

Relationship of Buccopharynx with the Food and Feeding Habits of *Labeo dero* (Ham.)

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Labeo dero is predominantly a bottom-feeding herbivorous fish which mainly feeds on sluggish food like algae, diatoms, plant material and zooplankton. In relation to its food and feeding, the inferior and slightly protrusible mouth of *L. dero* helps the fish in extracting food from the mud. The folded mucosa of the buccopharynx forms the grooves which provide suitable place for the food to settle down and forms guiding ridges for food. The transversely folded mucosa and combed plates beset with papillae, and maxillary valve prevent the escape of food. The shape and arrangement of gill rakers suit the formation of efficient sieve to filter the mud and save the gill filaments from the silt. The tongue is feebly developed. Inferior pharyngeal blunt teeth are meant for efficient grinding. The presence of taste buds on lips, buccopharyngeal epithelium and tongue helps the fish in detecting the food.

Key Words: Buccopharynx, Food and feeding of *Labeo dero*

Introduction

The mouth, buccal cavity and pharynx are associated with the selection and seizure of the food. The position and form of the mouth, dentition on the jaws and in the buccopharynx and gill rakers, show a close relation with the mode of feeding and the kind of food. Many researches have been conducted on the extent of adaptation of the alimentary canal in fully grown teleost to a particular kind of natural diet (e.g. Suyehiro 1942, Al-Hussaini 1945, 1946, 1947 *a,b*, 1949, Girgis 1952, Kapoor 1953, Pillay 1953, Khanna 1961, 1962, Lal et al. 1964, Sehgal 1966, Lal 1968, Sriwastwa 1970*a,b*, Verma et al. 1974). Though different species with the same type of diet may

differ in the structure of the alimentary system, yet the functional adaptations related to the nature of food, and feeding habits remain similar (Angelescu & Gneri 1949); although the degree of relation between the digestive tract and food varies.

Material and Methods

Specimens of *L. dero* were collected during different months of the year from fresh water of Muzaffarnagar and Meerut districts. One hundred and eighty-two specimens of *L. dero* ranging between 15 and 16 cm in length were examined for gut analysis. The fish was first dissected and stomach (intestinal bulb) was removed. The volume of stomach along

with its contents was determined by displacement method. Next the stomach was cut open and the contents were removed. The volume of the contents was calculated by deducting the volume of empty stomach from the volume of the stomach with contents. The stomach contents were then diluted with a small quantity of distilled water and a sample thereof examined microscopically to determine the frequency of occurrence of each food item present therein (Hynes 1950). The data for the gut content analysis, in a particular month, were tabulated and average percentage of each item was calculated.

For the study of buccopharyngeal region, freshly collected fishes were cut open through each angle of the mouth. The roof and floor of the buccopharynx were properly washed and a detailed study was carried out under the stereoscopic microscope. The buccopharynx was preserved in 70% alcohol and glycerine for sketching. pH of the buccopharynx was determined, and 6 to 8 μ thick sections of the lips, buccopharyngeal epithelium and tongue were cut and stained in haematoxylin and eosin to detect the presence of taste buds. Alizarine preparations of visceral skeleton were also made to confirm the presence of teeth.

Observations

Food and Feeding

The study of stomach contents of *L. dero*, during different months of the year, reveals that it is predominantly herbivorous and bottom feeder and feeds mainly on algae, diatoms, plant matter and zooplankton. It also takes considerable amount of sand and mud along with the food. It shows poor feeding intensity during April to August i.e. breeding season. After spawning i.e. in September it exhibits considerable increase in the feeding intensity and afterwards it starts

feeding voraciously. Table 1 gives an idea of the feeding intensity of the fish during different months of the year.

Table 1 Intensity of feeding during different months

Months	No. of specimens examined	Full Stomach	$\frac{3}{4}$ full	$\frac{1}{2}$ full	$\frac{1}{4}$ full	Empty
Jan.	10	30.00	—	20.00	10.00	40.00
Feb.	8	25.00	—	—	37.55	37.55
Mar.	25	20.00	—	32.00	12.00	36.00
Apr.	18	—	—	16.67	22.22	61.10
May	21	28.57	—	14.29	—	57.10
June	15	13.33	—	—	33.33	53.33
July	20	15.00	—	—	25.00	60.00
Aug.	12	—	—	25.00	16.66	58.33
Sept.	17	58.82	11.76	—	—	29.41
Oct.	16	62.50	—	12.50	—	25.00
Nov.	12	33.33	25.00	8.33	16.66	16.66
Dec.	8	37.55	—	—	37.55	25.00

The quantitative analysis of food reveals that the fish consumes 38.3% algae, 17.3% diatoms, 31.6% plant matter and 12.5% zooplankton. It also takes a considerable amount of mud along with its food which is considered as a separate item otherwise it might disturb the balance of other food items in relation to each other. Table 2 shows the quantitative estimation of the food items during different months of the year.

