosts varies in different species in relation to their feeding habits. The digestive system of a fresh water fish, Clarias batrachus is described below to serve as a typical example.

Gastrointestinal tract of a teleost, Clarius batrachus

Clarius batrachus is a carnivorous teleost. The gastrointestinal tract C. batarachus is modified according to its carnivorous food and feeding habits. Its main divisions are mouth, buccopharynx, oesophagus, stomach and intestine. The intestine is subdivided into duodenum, ileum and rectum.

The accessory digestive glands are in the form of pancreas and liver. The two glands are associated with the action of the upper part of the intestine. The gall bladder is located in the liver and associated with the storage of bile.

The mouth of C. batrachus is a transverse slit at the front end of the snout and opens behind into the buccopharyngeal cavity. Mouth is surrounded by four pairs of barbles

that are used for searching food. Numerous fine pointed teeth are present in two groups in the roof of buccal cavity, behind the upper lip. These are the maxillary and vomerine teeth. Mandibular teeth are present behind the lower lip. The rest of the buccal cavity is lined with soft mucous membrane & that may be folded slightly.

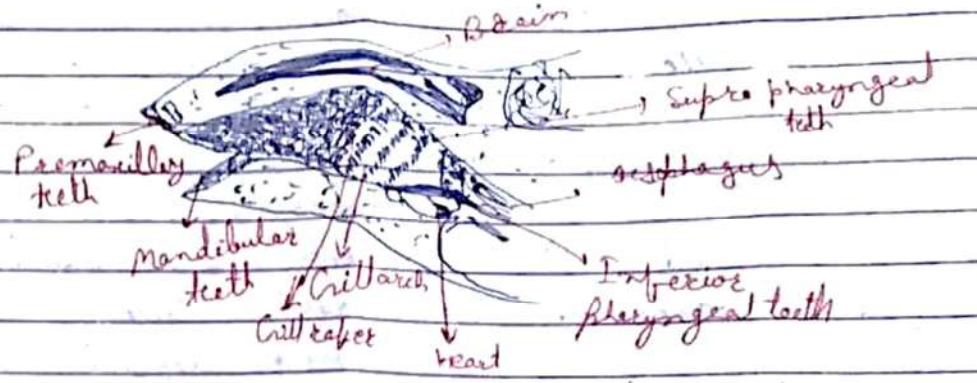


Fig. L.S. head of clarias batrachus.

The ventrolateral wall of the pharynx is perforated by oblique gill slits, ~~if~~ separated by means of four pairs of gills. Each gill has a longer lower limb and a short upper limb and bears gill lamellae towards the outer side and gill rakers internally. The gill rakers are fairly long, hard and pointed structure projecting into the pharyngeal cavity and are arranged either in one or two rows on each arch.

The gill rakers of the first arch are the longest while those on the fifth arch are the smallest in size. They serve to prevent the food from escaping out through the respiratory current of water.

Behind the gill arches at the hind end of the pharyngeal cavity, is a large circular aperture, the gullet leading into the oesophagus. A little anterior to the gullet and between the upper ends of the posterior gill arches, are present two hard bony plates bearing the superior pharyngeal teeth corresponding to these teeth on the ventral side also there is a pair of bony plates borne by the fifth gill arch and bearing numerous fine teeth, called the inferior pharyngeal teeth. These teeth serve to prevent the regurgitation of food of prey when once it has crossed into the gullet. The maxillary, vomerine and mandibular teeth are also not used for crushing or cutting of food but simply for preventing its escape after the prey has been caught. The hinder part of the bucco-pharynx shows slightly folded mucous membrane, the folds becoming more pronounced near the gullet.

The gullet is followed by a short,

tubular oesophagus which is continued behind into the stomach.

