

Pharyngeal Pockets of *Gadusia chapra* (HAM.)

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The study of pharyngeal pockets in clupeoid fishes has been recently attracting the attention of many research workers. Latest contribution in this subject is by IWAI (1955) on the pharyngeal pockets of the sardine, *Sardinops caerulea*. KAPOOR (1954) briefly described the work of HYRTL¹ (1855, 1863), RIDWOOD² (1904), RAUTHER³ (1910) and LAGLER and KRAATZ⁴ (1945). Communications by FANG (1928) describing the "super branchial organ" of *Hypophthalmichthys molitrix* and *H. nobilis*, and by VIALLI (1926) on the epibranchial organ in clupeids are also noteworthy. The observations recorded here are in continuation of the author's earlier note on the pharyngeal pockets in *Gadusia chapra*. The writer is thankful to Prof. Dr. M. L. BHATIA, Delhi University, for guidance and to Fisheries Development Adviser, Ministry of Agriculture, Government of India, for permission to publish this paper. The work was carried out at the Zoology Department, University of Delhi, and I am indebted to the Ministry of Education, Government of India, for the award of a Senior Research Training Scholarship.

Pharyngeal pockets

Anatomy: The pharyngeal pockets get fully exposed on cutting away the three gill arches on either side. The pockets are paired structures which constitute the pharyngeal organ. Both the pockets lie abreast on either side of the mid-line of the posterior portion of the pharynx, and each is partly covered over by gills on the upper limb of fourth gill arch.

Each pharyngeal pocket rests on the epibranchial piece of the fourth gill arch from which it gets the main support and attachment. A cartilaginous extension originating from the lateral edge of the epibranchial element of the fourth gill arch encapsulates the pocket ventrally and partially dorsally, and provides an additional support and place for attachment of muscles of the pocket. Bony plate of the fourth gill arch also supports the pocket. IWAI recorded in *Sardinops caerulea* that each pocket is supported by the fourth epibranchial bone expanded like the blade of a broad ax as described by PHILLIPS⁵ (1942). In addition a broad cartilaginous extension, arising on the lateral edge of the expanded epibranchial and dividing into two parts, supports the lateral portion of the pocket. The dorsal edge of the pocket is attached to the ventrolateral border of the vertebral column and partly to the ventral border of the parasphenoid by loose fasciae.

Each pharyngeal pocket in *Gadusia* (*vide* Fig. KAPOOR, 1954) is a diverticulum of the pharynx and is divisible into two portions: (i) the canal passage and (ii) the sac. (i) The canal passage is a channel-like portion of the pocket and is equipped with two rows of rakers which are in continuation of the mesial (posterior) row of rakers on the lower

limb of fourth gill arch; and the rakers borne on the fifth ceratobranchial. These rakers are smaller and different in form in comparison with those on the gill arches, and run up to the end of canal passage portion. (ii) The sac part of the pharyngeal pocket is a mesial blind muscular bag and is devoid of rakers.

FANG described that the "super branchial organ" enclosed the "gill raker duct" containing biserial gill rakers of the neighbouring arches in both the species of *Hypophthalmichthys*. He regards "gill raker duct" and the gill rakers contained therein as a supplementary sifting organ. IWAI mentioned two rows of numerous thin flat, blade-like plates, each possessing approximately eighty processes bearing spiny nodules at their tips and suggested that the plate is a modified gill raker. HUBBS⁶ (1929) and SCOFIELD⁷ (1934) attribute this structure to an adaptation to feeding habits.

Histology: The study is based on the material fixed in Bouin's fluid, cut into 8 μ sections and stained with Delafield's haematoxylin and eosin.

(i) The canal passage. The wall of canal passage is composed of mucosa, submucosa and muscularis (Fig. a). The mucosa is of stratified type and within it occur numerous mucous cells and a few taste buds. LAGLER and KRAATZ made no record of mucous cells and taste buds in the lining of the wall of canal passage of the pharyngeal pockets in *Dorosoma cepedianum*. The mucosa has many granular cells and is supported on a basement membrane. The submucosa has a thin stratum of fibrous connective tissue and a thick coat of adipose tissue. Blood capillaries occur in muscularis and submucosa.

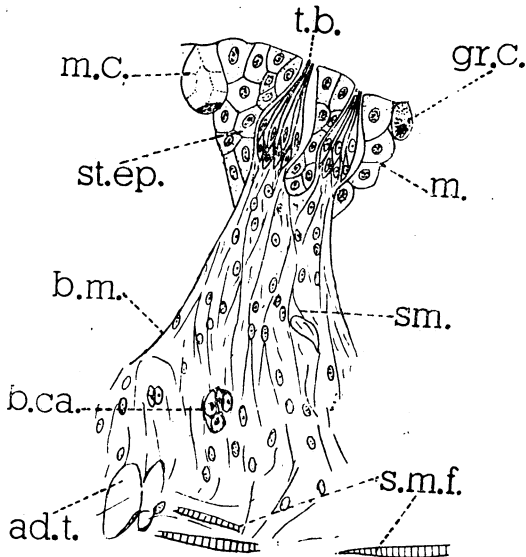
(ii) The sac. The sac wall is made up of mucosa, submucosa, muscularis and adventitia (Fig. b). The mucosa is stratified and is intensely folded. The mucous cells are more in number than in the lining of the wall of canal passage, while taste buds do not occur at all. The connective and adipose tissues form the submucosa. Muscularis is thicker than that in the wall of canal passage. Blood capillaries are present in all the layers except in the mucosa.

