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Structures associated with feeding in *Mastacembelus armatus* (Lacepede, 1800) from Kaigaon Toka (M.S.)

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Abstract
The structures associated with feeding of *Mastacembelus armatus* shows interesting modifications reflecting carnivorous mode of feeding habit with several morphological characters such as, mouth equipped with fine but firm jaws, upper jaw longer projecting over the lower jaw, buccal cavity is narrow, pharynx is wide, spacious and dorso-ventrally compressed, Teeth are sharp, tiny, robust, subequal, inclined inwards, villiform organised in patches, gill rakers are absent.

Keywords: Mouth, jaws, buccal cavity, pharynx, teeth, gill rakers

INTRODUCTION

The adaptations of the mouth of fishes to their food are particularly evident in the form of mouth size, shape and structure of the oropharynx, dentition, gill rakers. All these structures are subject to diverse and significant variations and modifications in accordance with the feeding habits of different fishes. The diversity in feeding habits that the fishes exhibit is particularly the result of evolution leading to structural adaptation for getting food from the equally great diversity of situations that have evolved in the environment. Conversely, the importance of food in the daily life of a fish is "reflected" in the form of mouth and jaws, dentition, the shape and size of the gill rakers etc, and therefore, the difference in their feeding habits.

Literatures pertaining to the morpho-anatomical structures of the mouth in freshwater teleosts are fragmentary and many authors while studying the alimentary canal, briefly described the morphology and structural organisation of the mouth structures of different fish species [35], [10], [11], [20], [21], [22], [14], [25], [16], [13], [26], [17], [28], [29], [30] and [9].

Mouth structures are specialized that cover the jawbones, and border the anterior orifice of alimentary canal. In general, mouth structures associated in different fish species may be considered as mainly concerned with the selection, capture, deglutition and pre digestive preparation of food. The effectiveness of these structures is dependent on modifications in relation to food and feeding habits of the fishes and environmental niches inhabited by them. Morphological data are also key to understanding fish nutrition in ecology and aquaculture, and during development as well as mechanisms for physiological adaptations to a changing environment.

MATERIALS AND METHODS

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For the study of jaws and teeth of *Mastacembelus armatus, Wallago attu* and *Clarias batrachus*. The fishes were collected randomly from Kaigaon Toka, Aurangabad District (M.S) India. They were washed and preserved in 10% formaline solution. The preserved fishes were cut and opened at each angles of the mouth. The roof and floor of the buccopharynx were properly washed and preserved in 70% alcohol and glycerine for stretching. The jaws, teeth, gills and gill rakers were examined properly for detailed studies.

RESULTS

Mouth

During the present study it was observed that the mouth of *Mastacembelus armatus* is pointed, oblique, and horizontal crescentic cleft, sub terminal or inferior in position bounded by upper and lower labial folds and surrounded by fine but firm jaws, the upper jaw and lower jaw. The upper jaw is longer than the lower jaw and projects beyond over the lower one forming an inverted 'Y' shaped opening. The snout is long, tri lobed and with fleshy appendage, consisting of a middle firm, solid and pointed process and two lateral soft, hallow and blunt ridges. There is a shallow grove in the ventral surface of the upper jaw which leads into the mouth. The gape of the mouth is wide enough and extends back as far as the anterior eye margin or somewhat forward of this point. The upper jaw consists of the premaxilla which is a weakly curved, rod like element, characterized by its short ascending process. Anteriorly each premaxilla curves medially to form a midline symphysis. The premaxillae are not protrusible.

The lower jaw consists of dentary which is a long bone and although straight is directed mesiad. Its symphysis lies posterior to the median connection of the premaxilla and there is a low symphysial projection on its anteroventral edge. The mouth leads into the buccal cavity (Plate 4a, 4b, 4c and 4d).

Buccal cavity

During the course of study it was observed that the buccal cavity of *Mastacembelus armatus* is narrow and widens into pharynx. Its roof is formed by the base of the cranium and side walls, and the floor of the buccal cavity is formed by the urohyal and branchial

arches. It is observed that the smooth mucous membrane with a large number of mucous secreting cells line the walls of buccal cavity (FIG. 1b).

