FISHERIES SCIENCE I

DIGESTIVE PHYSIOLOGY

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Digestive physiology

• Food and feeding

\* Types of food – 4 categories (Nikoloskii 1963)

1. Basic food – most preferred, consume in large quantity
2. Occasional or secondary food – small quantity
3. Incidental food – enter rarely in the digestive tract
4. Obligatory food- consumed during unfavourable condition

• On the basis of type of food, fishes are

1. Plankton feeders – filter feeder through gill rakers, eg:- sardine, hilsa sprt
2. Herbivorous fishes- feed upon different vegetation-adaptations- parrot and rabbit fishes
3. Carnivorous fishes- predators on molluscs, crustaceans and other fishes, eg:- shark
4. Omnivorous fishes- sand or mud feeders
5. Detrivorous fishes- feed upon decaying matter

## \*On the basis of selection of food, fishes are:-

1. Monophagic fishes – feed upon single type of food
2. Stenophagic fishes- feed upon certain selected kinds of food
3. Euryphagic fishes- feed upon a variety of different types of food

• On the basis of trophic niche, fishes are

NICHE- a particular combination of physiological factors

(microhabitat) and biotic relations required by a species for its life activities and existence in a community

1. Surface feeders- plankton feeders
2. Column or mid feeders- feed along the longitudinal column of water 3. Bottom feeders- mud feeders

## \*on the basis of manner of food capture and ingestion, fishes are

1. Predators – posses well developed grasping and holding teeth, eg:sharks
2. Grazers or browsers- food take by bite , eg:- butterfly fish
3. Strainers- filter feeders, eg:- butterfly fish
4. Parasites- derive nutrition from other fishes, eg:- Cyclostomes
5. Suckers- suck the food into their buccal cavity, eg:- eels

## Gastrosomatic index

* GaSI = wt. of the stomach content /wt. of the fish
* Feeding intensity in fishes can be calculated from GaSI
* GaSI shows seasonal variation – max. during post-spawning period and min. during spawning period

## Alimentary canal

* Teeth
* Tongue
* Buccal cavity and pharynx
* Taste buds and mucud secreting cells
* Oesophagus
* stomach
* Intestine
* Pyloric caeca
* Rectum

# Teeth

* Hollow cones of the dentine
* New generations are added from behind, older ones are pushed in front
* Shape of teeth varies with the feeding habits of the fishes- pointed, spherical, curved, fang like

Tongue

* Arise as a fold from the floor of the buccal cavity
* Without muscle, but supported by hyoid arch
* Small papillae, sensory receptorsa and teeth present on tongue

## Buccal cavity and pharynx

* Perforations of gill slits are located on each side of the pharyngeal wall
* Opening of gill slits supported by gill rakers
* Gill rakers protect the gill filaments and assist in the process of ingestion
* Assist in filtering and prevent the escape of food materials from the buccal cavity through gill slits
* Gill rakers vary in their form, number and size with feeding habits
* In carnivorous fishes- long, hard and teeth like forming rasping organs
* In omnivorous fishes- short and stumpy
* In herbivorous fishes- broad and sieved like
* In plankton feeders- long, and thin, form a perfect sieve
* Filtering efficiency increases from carnivorous to omnivorous and maximum in herbivorous fishes

## Taste buds and mucus secreting cells

* Taste buds are situated on the lips and buccopharynx
* Presence or absence of taste buds depends upon the mode of feeding
* Mucus secreting cells are present in the bucco- pharynx of all bony fishes
* Lubricate the ingested food for easy and smooth swallowing

## oesophagus

* With longitudinal folds to permit a greater distensibility
* Short and narrow tube in herbivores and omnivores
* Long and broad in carnivores
* Mucus secreting cells are scattered in the mucosa

## stomach

* Differentiated into a broad anterior part near to heart- cardiac stomach
* Posterior narrower part – pyloric stomach
* For storage and mastication of food components
* Internal lining containing gastric glands – true stomach
* Compared to oesophagus, mucosal folds are long and thick in stomach
* Sac like and thick walled in carnivores
* Sac like and thin walled in omnivores
* In some fishes, true stomach is absent, possess intestinal bulb or intestinal swelling – swollen anterior part for food storage
* Absorptive cells and mucus secreting cells are present in the mucus epithelium of intestinal bulb

