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# Correlation between medulla oblongata and feeding habits in two teleosts

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**Abstract**

A comparative study of hindbrain was analysed on medulla oblongata especially facial, vagal and somatic sensory lobe in two teleost namely *Aplocheilus lieneatus*, a carnivorous surface feeder and *Nemachilus rupecola* a bottom feeder. The former feed largely by sight and correspondingly large eyes and upwardly directed mouth, facial and vagal lobes are poorly developed; Whereas, in *N*. *rupicola,* being a bottom feeder and downwardly directed mouth and poorly developed eyes. Surface feeders are constantly exposed to external sound at the surface of water, their auditory centres in the brain especially the central acoustic area is well developed in *A*. *lieneatus* and this area is poorly developed in *N*. *rupicola.*

**Keywords:** Fish, Feeding habit, Medulla oblongata, Facial lobe, Vagal lobe, Central acoustic area**.**

## Introduction

The hind brain of fishes show a high degree of structural variation in different forms has long been known to zoologists. The principal factor that brings about variations in the structure of hind brain is widely regarded as their feeding habits. Primary division of the brain which consists of the medulla oblongata with the cerebellum and other less constant appendages in fishes is called "epencephalon". It is relatively larger, occupies a greater portion of the cranium, and more complex and diversified in fish than any of the higher class of vertebrata (Bhimachar, 1937). The important lobes of the medulla oblongata are the terminal centres for the nerve fibers of the vagal and the facial nerves respectively. The size of these lobes depends upon the extent to which their nerve fibers supply taste buds. The taste buds in the pharynx are supplied by the IX & X nerves and those on the snout and the outer surface of the skin is supplied by the VII nerve.

The facial lobes are connected with the taste buds of the lips, barbels and anterior part of the buccal cavity. The vagal lobes are connected with the taste buds of the posterior part of the buccal cavity, pharynx, gills and oesophagus. The connection of these lobes with the important centres related to tasting of food in fishes during feeding. The pioneers in this field are those of (Evans, 1931; Bhimachar, 1935, 1937; Pavloski,1953-55; Khanna & Singh, 1966; Saxena,1967; Sherly & Azis, 1993; Butler & Hodos,1996) correlated the structure of brain with the feeding habit.

The present study investigates on the structure of medulla oblongata in two fishes namely *Aplocheilus lineatus,* a surface feeder and *Nemachilus rupecola*, a bottom feeder belonging to different families with diverse feeding habits, to establish correlations between feeding habits and the structure of the hindbrain mainly facial, vagal and somatic sensory lobes.

## Materials and methods

Fishes like *Aplocheilus lineatus* and *Nemachilus rupecola* were collected from the natural habitats. The fishes were sacrificed and the brains were dissected out and fixed in neutral buffered formation. Thin sections were made act of 8µ thickness and sections stained in Harmatoxylin- Eosin and carefully examined to reveal the variations exist in the structure of medulla oblongata in these two fishes.

## Observations

*A. lineatus* is found to be a very active carnivorous surface feeder, usually feed by sight. It is also a larvivorous fish. The brain of *A. lineatus* is very small and completely fills the entire cranial cavity. The olfactory lobes are minute and without olfactory tract. The cerebral hemispheres almost rounded. The optic lobes are well developed or which is the largest portion in the brain of *A. lineatus*. The cerebellum is partially hidden by the optic lobes. The medulla oblongata is cylindrical and dorsoventrally compressed (Fig.1). The vagal lobes are not so well developed. The somatic sensory region is well developed. Large number of myelinated fibers can be seen around the vagal lobe, called substantia reticualaris (Fig. 2). It is the chief medium of communication between the sensory and motor centres for reflex pathways.

Facial lobes are very small. The two somatic sensory lobes are connected by thick - bundle of fibers called, commissura infima (Fig. 3). The chief sensory secondary tract, the leminiscus can be seen on either side of the median longitudinal fasciculus. Rostrally, it receives thick fibers from the vagal lobes. The most important region with hind brain of *A. lineatus* can be seen below the cerebellum as a prominent transverse small celled deeply stained area. This is the central acoustic area (Fig. 2). It is regarded as the terminal centre in the brain for the sense of hearing. It is an important feature in the medulla

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*Fig.1. Morphology of brain in A.lineatus*