Pharynx

Pharynx of *Mastacembelus armatus* is observed to be wide, spacious and dorso-ventrally compressed arising from narrow buccal cavity (FIG. 1b).

Tongue

Tongue of *Mastacembelus armatus* is observed to be well developed triangular with thick mucous membrane which is affixed along the mid dorsal line of the floor of the buccopharyngeal cavity (FIG. 1b, 1c and 2a).

Teeth

During the study it was observed that numerous teeth are present in *Mastacembelus armatus*. They are present on upper and lower jaws and pharynx. They are sharp, pointed, tiny, robust, subequal, inclined inwards, villiform organised in patches. There are two set of elliptical patches of superior and inferior pharyngeal teeth directed towards the gullet. On the upper jaw tooth-bearing alveolar surface of the premaxilla is broadest anteriorly and tapers posteriorly. The teeth are arranged in 1-8 irregular rows (depending upon the position along the premaxilla) and decrease in size medially. On the lower jaw long and narrow dorsal alveolate surface of the dentary is toothbearing. This toothed surface contains 3 rows of caniniform acrodont teeth. Teeth of the outer row are somewhat larger than the inner teeth. It was observed that the vomerine and palatine teeth are absent (FIG. 2b and 2c).

Gill rakers

It was observed that gill rakers are absent in *Mastacembelus armatus*. In the place of gill rakers there is an uneven gill arch surface (FIG. 1b, 1c and 1d).

DISCUSSION

The morphology of jaws and teeth of *Mastacembelus armatus* shows a number of interesting modifications which reflects the carnivorous mode of feeding habit with several morphological characters such as, the mouth which is equipped with fine but firm jaws. The upper jaw is longer and projects out over the lower one. The pointed mouth may facilitate probing of food items which may be under submerged objects and bottom deposits. There are numerous small but sharp and strong teeth on jaws which are villiform do not show any enlargement into canine or inscisor type of dentition. The nature of dentition suggests that it may help in grasping and holding the active prey and preventing its escape. The absence of gill rakers appears to be compensated by higher efficiency of dentition in performing the assigned function than is normally seen in predatory fishes having tooth like gill rakers to supplement the role of teeth. In the place of the gill arch there is an uneven gill arch surface.

Ingested organisms are generally swallowed whole, particularly when large, with no mastication. The fish lacks structural adaptation to consume items which require oral grinding. The mouth gape is wide enough to support intake crustaceans. Diameter and capacity of the buccopharyngeal cavity are equally accommodating.

Travers, [33] and [34]; Nelson [19]; Vreven [36] regarded Mastacembelidae as highly advanced synbranchiform fishes.

Mastacembelidae have a non-protrusible upper jaw, which is exceptional among percomorphs as jaw protrusibility is characteristic for most neoteleosts [34]. Requirements of a strong bite have led to secondary loss of upper jaw movements in teleosts and also in other predacious forms as noted by Gosline [7].

Sufi [31] and Roberts [23] while comparing the Mastacembelid and Synbranchid fishes stated that mastacembelid spiny eels have developed a unique, flexible trunk like extension of snout, while in synbranchids such extension of mouth is absent. The trunk like extension of the snout in mastacembelids is variably developed and is absent in related *Chaudhuria*. In *Macroganthus* at its most highly specialized condition bears tooth plates on ventral surface of the trunk like extension.

Frost [5] and [6] observed that the maxillaries were excluded from the gape of mouth in mastacembelelids. Nelson [18] and Rosen and Greenwood [24] observed that gill arches are reduced in mastacembelids.