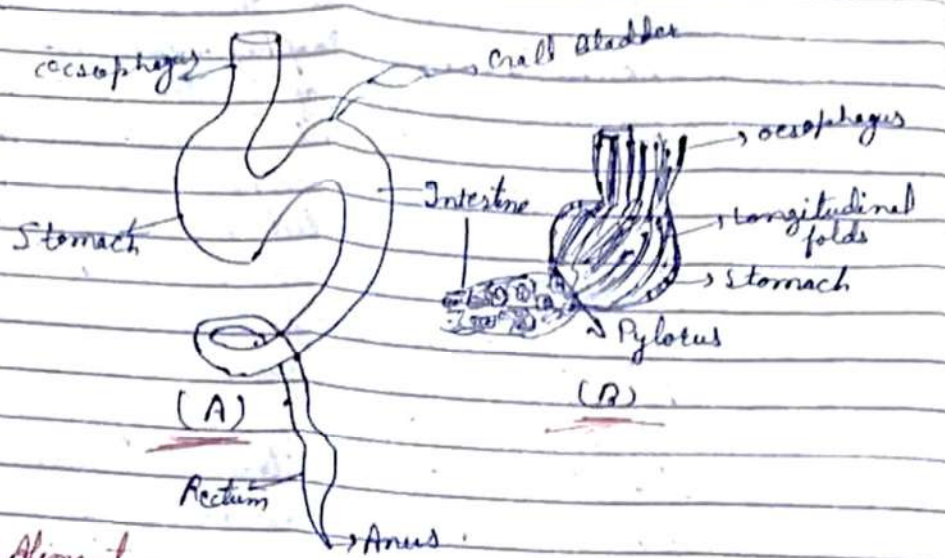


Fig: (A) Alimentary canal of Clarias batarachus
(B) Part of the alimentary canal of C. batarach, Cut open to show internal folds.

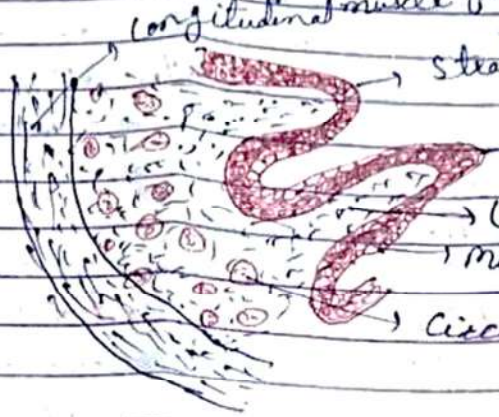
The stomach is wider in the middle that than at the two ends and looks sac-like. Its narrow distal end is continued into the intestine. and the duct junction is marked by a distinct construction called the pylorus. The intestine is of moderate length extending from the pylorus to the anus, making one or two coils before opening to the exterior. The first part of the intestine is wider, representing the rectum. Internally, the mucous membrane

of the gut is folded longitudinally. The folds are narrow in the oesophagus but become more prominent and thicker in the stomach. In the proximal part of the intestine, the folds are arranged in a zig-zag pattern, while posteriorly they become longitudinal and are indistinct. The pylorus is guarded by a muscular ~~Sphincter~~ Sphincter.

Histology of the Gut :-

The mucus membrane lining the bucco-pharynx is composed of mucosa, sub-mucosa and a thin muscularis. The mucosa consists of ~~satisfied~~ stratified epithelial cells arranged in several layers, the deepest cells forming the stratum Malpighii. A large number of characteristic large sized cells called the 'club-shaped-cells' are present in the mucosa. In the hinder region of the bucco-pharynx, numerous flask-shaped mucus secreting cells and a few taste buds are also present. The Sub-mucosa is vascular consisting of loose connective tissue fibres. The muscularis consists of a layer of scattered longitudinal muscle fibres. In the region of the gullet gullet, prominent folds of the mucous membrane

are seen. Here, the club cells may be absent and a much large number of mucous cells and taste buds are present.



T.S. of Gullet of Clarias Batrachus.

In the oesophagus, the mucosal folds are deep and lined with columnar epithelium having a large number of mucus secreting cells. The Submucosa is thin and includes longitudinal muscle but bundles that are scattered in it. The circular muscle fibres form a distinct layer covered externally by a thin serosa.

T.S. of oesophagus of C. Batrachus

The stomach

Fig: A Part of oesophagus (magnified).

The stomach has thicker muscular wall and is lined by columnar epithelium raised into several primary and secondary folds. Numerous gastric glands of simple tubular type are present below the epithelium epithelium and open into the lumen of the stomach.

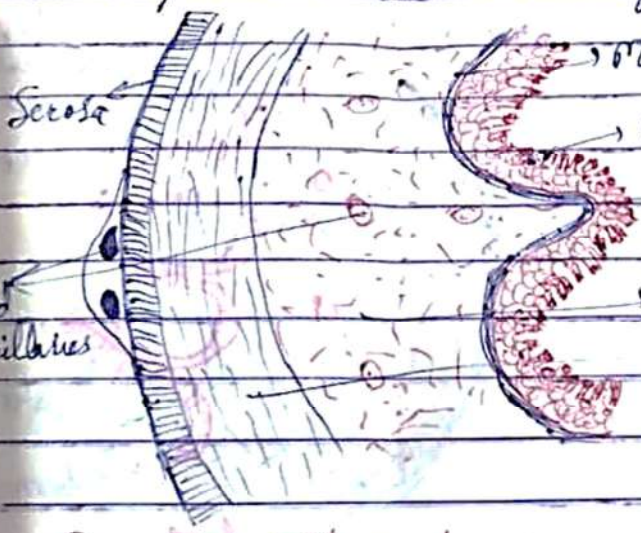


Fig: T.S. Stomach of clarias batrachus

A thin muscularis mucosa is present below the gastric glands. The submucosa and lamina propria are highly vascular. The muscularis consists of an inner layer of circular muscle fibres and an outer thin layer of longitudinal muscle fibres. The external covering is the serosa.