Buccopharynx (Figure 1)

The inferior mouth of *Labeo dero* is slightly protrusible in nature and is placed at the anteroventral end of the head. The jaws and palate are without teeth. The tongue is edentulous and feebly developed. The

mucous membrane lining the buccopharynx is thickly folded and has a large number of papillae. The gill rakers are thin, soft, small and plate-like structures forming an efficient sieve.

Buccal cavity (Figure 1)

The roof of the buccal cavity (b.c.) is bounded anteriorly with a well-developed upper lip which is beset with a large number

of blunt papillae. The upper lip is provided with a large number of taste buds (figure 2) and followed by a wide membranous and papillated maxillary valve. The mucosa of the roof of the b. c. is greatly folded so as to form the grooves and ridges. One pair of lateral ridges is quite prominent. The grooves are provided with numerous backwardly directed papillae. An oval depressed area in the mid dorsal line gives rise to a

Table 2 Quantitative estimation (%) of the gut contents of *L. dero*

Food	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Algae	35.5	60.7	18.0	30.0	75.0	40.6	85.0	—	21.0	55.0	9.8	30.0
Diatoms	2.5	15.2	52.5	9.5	3.5	34.4	—	—	—	7.2	38.2	45.6
Plant matter	0.5	—	10.5	55.4	21.5	14.5	15.0	95.0	70.2	37.8	45.0	14.4
Zooplankton	61.5	24.1	19.0	5.1	—	10.5	—	5.0	8.8	—	7.0	10.0

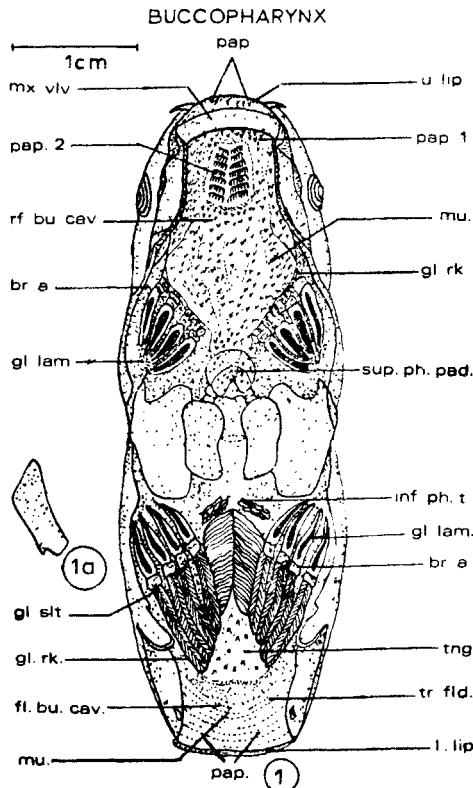
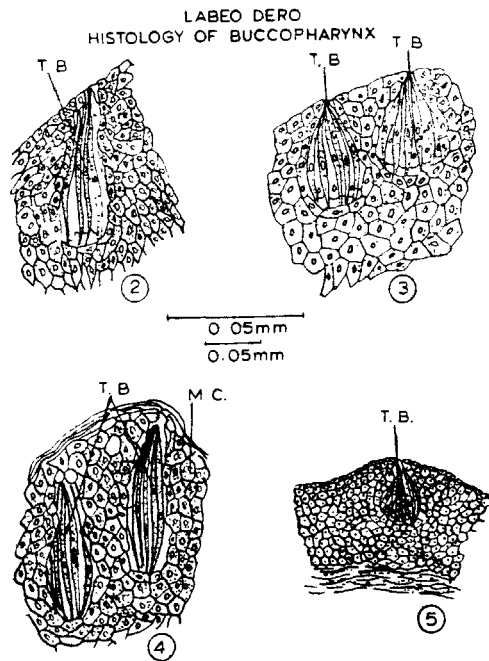


Figure 1 Buccopharynx; 1a, Inferior Pharyngeal bone tooth



Figures 2-5 C.S. of upper lip; C.S. of lower lip; V.S. of buccal epithelium; V.S. of tongue epithelium

number of thin-combed plates. The posterior margin of each plate is provided with papillae-like projections. Each plate hangs down in the buccal cavity in the form of comb plates. Behind the region of comb plates, the mucosa is again folded to form the ridged and grooved structure beset with a large number of backwardly directed papillae. The upper jaw and palate are edentulous.

