Oral Valves of Teleosts

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Despite the comprehensive morphologic accounts on the oral valves of fishes by DAHLGREN (1898), MITCHELL (1904), and GUDGER (1946), it is surprisingly noted that no detailed investigation on their histologic constituents has ever been attempted. Stray and brief descriptions of these structures have been mentioned in the contributions on the alimentary tract of fish by CURRY (1939), AL-HUSSAINI (1949) and GIRGIS (1952). The present report is confined to such a study in a siluroid fish, *Wallago attu* (BL. & SCHN.), the carp, *Catla catla* (HAM.) and *Barbus stigma* (C. & V.), and a clupeid fish, *Gadusia chapra* (HAM.).

For histology, the valves were cut off from the live fishes and were fixed in Bouin's fluid. Longitudinal sections were cut at 8 μ and stained with Delafield's haematoxylin and eosin.

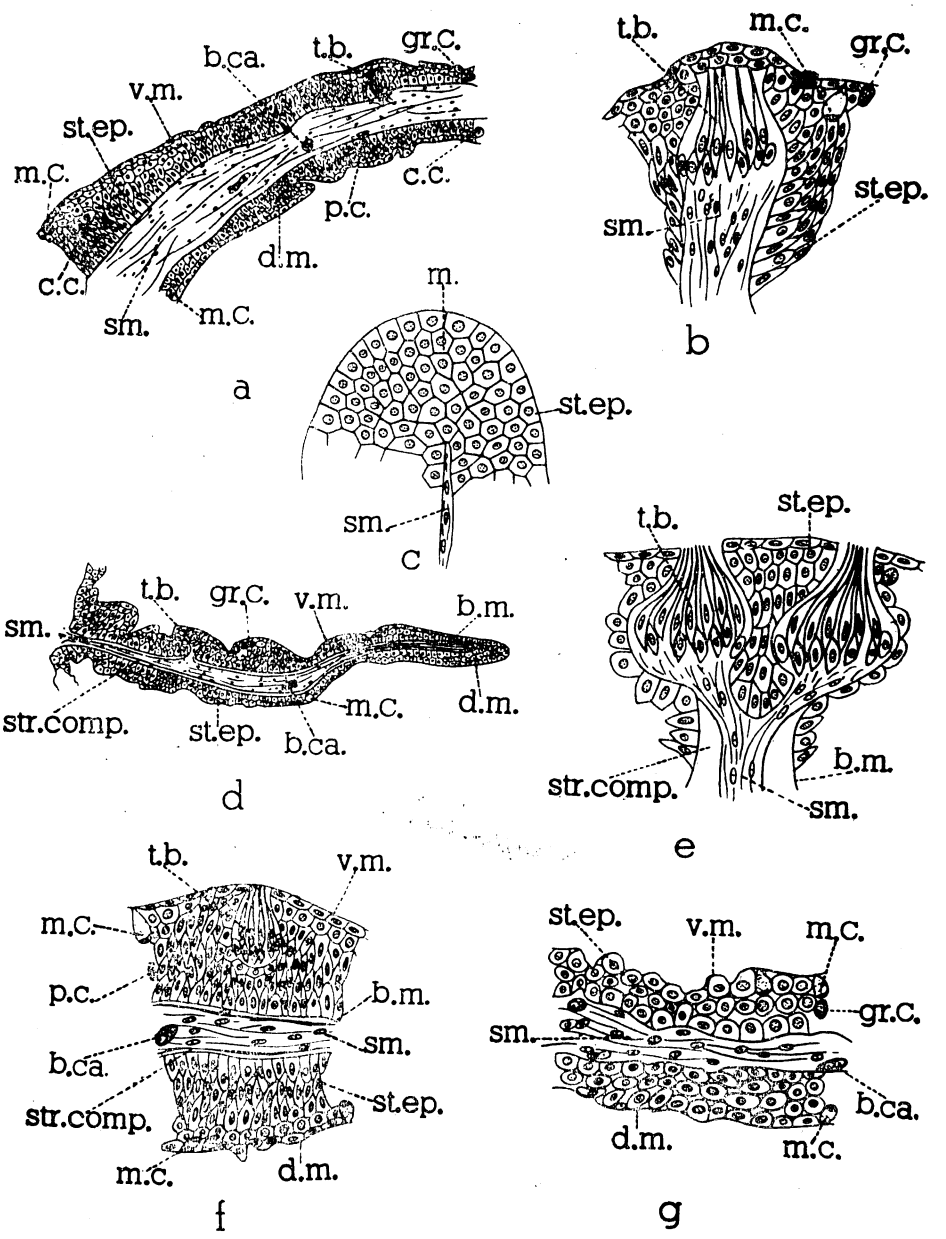
The author acknowledges with gratitude the incessant help and valuable suggestions from Prof. Dr. M.L. BHATIA, Department of Zoology, University of Delhi. Thanks are also due to Fisheries Development Adviser, Ministry of Agriculture, Government of India, for the kind permission to publish this article. The work was carried out at Zoological Laboratories, University of Delhi, and was aided by a grant of Senior Research Training Scholarship from the Ministry of Education, Government of India.

