

Histological Observation of the Barbel in the Spined Loach, *Iksookimia longicorpa* (Cobitidae)

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The barbel structure of the spined loach *Iksookimia longicorpa* were investigated histologically. Their barbels consist of epidermis, dermis, and a central rod. The epidermis contains mucous cells, terminal buds, granular cells, and epidermal cells. The mucous cells are thin rims of basophilic cytoplasm and are located at the surface of the epidermis. The terminal bud is basophilic and is situated at the distal portion of the epidermis. The dermis consists of loose connective tissue containing blood vessels, pigment cells, and nerve cells. The central region of cartilage is the innermost region and is enclosed within muscle layers.

Key words : *Iksookimia longicorpa*, histology, barbel, mucous cell, terminal bud

Introduction

A great variety of marine and fresh-water fishes possesses externally situated appendages, the barbels. These are accessory feeding structure that carry sensory organs and thus seem to play an useful and important role in their daily activities. The barbels show considerable variations in their structures among fishes. And the number, length and position are extremely variable. Comparison of histological structures of the barbels was made in some species (Satô and Kapoor, 1957; Nagar and Mathur, 1958; Srivastava and Sinha, 1961; Agarwal and Rajbanshi, 1965; Rajbanshi, 1966; Kapoor and Bhargava, 1967; Singh and Kapoor, 1967; Satô, 1977).

The genus *Iksookimia* was transformed from *Cobitis* by Nalbant (1993) and contains six species in Korea (Kim, 1997). *Iksookimia longicorpa* is a benthic freshwater fish which inhabits pebbly bottom. *I. longicorpa* has three pairs of barbels and its structure has not been reported histologically. Therefore, the present work is to study the structure of the barbel of *Iksookimia longicorpa* belonging to the family Cobitidae.

Materials and Methods

The observed eight specimens were collected from the Nakdong River, Korea. *Iksookimia longicorpa* has three pairs of barbels, but observation was performed only the third barbel. The specimens were fixed in 10% neutral buffered formaldehyde. The barbel was dehydrated through a standard ethanol series to 100%, cleared in xylene and then embedded in paraffin (Paraplast, Oxford). 5 µm sections were deparaffinized and were stained with Ehrlich Haematoxylin in combination with eosin. Observation and evaluation was made by light microscope (Carl Zeiss).

Results

The barbel consists of three principal layers: epidermis, dermis, and a central skeletal axis of cartilage (axial rod) (Fig. 1A).

The thickness of the epidermis is approximately 90.8 µm. The epidermal layer is composed of stratified epidermal cells which have spherical or ovoid shape in the surface layer, while they are columnar in the basal layer (Fig. 1A-C). In the surface of the epidermis, mucous cells with basal nuclei are found and they have a thin rim of