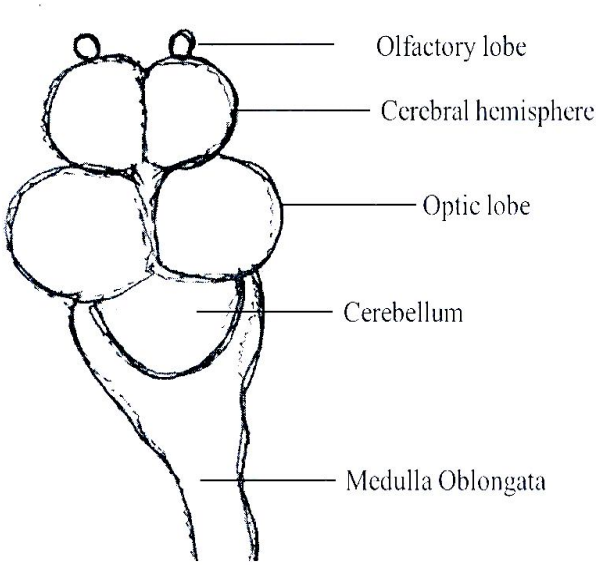



*Fig.4. Morphology of brain in N.rupecola*

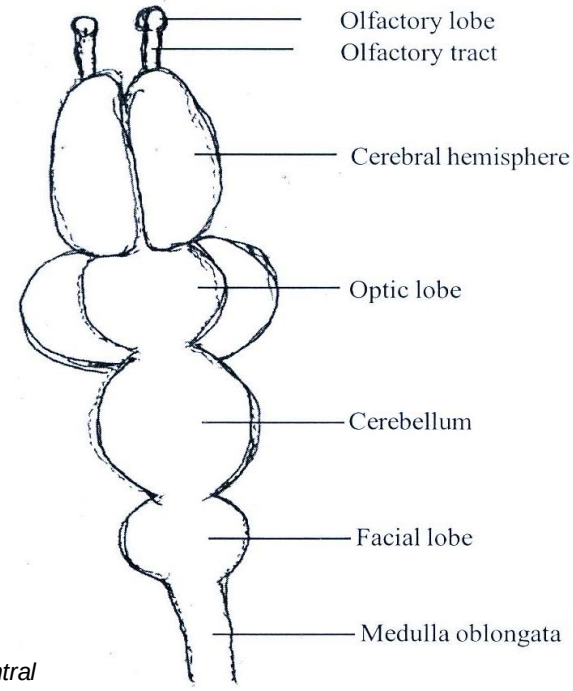



*Fig.2. Photomicrograph showing central acoustic in A. lineatus*

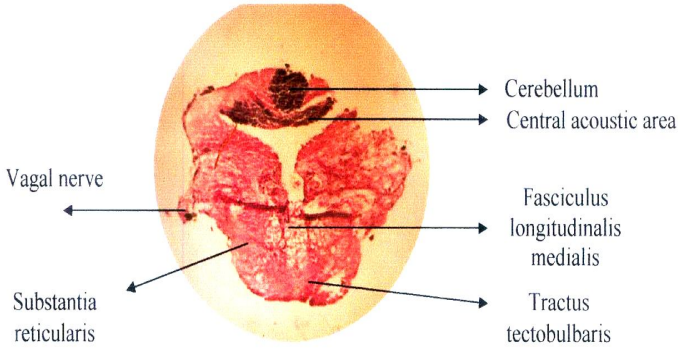



*Fig.3. Photomicrograph showing the hind brain in A. lineatus*

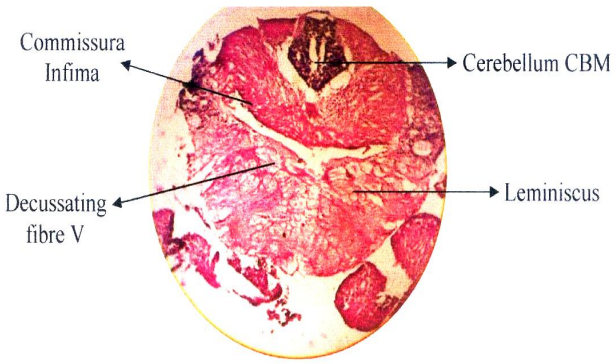
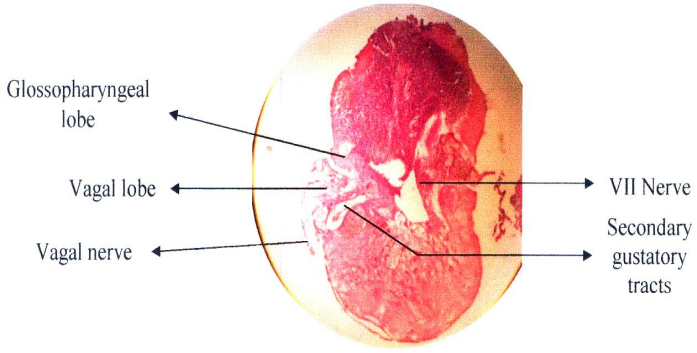



*Fig.5.Photomicrograph showing hind brain in A. rupicola*



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oblongata of sight feeding fishes. In *A. lineatus* sight and hearing are well developed.