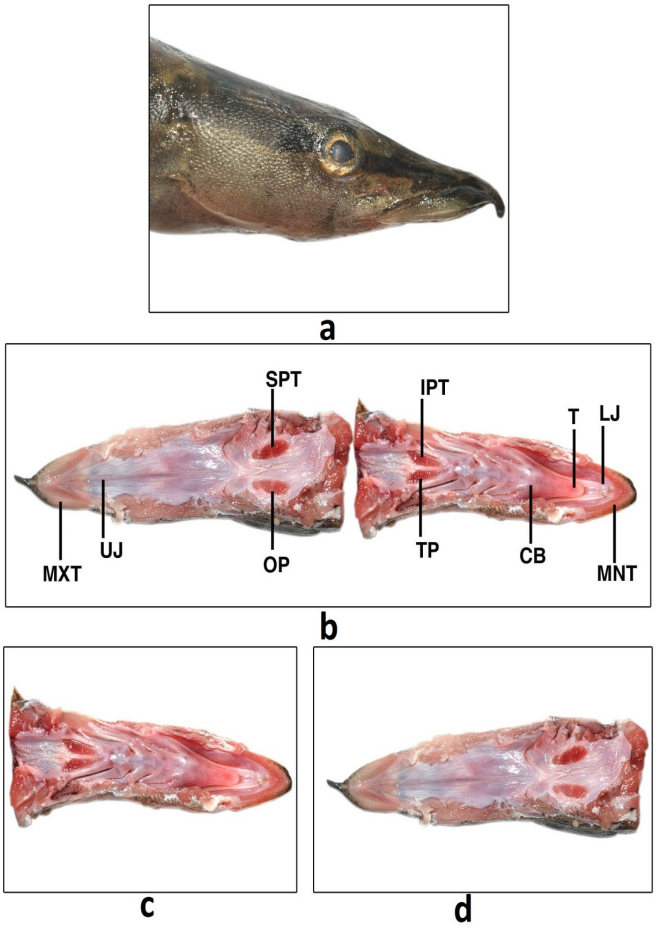

Fig 1. a. Lateral view of mouth of *Mastacembelus armatus*. b. Buccal cavity of *Mastacembelus armatus* showing showing (MXT) maxillary teeth, (MNT) mandibular teeth, (T) tongue, (SPT) superior pharyngeal teeth, (IPT) inferior pharyngeal teeth, (UJ) upper jaw, (LJ) lower jaw, (CB) ceratobranchial, (OP) oval pad and (TP) Triangular pad. c. Lower jaw or floor of the mouth of *Mastacembelus armatus*. d. *Upper jaw or roof of the mouth of Mastacembelus armatus.*

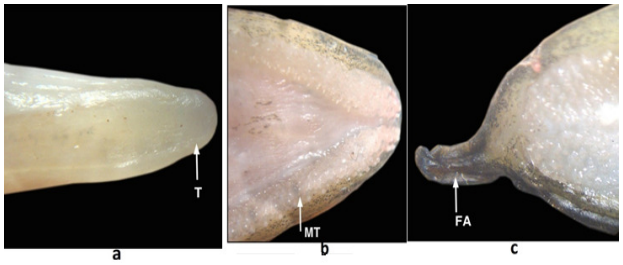

Fig 2. a. Magnified view of lower jaw of *Mastacembelus armatus* showing (T) tongue. b. Magnified view lower jaw of *Mastacembelus armatus* showing (MT) mandibular teeth. c. Magnified view upper jaw of *Mastacembelus armatus* showing maxillary teeth and (FA) fleshy appendage.

Sulak and Shcherbachev [32] described the dentition on the vomer and the premaxillare-ethmoid complex while studying the diagnostic characters of Synaphobranchus kaupii and Synapho branchus affinis.

Similar results were observed by Dutta [4], Serajuddin et al., [27] on feeding while studying the biology of *Mastacembelus armatus.*

Similar results were observed by Agrawal and Tyagi [1] while studying morphology and physiology of *Mastacembelus pancalus*. Khanna and Pant [12] while studying digestive tract and feeding habits of teleost fishes observed similar results.

The position and size of the mouth shows a close relationship to the location and size of food items, and the relative size of the mouth can be used to determine the size of food particles ingested [8]. Particles which are too small may not be detected or captured easily by the fish, while those which are too large may be too difficult to ingest quickly or whole [15]. Moreover, loss of nutrients from large and small food particles after soaking and softening, inevitably lead to wastage. For that mouth size appears to be a limiting factor in feeding with both live and artificial diets.

Travers [33] and [34], Britz [2], Vreven [36], [37] and Britz [3] have studied the feeding morphological characters while classifying the Mastacembelidae family.

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