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Morphology and Surface Ultrastructure of the Olfactory Rosette of Major Carp *Labeo rohita* (Ham.)

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Abstract

The morphology and surface ultrastructure of the olfactory rosette of Indian Major Carp, *Labeo rohita* has been studied with Scanning Electron Microscope (SEM). The olfactory rosettes are oval shaped which are situated at the dorsal aspect of the head. The olfactory rosettes are lodged in pair of olfactory chamber. Each chamber has two separate openings, the anterior and posterior nostrils. The olfactory lamellae are arranged in all sides of the raphe. In lamellar surface the ciliated patches consists mostly of type-1 ciliated cells as their cilia are long. The non ciliated epithelium or the indifferent epithelium is characterized by the presence of microridged epithelial cells interspersed with prominent mucous gland openings. The linguiform process of lamella shows many mucous gland openings between the epithelial cells. These epithelial cells do not have any microridges.

Keywords: *Labeo rohita*, Olfactory rosette, Morphology, Scanning Electron Microscopy (SEM)

Introduction

Fishes posses a good sense of smell and are able to detect Odour with the help of a pair of olfactory organs. The olfactory organs of great biological importance as they help in detection of food and prey (Parker, 1922) and in other behaviours like parental care, recognition of sexes (Nordeny, 1971) and orientation etc. The morphological and surface ultrastructure of the olfactory epithelium of different teleosts have been described by various authors including Bateson (1889), Burne (1909), Liermann (1933), Teichmann (1954), Singh (1967), Ojha and Kapoor (1973 b), Yammamoto Ueda (1978), Bandopadhyay and Datta (1998), Chakrabarti and Choudahry (2007), Bhuti & Baile (2007), Ghosh and Chakrabarti (2013), Kumari *et al* (2013), Ghosh *et al* (2015) and Kumari and Ghosh (2020). Although, few information are available in fresh water major carp fish *Labeo rohita*. The present study and attempt has been to examine the morphology and the surface ultrastructure details of olfactory rosette of fresh water major carp *Labeo rohita*.

Objective of the Study

Study of morphology and ultrastructural (SEM) details of olfactory rosette of freshwater Indian major carp.

Materials and Methods

Live specimens of *L.rohita* were collected from different ponds of Bhagalpur, Bihar, India. The fishes were anesthetized in MS2222 and preserved in formalin for further morphological studies. The fishes were carefully dissected their olfactory organs were exposed and their connection with the brain was traced out. For Scanning Electron Microscopy, the olfactory rosette were dissected out from the anesthetized fish, fixed in 2.5% cold glutaraldehydre prepared in 0.1M phosphate buffer (pH 7.4) for 24 hrs. The tissue was dehydrated in graded ethanol, acetone and stored in unhydrous acetone. The rosettes were further critical point dried, mounted on the SEM stubs with double adhesive tapes, conducted with silver dag, gold coated and observed under Quanta 200 SEM at RSIC Bose Research Institute, Kolkata.

Result and Discussion

Labeo rohita (Ham.) belongs to the family cyprinidae of the order cypriniformes. The olfactory rosettes are lodged in a pair of olfactory chamber which are situated at the dorsal aspect of the head. Each