Oral valves

Anatomy: The oral valves (velar folds or flaps of tissue), originating from mucosa, just behind the jaws, swing inward and backward to allow free entry of water in the mouth of the fish. When the mouth cavity contracts to expell the water over the gills, they swing outward and so prevent regurgitation. They thus act very much like the valves of a pump guiding the water in the desired direction. It is evident that the movements of the valves are brought about by the water pressure of the respiratory current.

In *Wallago attu* and *Gadusia chapra,* like the majority of teleosts, both the maxillary and mandibular valves are present and are crescentic in shape with wavy margin; while in *Catla catla* and *Barbus stigma* there exists only the maxillary valve which is flat and has a wavy border.

MITCHELL (1904) found two types of valves: crescentic and the U-shaped types. The crescentic type of valve is typically shown in the catfishes (Siluridae). This has tapering ends. In the U-shaped type, the ends do not taper but are bluntly truncate. A third kind of valve has been mentioned as being a modification of either the crescentic or U-type as in the case of carp (Cyprinidae).



Explanation of figures

a. A part of the longitudinal section passing through the maxillary valve of *Wallago attu.* ×80. b. The mucosa of the maxillary valve of *Wallago attu.* ×560. c. The mucosa at the border of the maxillary valve of *Catla catla.* ×560. d. A longitudinal section passing through the maxillary valve of *Catla catla.* ×60. e. A part of the mucosa of the maxillary valve of *Catla catla* at the position of taste buds. ×560. f. A part of the longitudinal section passing through the maxillary valve of *Barbus stigma.* ×315. g. A part of the longitudinal section passing through the maxillary valve of *Gadusia chapra.* ×560.

b. ca., blood capillary; *b. m.*, basement membrane; *c. c.*, club cell; *d. m.*, dorsal mucosa; *gr.c.*, granular cell; *m.*, mucosa; *m. c.*, mucous cell; *p. c.*, pigment cell; *sm.*, submucosa; *st. ep.*, stratified epithelium; *str. comp.*, stratum compactum; *t. b.*, taste bud; *v. m.*, ventral mucosa.

AL-HUSSAINI (1949) observed only the maxillary valve in the fishes studied by him, the mandibular valve is wanting. He describes these as crescent-shaped structures of the mucous membrane, and states that the maxillary valve must operate against the floor of the mouth. GIRGIS (1952) mentions a flat maxillary valve beheind the upper cutting edge of the mouth in *Laeo horie*.

Histology: The maxillary valve in *Wallago attu* is composed of the dorsal and ventral layers of mucosa, and an intermediate submucosa (Figs. a, b). The mucosa on the ventral side is of stratified type with polygonal, columnar, club-shaped, mucous cells and taste buds. The club cells are sparsely present, and mucous cells are limited to the border. Numerous taste buds, present on the submucosal elevations, occur only on this side of the valve which comes in direct touch with the food material. A few granular cells are also present.

The mucosa on the dorsal surface of the valve has the same type of lining with very few club cells and mucous cells in it; there are no taste buds on this side. The intermediate submucosa consists of connective tissue fibres which have pigment cells and blood capillaries in it. The mandibular valve has the same histological features, here also, the taste buds are present on that mucosal surface which comes in direct contact with the food.

The maxillary valve in *Catla catla* has the dorsal and ventral mucosal layers and an intermediate submucosa (Figs. c, d, e). The mucosa consists of a stratified epithelium in which flat, polygonal and columnar cells are present. The mucosa on the ventral side has plenty of taste buds and a few mucous cells in it; while the dorsal mucosa has no taste buds and very few mucous cells are present. Taste buds, in the ventral mucosa, are on the sub-mucosal elevations. Both the layers of mucosa are supported on the basement membrane and stratum compactum of either side. The intermediate submucosa is made up of connective tissue fibres with oval, spindle-shaped or round nuclei, and has many blood capillaries in it.