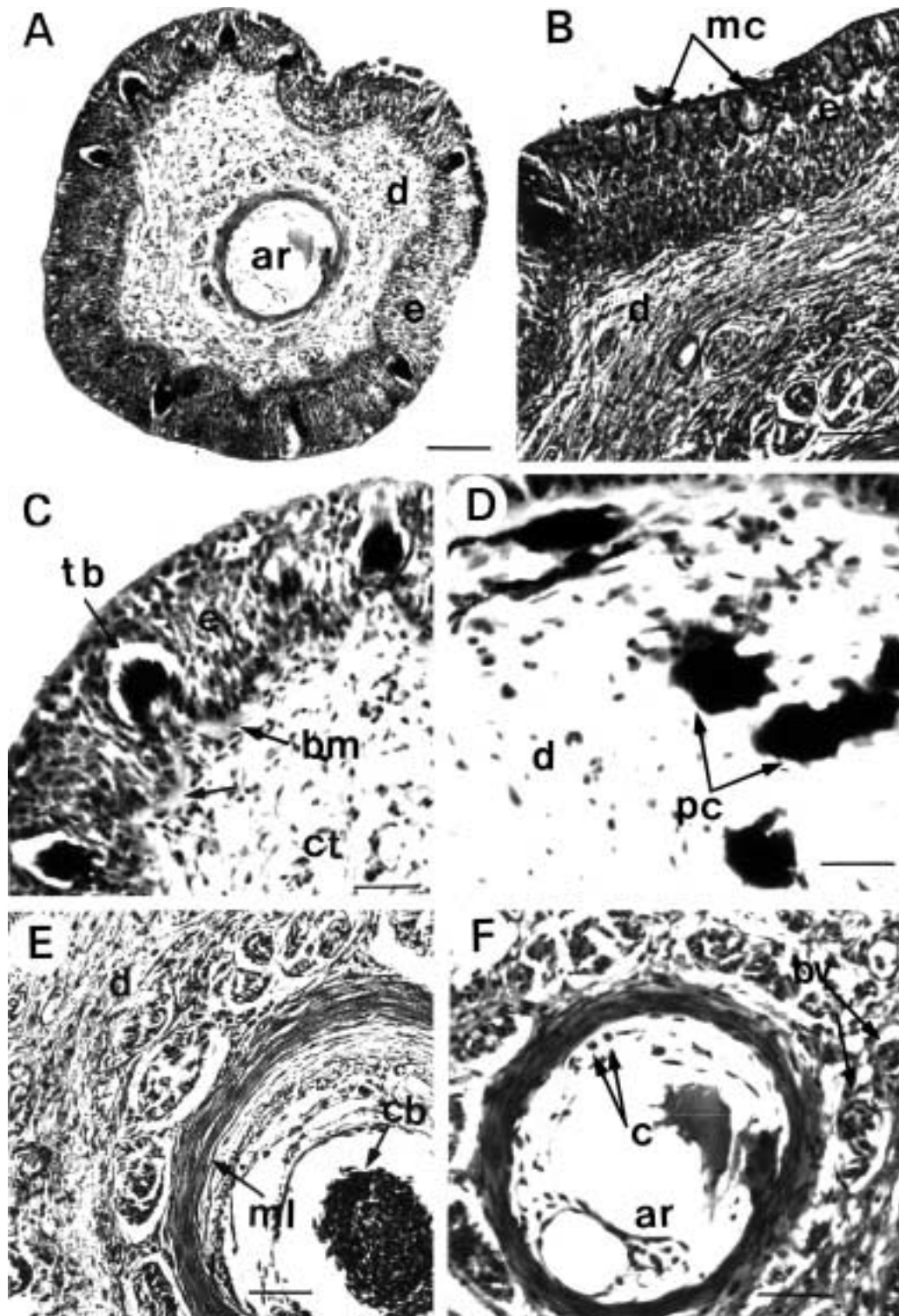


Fig. 1. Structure of barbel of *Iksookimia longicorpa*. (A) transverse section of the third barbel showing the structure of the epidermis, dermis, and axial rod of cartilage. Bar = 6 μ m. (B) mucous cells. Bar = 3 μ m. (C) terminal buds, basement membrane, loose connective tissue. Bar = 2.5 μ m. (D) pigment cells. Bar = 4 μ m. (E) central blood vessel, smooth muscle layer. Bar = 2.5 μ m. (F) cartilage cells, blood vessels. Bar = 2.5 μ m. (Abbreviations: ar, axial rod of cartilage; bm, basement membrane; bv, blood vessels; c, cartilage cells; cb, central blood vessel; ct, loose connective tissue; d, dermis; e, epidermis; mc, mucous cells; ml, smooth muscle layer; pc, pigment cells; tb, terminal buds).

slightly basophilic cytoplasm. There are a great number of terminal buds among the epidermal cell (Fig. 1C). The terminal bud varies in size and flush with or even cross the periphery and lies closer in the distal portion than the proximal of the barbel. They are basophilic. Among the epidermal cells, there are granular cell with deeply stained nuclei and small amounts of faintly stained cytoplasm.

The dermis is separated by basement membrane with epidermal layer and their thickness is thicker than epidermis, approximately 167.9 μm (Fig. 1A–E). The dermis consists of loose connective fibers, which contain abundant blood vessels, pigment cells and nerve fibers. The pigment cells are scattered in the superficial dermis (Fig. 1D).

The axial rod of the barbel is the innermost region consisted of cartilaginous tissue, approximately 191.1 μm in the thickness (Fig. 1E–F). The axial rod forms “supporting rod” of the barbel. Cartilage cells are irregular in shape and each of them has a nucleus in the center (Fig. 1F). This cartilage has a little ground substance which contains dispersed fibers. The axial rod is ensheathed by an inner circular and several bundles of longitudinal layers of muscles which in turn are surrounded by a circular layer of smooth muscles (Fig. 1E–F). The axial rod contains central blood vessels (Fig. 1F).

Discussion

Barbels of fish are fleshy and elongated structures that carry tactile and chemosensory receptors although there are some differences by species (Bond, 1996). In particular, movable barbels of some catfishes seem to play an important role in food localization (Singh, 1967). The high gustatory sensitivity of the barbels extends the usefulness of these chemoreceptors a reasonable distance from the fish, presumably to aid in finding food in murky water (Moyle and Cech, 2000).

As listed by Kapoor and Bhargava (1967), barbels were divided into two types: (1) tender and yielding type—each lacks the axial cartilaginous rod and the dermis has a network of blood vessels, (2) stiff barbels of motionless, and flexible kinds. The motionless barbel has a supporting axis of true bone. The flexible barbels have a cartilaginous axis. The barbel of *Ikookimia longicorpa* has epidermis of mucous cell, terminal bud, and epidermal cell, and dermis with plenti-

ful blood vessel, and axial cartilaginous rod. In accordance with the above classifications, the barbel of *Ikookimia longicorpa* is of a tender and flexible type.