Lower lip is beset with blunt papillae and taste buds (figure 3) and forms the anterior boundary of the floor of the b.c. However, the mandibular valve is absent. The mucosa of the floor of the buccal cavity, behind the lower lip, is transversely folded and is beset with minute papillae. The buccal epithelium too possesses taste buds and mucous cells (figure 4). Along the mid-ventral line behind the transversely folded mucosa, lies a feebly developed tongue which is covered by a thick fold of connective tissue and mucosa. It is supported by basihyal (figure 7). The lower jaw along with the floor of the buccal cavity and tongue is edentulous.

Pharynx (Figures 1 and 7)

The pharynx is distinguished from the b.c. by a V-shaped fold of the mucous membrane. It can be divided into an anterior respiratory and gustatory part and the posterior masticatory part. The dorso-lateral wall of the pharynx is perforated by gill slits supported by branchial arches which bear gill lamellae and gill-rakers. The posterior part of the roof of the pharynx is provided with a soft, thick and papillated superior pharyngeal pad.

The ventro-lateral wall of the pharynx is also perforated by gill slits supported by branchial arches (figure 7). The branchial arches are provided with gill-rakers and gill lamellae. The floor of the pharynx is supported by a median cartilaginous rod which represents the fifth arch. The

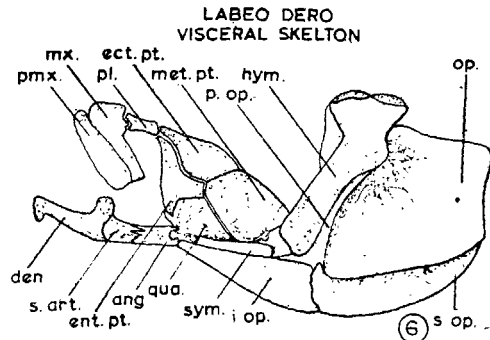


Figure 6 Inner lateral view of the skull showing mandibular arch, a part of the hyoid arch and opercular bones

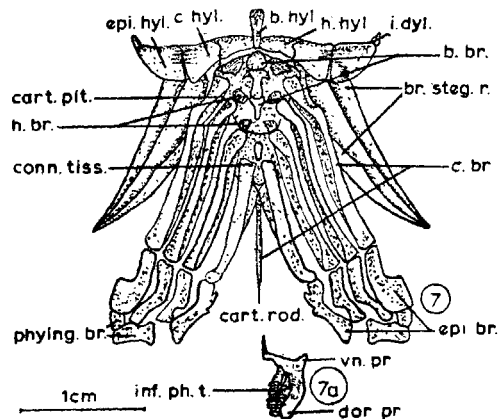


Figure 7 Hyobranchial skeleton; 7a, Inferior pharyngeal bone with teeth

posterior end of the rod possesses a pair of inferior pharyngeal bones. Each inferior pharyngeal bone is beset with 10-15 large, blunt and upwardly directed inferior pharyngeal teeth. The inferior pharyngeal teeth lie opposed to the dorsal pair of pharyngeal pads and form an efficient grinding surface.

Tongue (Figure 1)

The tongue, which lies attached along the mid-ventral line of the floor of the b.c. is not very well developed and is represented

only by a thick layer of connective tissue and mucosa. It is edentulous in nature and is supported by basihyal, and provided with numerous taste buds (figure 5).

Teeth (Figures 1a and 7a)

The only teeth present in *Labeo dero* are those borne by a pair of inferior pharyngeal bones. The dorsal surface of inferior pharyngeal bone is beset with 10–15 long, blunt and upwardly directed teeth which lie opposed to the dorsal pair of pads and form an efficient grinding surface. Each tooth of the inferior pharyngeal bone measures* about 26.8μ in length, 8.4μ in width in the middle and 7.6μ at the base.