chamber has two separate opening, the anterior and the posterior nostrils. Both the nostril are situated very close to one another and are separated by a nasal flap of skin (Figure-1). The anterior nostril is comparatively small and more or less round in shape, whereas the posterior nostril is transversally oval in shape. Both the nostrils open just above the olfactory rosette. The olfactory bulbs are vase shaped structures that lies just below the olfactory rosettes of each side. They remain connected with the olfactory tract. Each olfactory tract arises from the vase shaped olfactory bulb and runs backward through the frontal region of the skull. It eventually terminates in the telencephalon. The olfactory lobes are not differentiated (Figure-2). A similar situation was observed by Kumari (2008) in the Indian major carp *Catla catla* and Sinha et al (1981a, 1982b) the exotic carp fishes like *Ctenopharyngodn idella* and *Cyprinus carpio*. An accessory nasal sac is present the anterior side of the rosette on both the sides. According to Ojha and Kapoor (1973b), each olfactory chamber communicates with an anterior ventrally accessory sac whereas Burn's (1909) observation that accessory sacs are absent in carps. Movements of the Jaw bones dilate and compress the accessory sac. Kyle's suggestion (1899) that the presence of accessory sacs in a fish is largely determined by its habit and that, it is a feature characteristic of semisedentory, sluggish or bottom feeding fishes should not be casually brushed a side. In *Labeo rohita* the rosette is oval in shape and which are obliquely oriented, it can be classified under Bateson's (1889) rosettle type-3, Burne's (1909) rosette column-I and Teichmann's (1954) rosette group-I (eye-nose) fishes. The oblique orientation of the rosette in *Labeo boggut* and *Ailia coilia* has been reported by Sinha (1991). The overall structures of the olfactory rosette are very similar to another carp *Catla catla* kumari (2008). The olfactory lamellae are arranged on all sides of the raphe except the anterior end (Figure-3). Which lamellae are arranged in parallel manner. The anterior lamellae are small and they gradually become larger towards the posterior end of the raphe. Some black pigments have been observed on the upper surface of each lamella. Each lamella is a flat structure having an in curved notch at its distal end that gives rise to linguiform process (Figure-4).

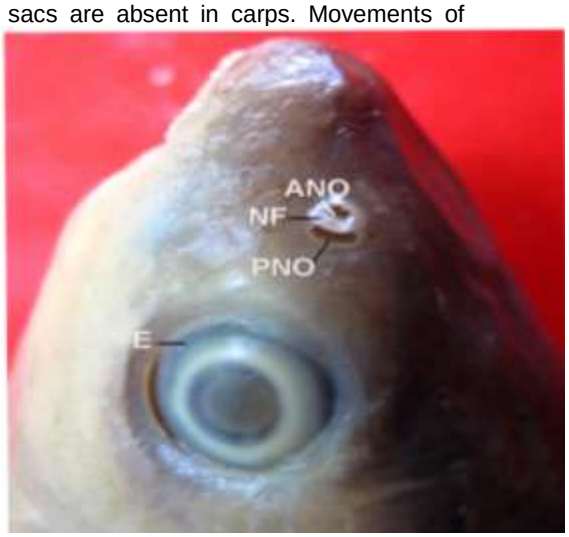

Fig. 1 : Dorsal view of the Head region showing the position of anterior and the posterior nostrils

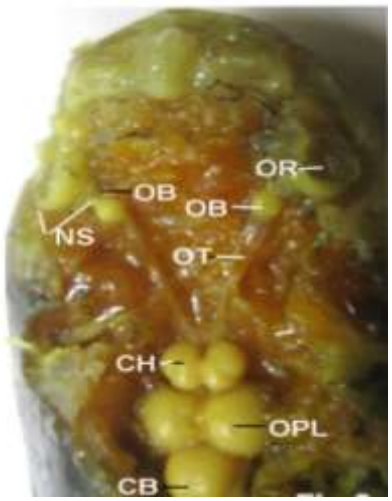

Fig. 2 : Showing the olfactory rosettes and their relationship with the forebrain.

Fig 3 : Structure of one complete olfactory Rosette.

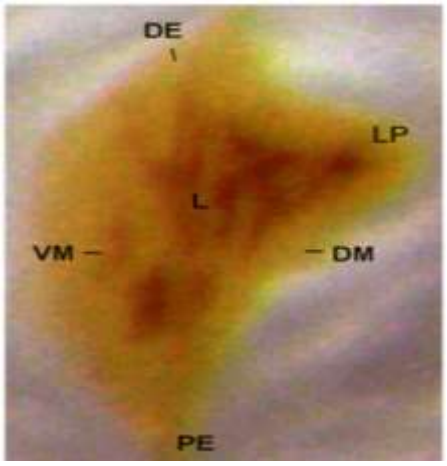

Fig. 4 : Structure of one complete olfactory lamella.