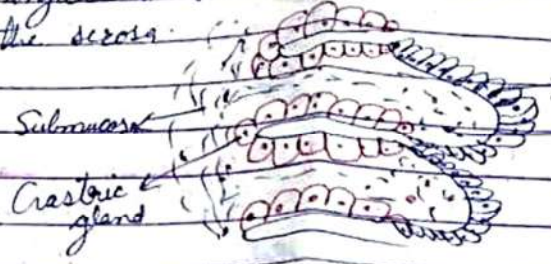


Fig. A part of gastric mucosa magnified.

The intestine has thin wall and its mucous membrane is thrown into prominent folds forming villi. In proximal wider part of the

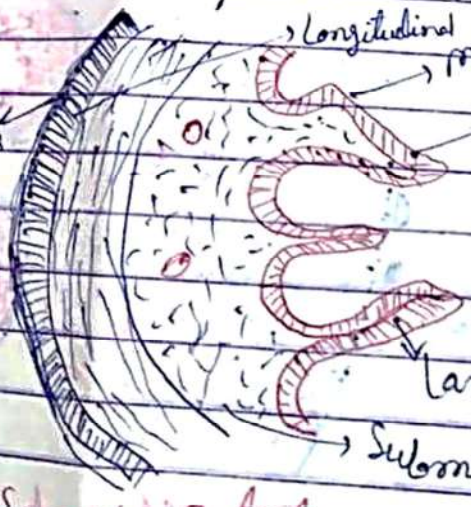


Fig. T.S. of Intestine of Clarias batrachus

intestine, the villi are numerous and are fused with each other. Histologically, the proximal and distal parts of the intestine do not differ from each other. The mucosa is composed of columnar epithelium consisting of absorptive and mucus secreting cells. The Submucosa is vascular and extends into the villi as lamina propria. The muscularis is formed of inner circular and outer longitudinal muscle fibres. The serosa has blood capillaries in it.

The rectum has relatively thicker layers of circular and longitudinal muscle fibres and a larger number of mucus secreting cells than in the intestine. The mucosal folds of the rectum are short and broad.

Digestive glands of Clarias Batrachus :→

The accessory digestive glands are in the form of Pancreas and the liver.

The liver is a yellowish, brown gland consisting two main lobes that are subdivided into smaller lobes. one small lobe of the liver is isolated on each side between the skin and the muscles.

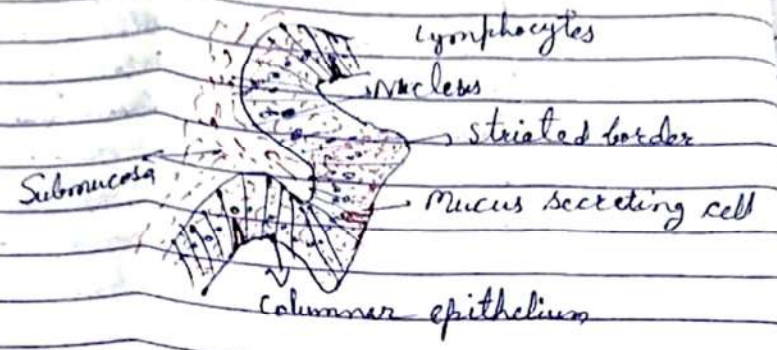


Fig. A part of intestinal mucosa.

The gall bladder is a narrow sac between the intestine and the right lobe of the liver. Bile duct is a short tube opening into the intestine, a little behind the pylorus. The pancreas is a well developed diffused gland surrounding the blood vessels between the lobes of the liver. A part of it extends over the surface of the stomach also.

Fig. Liver and Pancreas of Clarias.

The liver is composed of a larger number of polyhedral hepatic cells each of which contains granular cytoplasm and a central nucleus. Numerous bile ducules and blood capillaries are scattered in it. In the pancreas, the secretory acini are composed of cuboidal exocrine cells, each containing numerous zymogeny granules and a large nucleus. Scattered in the pancreatic tissue are a large number of Islets of Langerhans.

The exocrine pancreatic acini secrete pancreatic juice containing many digestive enzymes and the alpha and beta cells of its endocrine part secrete the glucagon and insulin hormones respectively.

These hormones help in carbohydrate metabolism - fat metabolism and it help in the storage of glucose in the form of glycogen