Gill-Rakers (Figure 1)

The gill-rakers (g.r.) are numerous, thick laterally flattened and plate-like structures. Each g.r. is roughly triangular in shape and is attached to the branchial arch through its base. The dorsal margin of the g.r. is flat while the ventral margin is arched. The plate-like g.r. are further supplemented by 45–55 small, pointed finger-like and edentulous g.r. on each arch. These are longer in the middle and smaller towards the two ends of the arch. When the two branchial arches are brought closer the posterior g.r.s. of an arch alternate with the anterior g.r.s. of the succeeding arch, thus forming an efficient sieve.

pH of the Buccopharynx

The average pH of the b.c. and the pharynx was observed as 6.4 and 6.7 respectively.

Discussion

Mouth in fishes forms an important organ of ingestion. Its position, shape and size

vary in different fishes which can be correlated with their feeding habits. The inferior and slightly protrusible mouth of *L. dero* helps the fish, a bottom feeder, in extracting food from the mud. The inferior mouth has also been reported in some other bottom feeders like *Mugil tade*, *Labeo horie*, and *Chagunius chagunio* by Pillay (1953), Girgis (1952) and Lal et al. (1964).

The folded mucosa of the buccopharynx forms the grooves which provide a suitable place for the food to settle down and form guiding ridges for minute aquatic vegetation and diatoms. Khanna (1962) also reported folded mucosa in herbivorous forms like *Mugil corsula*, *Catla catla*, *Barbus sarana*, and *Cirrhina mrigala*.

The transversely placed mucosal folds of the floor of the buccal cavity are beset with papillae and similarly the comb-plates lie on the roof of the buccal cavity. These structures prevent the escape of food and thus compensate the absence of mandibular valve and the teeth. The maxillary valve being slightly loose touches the floor of the buccal cavity when the mouth is closed and thus prevents the escape of prey.

The laterally flattened, thin and plate-like gill-rakers arranged in the form of the leaves of a book and situated on the anterior as well as posterior dorsal margins of each arch, on coming close together, tend to form an efficient sieve to filter the mud and food. Besides, they also protect the gill filaments from the silt. Similar condition has been reported by Kamal Pasha (1964) in *Mystus gulio*.

The tongue of *L. dero* is feebly developed and is represented by a slightly raised area of the floor of the buccal cavity because it feeds on sluggish food material which does not make effort to escape from the buccal

*The measurements have been taken from a fish 15.5 cm long.

cavity. Pillay (1953) also described rudimentary tongue in *Mugil tade*. Khanna (1962) reported feebly developed tongue in *Catla catla*, *Barbus sarana* and *Cirrhina mrigala*.

The teeth are absent from the jaws and palate in *L. dero*. Only inferior pharyngeal bones are beset with blunt teeth which form an efficient grinding surface to crush the minute plants into finer particles. Similar condition has been reported by Khanna (1962) and Lal et al. (1964) in herbivorous fishes.

The presence of taste buds on the lips, buccopharyngeal epithelium and tongue of *L. dero* help the fish in detecting the food, which confirms its bottom feeding habits. Al-Hussaini (1946, 1947 b) has also mentioned the specialized gustatory sense in *Cyprinus*, *Gobio* and *Mulloidides auriflamma*

as an adaptation to the bottom feeding habit.

The pH in the buccal cavity ranges between 6.4 and 6.6 while in pharynx it ranges between 6.6 and 6.8, indicating therein a weakly acidic medium. It is doubtful, if these readings can be correlated with the feeding habit of the fish. Barrington (1957) while discussing in a general way the digestive physiology of fish, came to similar conclusion. It, therefore, seems likely that the buccopharynx does not take part in the process of digestion.

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Abbreviations

b. hyl., Basihyal; *br. a.*, Branchial Arch; *cart. rod.*, Cartilaginous rod; *fl. bu. cav.*, Floor of the Buccal cavity; *gl. lam.*, Gill lamellae; *gl. rk.*, Gill rakers; *gl. slt.*, Gill Slits; *inf. ph. t.*, Inferior pharyngeal teeth; *l. lip.*, Lower lip; *mx. vlv.*, Maxillary valve; *mu.*, Mucosa; *M. C.*, Mucous cells; *pap.*, Papillae; *rf. bu. cav.*, Roof of the buccal cavity; *sup. ph. pad.*, Superior Pharyngeal pad; *T. B.*, Taste buds; *ing.*, Tongue; *tr. fld.*, Transverse folds; *u. lip.*, Upper lip.