The surface ultrastructure of the olfactory rosette of *Labeo rohita* revealed that the olfactory rosettes are oval cup shaped in structure (Figure-5). The ciliary patches are scattered on the surface of lamellar areas has been observed (Figure-6). The ciliated patches consists mostly of type-I ciliated cells as their cilia are long (Figure-7). Yamamoto and Ueda (1978) also reported similar inclination and patchy distribution of cluster of type-I ciliated cells seems to be a specific features of cypriniformes. However, complete absence of type-2 ciliated cells in *L.rohita*. A very similar observation by Kumari (2008) in *Catla catla* order cypriniformes, whereas Type-2 ciliated cells present in *Scizothorax richardsonii* of order cypriniformes (Kumari and Ghosh, 2020). The non ciliatd epithelium is characterized by the presence of microridged epithelial cells with prominent mucous gland openings. The lamellar surface of the marginal area and the linguiform process shows many mucous gland opening between the epithelial cells (Figure-8). Interestingly these epithelial cells do not have microridges and the surface appears rough and irregular. This area is devoid of any ciliated cells. However, the cilia are less developed in *Catla catla* (Kumari, 2008). An intentionally ruptured olfactory lamella shows the two layers of epithelial surface enclose within them a middle central core and rows of different kinds of cells on both sides of central core (Figure-9). The layers are characterized by mucous cells, the columnar ciliated cells, basal cells and the supporting cells. The ultrastructural details of the median raphe in the rosette of *L.rohita* shows the indifferent epithelium bearing finger print like microridged epithelial cells with few mucous gland openings of different diameters (Figure-10).

Fig. 5 : Full view of an olfactory rosette with the mediam raphe.

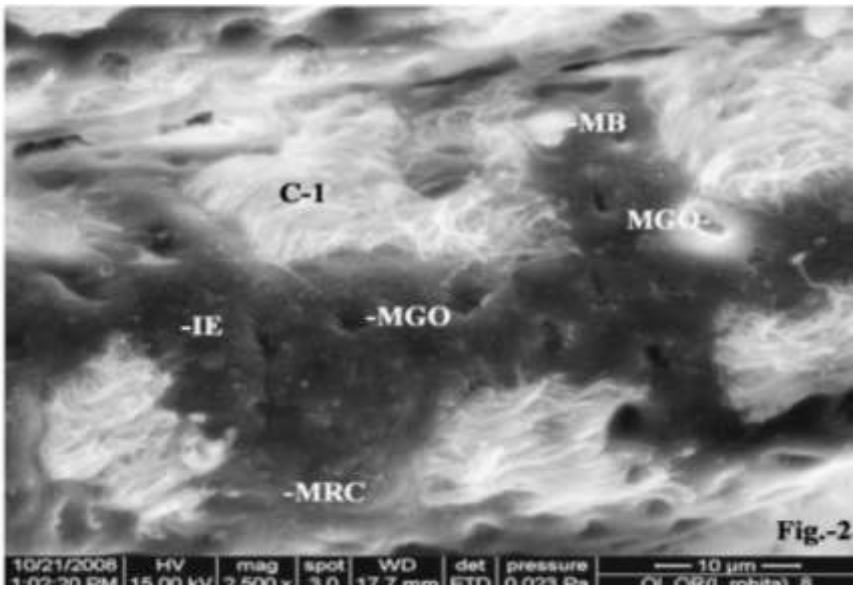

Fig. 6 : Part of the lamellar surface showing ciliated type-1 cells in patches, indifferent epithelium, mucous ball and mucous gland openings.