Both the dorsal and ventral mucosal surfaces of the maxillary valve in *Barbus stigma* have almost the same major histological elements only with a few differences (Fig. f). The ventral mucosa has a stratified epithelium which has mucous cells and taste buds. The superficial cells lie parallel to the surface plane and are followed by polygonal, fusiform and columnar cells. The mucous cells and taste buds occur in large number; pigment cells are also present in the epithelium. The dorsal surface of the valve has mucous cells in abundance while taste buds do not occur at all. Each mucosal surface is supported on a basement membrane followed by a stratum compactum. The submucosa is made up of connective tissue fibres and has blood capillaries and pigment cells in it.

The maxillary valve in *Gadusia chapra* has the usual dorsal and ventral mucosal layers, having a central submucosa (Fig. g). It is surprising to note that taste buds do not occur on any side of the stratified epithelium, while mucous cells are present in large number in the ventral mucosa and a few in the dorsal mucosa; granular cells are also present. The submucosa consists of connective tissue fibres with blood capillaries in it. The mandibular valve has also fundamentally the same microscopic constituents.

Discussion : OWEN[1] (1866) suggests that oral valves prevent the reflux of the respiratory stream. MACALLUM (1884) mentions in his article on *Amiurus* that behind the pads of teeth and running concentrically with them are folds, one above and one below, arising from a relaxation of the lining membrane ; that behind the maxillae is the largest, but both may be absent. No mention of the functions of these folds of membrane is made. STANNIUS[2] (1839) has described them, as has also CUVIER[3] (1836) who suggests that they not only prevent the reflux of water but the escape of food. GALTON[4] (1871) describes the valves and their working in detail. HOWES[5] (1883) refers to them in trout explaining their function. In 1898 DAHLGREN who knew nothing of GALTON's article took up the subject in detail and observed these valves in operation in over fifty species of fresh-water and marine teleost fishes. He describes the valves in the common sunfish, *Eupomotus gibbosus* and states that the valves are sheets of membrane composed of elastic tissue covered with a membrane continuous with that lining the mouth. They are situated in the oral cavity just caudad of the maxillary and mandibular teeth. The function of the oral valves is to aid in the act of breathing which has hitherto been described as a kind of swallowing. In the light of his observations and experiments he described the act of breathing in the teleost fishes explaining the significance of two sets of valves, an anterior set (the oral valves) and a posterior set (the branchiostegal valves). He states that these valves are of value as breathing organs is evident upon casual observation ; that they are of much importance is shown by the compensatory action brought about by injury ; that they are not of immediate vital importance is proved by the fish's ability to get along without their services until they are repaired. MITCHELL (1904) described the oral breathing valves of teleosts, their modifications and relation to the shape of the mouth. About seventy species of fish examined belonged to Catostomidae, Siluridae, Clupeidae, Percadae, Centrarchidae and Argentinidae. She stated that many of the Cyprinidae apparently had no mandibular valve. In the minnows the place of mandibular valve was taken by several rows of tall papillae, the function of which may be to aid in the finding of the food. GUDGER (1946) only reviewed the work on the oral breathing valves in fishes-teleosts, ganoids, dipnoans and elasmobranchs.

CURRY (1939) in an account on the histology of the digestive tube of the carp (*Cyprinus carpio communis*) mentions a flap of tissue at the back of upper lip, attached to its base and free at the posterior border, which possesses numerous goblet cells and taste buds. AL-HUSSAINI (1949) also observed numerous taste buds on the ventral surface of the maxillary valve. Dorsal surface of the maxillary valve has no taste buds and mucous cells in plenty. The taste buds are concentrated on the ventral surface and the food is immediately sampled. GIRGIS (1952) states that the epithelium of the ventral side of the flat maxillary valve in *Labeo horie* has one and occasionally more taste buds, goblet cells are rare. The epithelium on the dorsal side of the valve is thinner than that of the ventral. It has a few scattered goblet cells and no taste buds. Each mucosal side rests on its own basement membrane and stratum compactum. A common areolar tissue rich in collagenous fibres lies between them. He states that no muscular fibres whatsoever are found in or near it.

Observations on the oral valves in *Catla catla* and *Barbus stigma* are almost identical with those on the valve in *Labeo horie*. The valves in *Wallago attu* and *Gadusia chapra* exhibit histological differences, particularly in regard to the taste buds.

On the basis of morphologic grounds and histologic examination it may be concluded that the valves and the buccal lining have the identical microscopic structure. Remarkable feature is the occurrence of numerous taste buds and a few mucous cells on that surface of the valve which comes in direct touch with the food. On the other surface taste buds do not occur, only mucous cells are present.

It is hoped that the publication of this article shall provide a promising field for such investigations, because it has been least cultivated, particularly in the case of fishes of Asia.

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