The epidermis of *I. longicorpa* is the mucous cell of surface layer and the terminal buds which buried among epidermal cells. The terminal buds and club cells of the skin of the barbel were reported in a marine catfish, *Arius thalassinus* (Kapoor and Bhargava, 1967). Also, the terminal buds, mucous cells, and club cells were observed in the barbel of *Callichrous bimaculatus*, *Heteropneustes fossilis* (Satô and Kapoor, 1957), *Clarias batrachus* (Srivastava and Sinha, 1961), and *Rita rita* (Singh and Kapoor, 1967). The presence of terminal bud was founded in the barbels of *Bagarius bagarius* (Nagar and Mathur, 1958) and *Blepsias cirrhosus draciscus* (Satô, 1977). In the barbel of *Mystus vittatus*, terminal buds, mucous cells, and club cells were lacked and therefore function of the barbel was restricted to be tactile, not gustatory (Agarwal and Rajbanshi, 1965). Otherwise, Rajbanshi (1966) stated the mucous cells and copious terminal buds as well as tactile organs in *Wallago attu*. However, such a tactile organ was not founded in the barbel of *I. longicorpa*.

The terminal buds have a dual function, organs of chemical sense and a gustatory function (Moore, 1950). There may even be a possibility that in some species these structures possess the single function of taste, whereas in others they may have taken on tactile, thermal, or common chemical sense—functions (Moore, 1950). The structure of the terminal bud of *I. longicorpa* is similar to that described above but its function is uncertain.

References

- Agarwal, V.P. and V.K. Rajbanshi. 1965. Morphology and histology of the cutaneous sense organs of *Mystus vittatus* (Bl.). Proc. Ind. Acad. Sci., B, 61 : 39–48.
- Bond, C.E. 1996. Biology of Fishes. 2nd ed. Saunders college publ. Co., New York, 750 pp.
- Kapoor, B.G. 1965. Histological observations on the skin of the head of a siluroid fish, *Wallago attu* (Bl. & Schn.). Mikroskopie, 20 : 123–128.
- Kapoor, B.G. and S.C. Bhargava. 1967. A study on the barbels of a marine catfish, *Arius thalassinus* (Rüpp.). Japan. J. Ichthyol., 14 : 201–206.
- Kim, I.S. 1997. Illustrated encyclopedia of fauna and flora of Korea Vol. 37. Fresh-water fishes.

- Ministry of Education, Korea. National Textbook Co. 629 pp. (in Korean)
- Moore, G.A. 1950. The cutaneous sense organs of barbeled minnows adapted to life in the muddy waters of the Great Plains Region. Trans. Amer. Micros. Soc., 69 : 69~95.
- Moyle, P.B. and J.J. Cech, Jr. 2000. Fishes: An introduction to Ichthyology. 4th ed. Prentice-Hall Inc., New Jersey, 612 pp.
- Nagar, S.K. and R.P. Mathur. 1958. Morphological and histological observations on the barbels of a few Indian fresh-water teleosts. Proc. Zool. Soc., Calcutta, 11 : 63~68.
- Nalbant, T. 1993. Some problems in the systematics of the genus *Cobitis* and its relatives (Pisces, Ostariophysi, Cobitidae). Rev. Roum. Biol. (Biol. Anim), 38 : 101~110.
- Rajbanshi, V.K. 1966. A note on the study of gustatory senses of the barbels of fresh water teleosts. Naturwissenschaften, 8 : 208~209.
- Satô, M. and B.G. Kapoor. 1957. Histological observations in the barbels of Indian fresh-water fishes, Alaska codfish and *Podothecus acipenserinus*. Annot. Zool. Japon., 30 : 156~161.
- Satô, M. 1977. Histology of barbels of *Blepsias cirrhosus draciscus* (Cottidae). Japan. J. Ichthyol., 23(4) : 220~224.
- Singh, C.P. and B.G. Kapoor. 1967. Histological observations on the barbels of a bagrid catfish, *Rita rita* (Ham.). Japan. J. Ichthyol., 14 : 197~200.
- Srivastava, C.M. and A.N. Sinha. 1961. Contribution to the study of barbels of fishes. Vest. Cs. spol. Zool., (Acta soc. zool. Bohemosla.) 25 : 12~15.
- Rajbanshi, V.K. 1966. A note on the study of gusta-

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왕종개 *Iksookimia longicorpa* (Cobitidae) 수염의 조직학적 관찰

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*Iksookimia longicorpa*의 수염은 표피, 진피, 중축으로 구성되어 있다. 표피는 중층막으로 되어 있으며 미뢰, 점액세포, 과립형 세포, 표피 세포를 포함한다. 점액세포는 약한 호염기성을 보이며 표피의 표면에 위치하고 있다. 반면에, 미뢰는 강한 호염기성을 나타내며 표피의 기부에 위치하고 있다. 진피는 소성결합조직으로 구성되어 있고, 혈관, 색소세포, 신경세포를 함유하고 있다. 중축은 가장 깊숙한 부분으로 근육층으로 둘러싸여 있다.