IWAI noted mucous cells and taste buds throughout the epithelial lining of the pocket. Present investigators agree that the histological structures are virtually the same as those of pharynx.

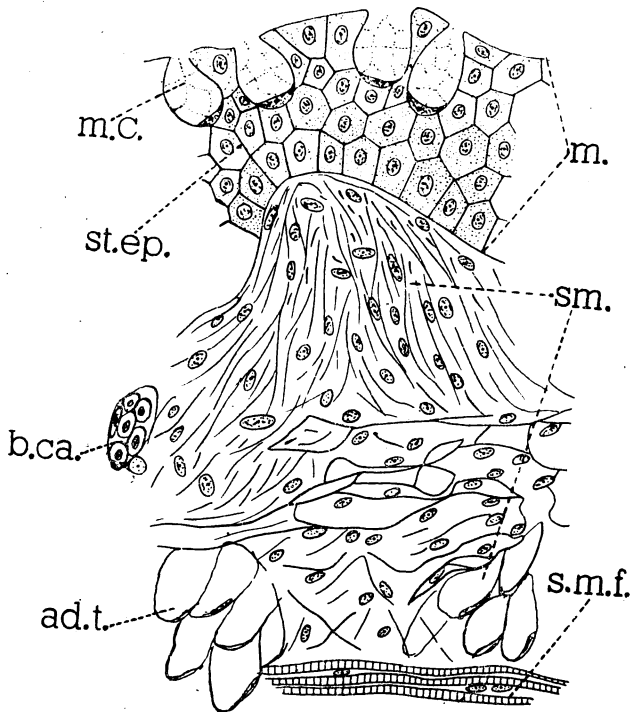
Discussions: HYRTL, and RAUTHER have interpreted similar structures in related fishes as of respiratory significance. LAGLER and KRAATZ based their view that the organs in *Dorosoma cepedianum* are accessory to the digestive, rather than to the respiratory system on the following evidences: (i) the epithelial lining of the lumen is stratified and non-vascular;

(ii) the musculature is striated, indicating a voluntary control; (iii) the included lamellar structures are modified rakers with a hard skeleton, not modified gill filaments and (iv) the manner in which the organs may be accessory to the digestive system can be postulated on the basis of structure and location of the organs and on the apparent needs of fish. KAPOOR in the case of pharyngeal organs in *Chanos chanos* and *Hilsa ilisha* endorsed the view of LAGLER and KRAATZ. KAPOOR also remarked that the organs are glandular due to the presence of unicellular mucous glands whereas LAGLER and KRAATZ did not observe mucous cells in the lining of the organ. The presence of a few taste buds in the

Pharyngeal pocket



a



b

Explanation of figures

a. A part of the transverse section passing through the canal passage portion of the pharyngeal pocket in *Gadusia chapra* (HAM.). × 560.

b. A part of the transverse section passing through the sac portion of the pharyngeal pocket in *Gadusia chapra* (HAM.). × 560.

ad.t., adipose tissue; b.ca., blood capillary; b.m., basement membrane; gr.c., granular cell; m., mucosa; m.c., mucous cell; s.m.f., striated muscle fibres; sm., submucosa; st.ep., stratified epithelium; t.b., taste bud.

lining of the canal passage of the pharyngeal pockets in *Gadusia chapra* further strengthens the view that the pockets serve as accessory part of the alimentary system rather than that of respiratory system. IWAI also adequately supports the above statement in his researches on *Sardinops caerulea*, and on the basis of recent study on the pharyngeal pockets of the Japanese gizzard shad, *Konosirus punctatus*⁸ where squamous epithelial lining is composed of non-vascular, striated cells; a number of taste buds are recognizable in the epithelium, and the internal lamellar structures appear to be modified gill rakers. KAPOOR found plankton in the pharyngeal pockets but IWAI observed no edible food there in.

It is concluded that the pharyngeal pockets, on account of their expansion and contraction, contribute to the concentration and swallowing of food.

References

- FANG, P. W. 1928. Notes on the gill-rakers and their related structures of *Hypophthalmichthys nobilis* and *H. molitrix*. *Contr. biol. Lab. Sci. Soc. Chinà*, iv, no. 5, pp. 1-30.
- IWAI, T. 1955. The pharyngeal pockets of the sardine, *Sardinops caerulea* (GIRARD). *Calif. Fish and Game*, xli, no. 1, pp. 113-116.
- KAPOOR, B. G. 1954. The pharyngeal pockets and its associated structures in *Gadusia chapra* (HAM.). *Curr. Sci.*, xxiii, no. 5, pp. 162-163.
- 1954. The pharyngeal organ and its associated structures in the milk-fish, *Chanos chanos* (FORSKAL). *J. Zool. Soc. India*, vi, no. 1, pp. 51-58.
- 1954. The anatomy and histology of the pharyngeal organ in *Hilsa ilisha* (HAM.). *J. Zool. Soc. India*, vi, no. 2, pp. 167-172.
- VIALLI, M. 1926. L'organo epibranchiale dei Clupeidi. *Monit. Zool. Ital.*, xxxvii, no. 8, pp. 174-185.