## Intestine

* Divided into 2 parts
* Anterior long but narrower segments – small intestine
* Posterior short but broader – large intestine
* Anterior part of the SI just behind the stomach receives ducts from the liver and pancreas- duodenum
* Rest of SI is called ileum
* Intestine is lined by absorptive and mucus secreting columnar epithelial cells, and granular cells
* Mucus secreting cells are fewer in number in the anterior part , rare in the middle region, numerous in the posterior
* Outer muscular layer is thin consist of outer longitudinaln and inner circular muscles
* Length of intestine depends upon the feeding habits pf the fishes
* Short and straight in carnivores
* Long, thin walled and highly coiled in herbivores
* Intermediate condition in omnivores

## Pyloric caeca

* Finger like out growth in the anterior part of intestine (pylorous)- intestinal caeca
* Vary in number in different in species
* Act as accessory food reservoirs

Rectum

* Separated from intestine by ileo- rectal valve
* Mucosal fold of rectum is short and broader
* Posses a large number of mucus secreting cells and thicker muscle • Mucus aid in easy defecation

## Digestive glands

* Liver, pancreas and glands present in the digestive tract
* Liver is bi or tri lobed structure united anteriorly mesenteries
* Mucosal lining and submucosa containing glands of digestive function
* Dgs are absent in buccal cavity of some fishes which carry eggs in their mouth- buccal epithelium temporarily folded during spawning phase to form oral glands
* Secretion from oral glands nourish eggs
* Pharynx is without digestive glands
* Gastric glands present in the cardiac and pyloric region of stomach
* Granular cells produce gastric juice
* Goblet cells and granular cells of intestinal mucos perform secretory function
* Rectum is without digestive glands
* Rectal glands produce Nacl from blood

## Digestive system help to:-

* Dissolve food into soluble form – absorb and utilize in the metabolic process
* Remove toxic properties of food materials
* Absorb digestive products in solution – lining of intestine is highly absorptive
* Absorptive area highly increased by lengthwise folds, transverse folds and villi
* Gastric glands in the stomach produce HCl and pepsinogen – split large protein molecules, PH- 2.4-3.6
* Pyloric caeca perform digestive and absorptive function- produce lactase
* Absorption of fats doubled in the anterior part of the intestine
* Biles salt from gall bladder hydrolyze facts and maintain proper alkalinity for digestive enzyme activity
* Liver along with digestive activity ,serve as a storage organ
* Stomach, intestinal mucosa, pancreas and pyloric caeca are source of protein digesting enzymes
* Intestinal enzymes secreted in an inactive form- zymogens, activation by enterokinases
* Sucrase, maltase, lactase and amylase found in the intestine and pyloric caeca
* Lipase secreted from pyloric caeca and intestinal mucosa
* Adrenal gland influence digestive activity

## Adaptive modification in digestive tract

1. Mouth and jaws

* Position , shape and size of the mouth is correlated with type of food and mode of feeding
* In parasitic fishes, mouth is circular and equipped with a suctorial disc
* Mouth is terminal in column feeders, dorsal in surface feeders and ventral in bottom feeders
* Elongated mouth in grazers and suckers
* Half beak in surface feeders
* Downwardly bent beak in mud feeders
* Protractile mouth in Anabas

## 2. Lips

* Fleshy lips in suctorial fishes
* Lips thin or absent in carnivorous fishes

3. Teeth

* 3 kinds- jaws, mouth and pharyngeal
* 5 forms- cardiform, villiform, canine incisor and molariform
* Predacious fishes have sharply pointed or curved molariform pharyngeal teeth for grasping, tearing, and grinding
* Teeth absent in plankton feeders

## 4. Gill rakers

* Comb like in piscivorous fishes to prevent the escape
* Feather like in filter feeders
* In the form of broad sieve like in herbivores
* In the form of hard rasping organ in carnivores

## 5.Stomach

* Elongated stomach in piscivores
* Sac shaped in omnivores
* Grinding structures with tubular gastric glands present in carnivores
* Herbivores lack true stomach

## 6.Intestine

* Short in carnivores
* Elongated and many folded in herbivores