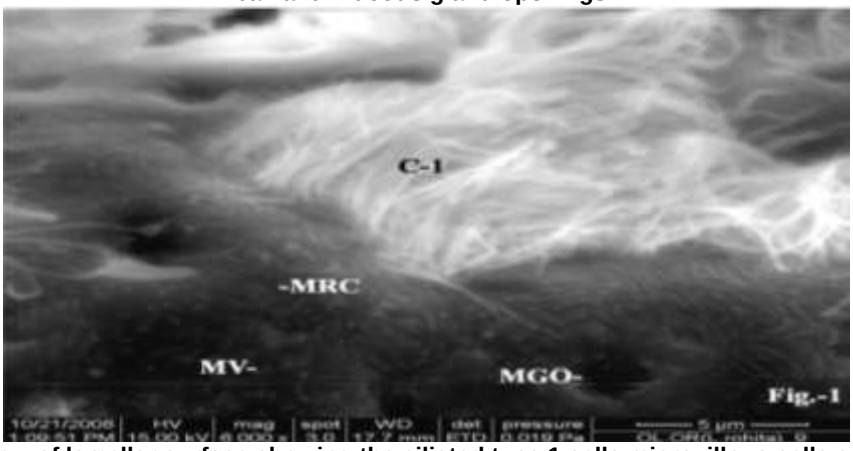

Fig. 7 : Enlarge view of lamellar surface showing the ciliated type 1 cells microvillous cells and non sensory microridged epithelial cells.

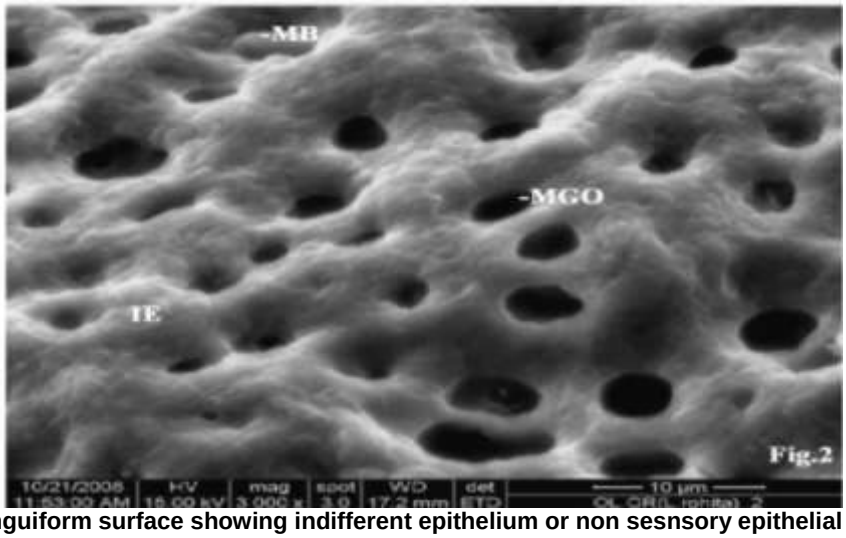

Fig. 8 : Part of linguiform surface showing indifferent epithelium or non sesnsory epithelial cells numerous mucous gland openings and the absence of ciliary patches in this part.