*Nemachilus rupicola* is a bottom feeder and sort out food by the taste bunds present in the barbels. The telencephalon consists of a pair of small, solid and almost triangular olfactory lobes in addition to the elongated cerebral hemispheres (Fig.4). The olfactory tracts are short each ending in a bulb. The optic lobes are small and rounded. The taste buds in the barbels are innervated by the VII nerve and consequently the facial lobe is highly developed in this fish. The facial nerve is divided into two branches after entering, the brain. The vagal lobes are small. The facial lobes are involved in skin and barbel tasting while vagal lobes are concerned with mouth tasting. In *N. rupicola* mouth tasting is least important due to poorly developed vagal lobes (Fig. 5). And skin and babels were the main taste sensors.

## Discussion and conclusion

*Aplochictus lineatus* is a surface feeding fish that feeds primarily by sight. This has led to the poor development of the facial and vagal lobes. But has stimulated the growth of an auditory centre in the brain the central acoustic area. This auditory centre is an additional advantage to this fish. As a result of sight feeding the gustatory organs (taste buds) are poorly developed, and thus the correlation centres of the gustatory organs are poorly developed.

According to Evans (1932) and Bhimachar (1935) the central acoustic area is highly developed in surface feeding fishes. It is auditory in function. The explanation for the development of central acoustic area in surface feeding fishes is that, as a result of constant exposure to the external sounds at the surface of water they have acquired a keen sense of hearing, is true in the case of *A. lineatus* while the ears hear the external sounds, tones of low frequency are perceived by the lateral line sense organs. The acoustic area is a highly complex structure in the brain of the fish.

The fibers of the VIII nerve has two distinct functions, auditory and vestibular and also all the fibers of the lateral line nerves conveys a third type of impression terminate in this area. The acoustiolateral area of fishes receives all nerve fibers from the external ear and from several kinds of lateral line organs, and the central terminations of these different sets of fibers are so intertwined within this area that it has hitherto not been possible to separate completely the reflex centres of many diverse functions represented in this complex system of peripheral sense organs (Herrick, 1924).

In *N. rupicola* (cyprinoids), which possess taste buds all over the body and especially on the head and barbels, there is an enlargement of VII, IX & X sensory nuclei. The presence of taste buds on the barbels is responsible for the division of the VII nerve into an anterior and a posterior branch. These branches are separated by the descending gustatory fibers from the facial lobes. It is suggested that, in all fishes in which barbel is gustatory in function, the VII nerve divides into 2 and further branches out after entering the facial lobe. In the surface feeders, the barbels are no longer of any use to the fish and hence they are absent or highly vestigial. In *N. rupecola*, three pairs of barbels with taste buds have gustatory in function. The acoustic area is prominently developed in all sight feeders, (*A. lineatus*) but, poorly developed in bottom feeding fish (*N. rupecola)* which is not exposed to the influence of the external sound waves; this area is almost completely absent.

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## References

1. Bhimachar BS (1935) A study of correlation between the feeding habits and structure of hind brain in some south Indian cyprinoid fishes. *Proc. Roy. Soc. London. CXVII (B),* 258-272.
2. Bhimachar BS (1937) A study of cyprinoid fishes with special reference to their feeding habits. *Ibid. CXXIII (B)*, 59-68.
3. Butler AB and Hodos W (1996) Functional organization of zebrafish hindbrain. NY *Ac. Sci*. 563, 11-33.
4. Evans HE (1931) A comparative study of brain of british cyprinoids in relation to their feeding habits with special reference to the anatomy of medulla oblongata. *Proc. Roy. Soc. London. CVIII (B).* 233-257.
5. Herrick CJ (1924) Neurological foundations of animal behavior. Hafner Publ. Co., NY. pp:220.
6. Khanna SS and Sigh HR (1966) Morphology of teleostean brain in relation to feeding habits. *Proc. Acad. Sci. India. XXXVI (B).* 306-316.
7. Mookerjee HK Ganguly DN and Mookerjee PS (1950) Study on the brain of some Indian fishes in relation to feeding habits*. Proc. Zool. Soc. Bengal. III.* 119-316.
8. Pavloski FN (1953-55) Structure of fish brain in connection with their mode of life*. Trud. Sovesh. Ichthiol Komm*. pp: 70-77.
9. Saxena PK (1967) Studies on the correlation of brain with feeding habits in certain teleostean fishes. *Proc*. *Nat. Acad. Sci. India.* 37(B). 367-372.
10. Sherly PS and Abdul Azis PK (1993) Studies on the fish brain in relation to feeding habits. Ph. D. Thesis, Kerala University. India.