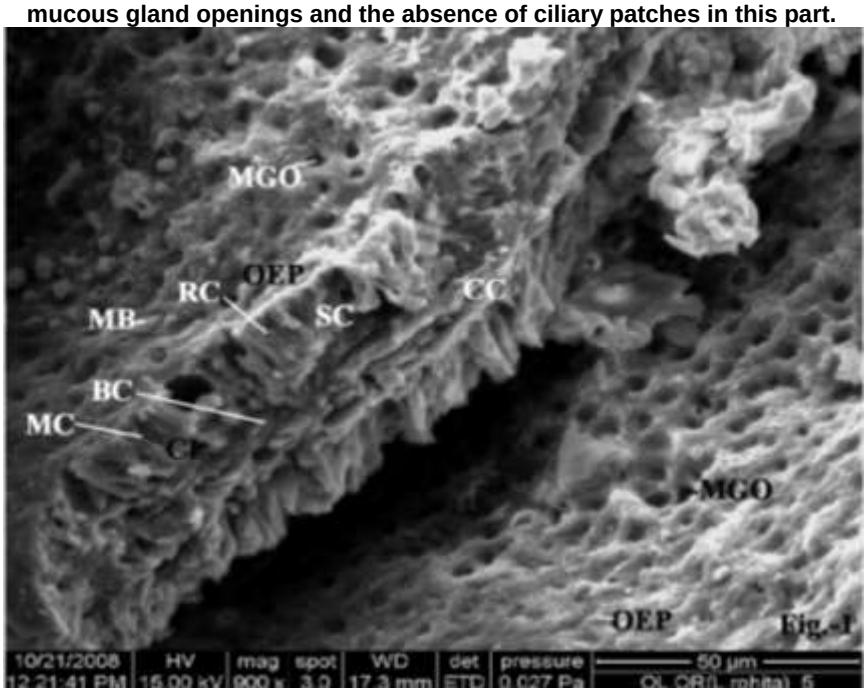

Fig. 9 : inner view of lamella showing central core, receptor cells, mucous cells and supporting cells.

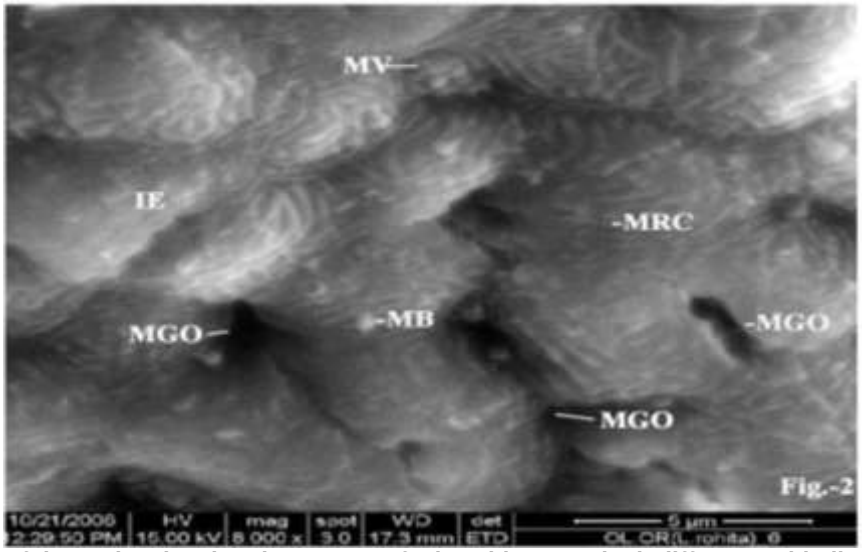

Fig. 10 : Surface of the raphe showing the pattern of microridges on the indifferent epithelium and openings of mucous glands.

Conclusion

The olfactory rosettes are lodged in a pair of olfactory chamber,

1. Each chamber has two separate opening, anterior and posterior nostrils.
2. Nostrils are situated very close to one another and are separated by nasal flap.
3. Elongated olfactory tract present and olfactory bulbs are vase shaped structure.
4. Olfactory lobes are completely absent
5. Olfactory rosettes are found in oval shaped.
6. Each lamella is flat structure having in curved notch and this part is known as Lingui form process.
7. The ciliary patches are scattered on the surface of lamellae consists mostly of Type-1 ciliated cells.
8. Type-2 ciliated cells are absent.
9. In linguiform process, micro ridges are absent and surface appears rough and irregular.
10. Indifferent epithelium bearing finger print like micro ridges epithelial cell with few mucous gland openings of different diameter.

Abbreviations

ANO-Anterior Nasal Opening, CB-Cerebellum, CH-Cerebral Hemisphere, DE-Distal End, DM-Dorsal Margin, E-Eye, L-Lamella, LP-Linguiform Process, NF-Nasal Flap, OB-Olfactory Bulb, OE-Olfactory Epithelium, OPL-Optic Lobe, OR-Olfactory Rosette, OT-Olfactory Tract, PE-Proximal End, PNO-Posterior Nasal Opening, R-Raphe, VM-Ventral Margin, C-1-Ciliatd type-1 Cell, C-2-Ciliated type-2 Cell, CC-Central Core, IE-Indifferent Epithelium, MB-Mucous Ball, MGO-Mucous Gland Opening, MRC-Microridged Epithelial Cell, MV-Microvillous Cell, RC-Receptor Cell, RDC-Rod Cell, SC-Supporting Cell.

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