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Histological study of maxillary barbels in *Silurus triostegus* and *Heteropneustes fossilis* (SILURIFORMES) fishes collected from Basra City waters

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Abstract

In this study the maxillary barbels were investigated in *Silurus triostegus* (Heckel, 1843) and *Heteropneustes fossilis* (Bloch, 1794) which collected from Basra (Shatt Al Arab) waters**.** After histological preparations, the histological results revealed that in the two species, the barbels showed epithelium, dermis, muscle layers, tastes buds, blood vessels, nerve fibers and cartilage. The thickness of epithelium differs between the two species also the shape of taste buds. The cartilage occupies the core of the barbel and consider to be primitive cartilage with chondrocytes and matrix. Two types of muscles were distinguished in the studied species smooth and skeletal muscles..

Introduction

Fishes have many and various appendices that extended from the skin, like barbels which differ in location or in structure and developed in many species independently as an accessory structure that being important in feeding. Barbels are found in many families in marine and freshwater fishes for example Acipenseridae, Mullidae, Siluriformes and Cobitidae [1]. Barbels in fishes are different in number in some fishes they reach to 11 paired or unpaired barbels on jaws, lips and head. Also, inside the same species there is barbels variation because of sexually dimorphic or polymorphic among individuals of either sex [2,3].

The taste buds present widely over many parts of fish body and barbel is one of these parts, the taste buds concentrated on barbels epidermis in the anterior edge [4-8]. It is obviously that all siluriform fishes have barbels witch the numbers of pair ranging from one to four, the barbels are different also in form, there from most minute to as long as body length, in hagfish (Myxiniformes) the most notable are the three pairs (nasal barbels, maxillary barbels and mandibular barbels) around mouth and nostril [9-11].

The barbel can be classified as a barbel with and without cartilage axial, the skeleton rod found among Siluridae, Cobitidae and Pristiphoridae, while genus *Cyprinus* had barbels

without skeleton support. In addition to epidermis, the barbell had dermal layer with blood vessels connective tissue, pigment cells and nerves [12,13].

Iraqi waters have different fishes species belongs to different families and orders [14,15]. Many species belong to Siluriforms recorded in Iraqi waters such as *S. triostegus* and *H. fossilis* which belong to some of these species [16], so the aim of this study is to compare the histological features of maxillary barbels between the two above species.

Material and Methods

Sampling

The samples of this study (5speciemens from each species, Wels catfish *S. triostegus*: Siluridae with 31.6 mm ± 1.94 in total length and fossil catfish *H. fossilis* with total length 12.6 mm ± 1.59: Heteropneustidae) were collected from Shatt Al-arab in Basra city by using gill net during the period from March to May 2019. Samples were kept in big containers and transported to the histology laboratory in veterinary medecine collge in Basrah University, in order to achieve the histological study.

Histological preparation

The fishes were killed by percussive stunning that involves hitting the fish's head with object in brian location and then the dead fishes were preserved and fixed in 10% formalin for 7 days. Length was measured using a vernier. The maxillary barbels were collected from the head of the fish after detecte the crtian barbels, by using scissors pecies of barbel was cut and washed with tap water to remove the formalin then were dehydrated progressively with different concentrations of ethanol (100-50%) clearing with xylene and embedded in paraffin. Five micrometers thick sections of paraffin embedded tissue specimens were mounted on glass slides and stained with hematoxylin and eosin. Sections were examined by light microscope under different maginifiaction power [17], and photographed by canon camera.

Results and Discussion

Generally, the histological sections of barbels in two fish's species, Wels catfish *S. triostegus* and fossil catfish *H. fossilis* showed the same layers which including epithelium, dermis, muscle layers (smooth and skeletal) and in the center of the barbels there was the cartilage, which consider the core of the barbels but there are so many differences in tissue structures and in measurements between the two species (Figure 1 A and B).

In *S. triostegus* the epithelium was stratified squamous, with 39.285µ ± 11.338, the cells were revealed in many layers (with rounded cells and center blue rounded nucleus, among the epithelial cells (13-17 layers) there are big rounded white cells (mucous cell) which found lots in different layer of epidermis, there are many taste buds in this barbel that could be distinguished by the arrangement of cell that colored with dark blue. In *H. fossilis* the epithelial contain 2- 3 squamous cells layers with 14.285µ ± 7.867 the mucous cells diffuse between the layers, there were small taste buds also in these layers (Figure 2, A and B).

The epithelium in both species was stratified squamous epithelium which contains taste buds and mucus cells. The mucus producing skin of the fish represents the first line of defense against foreign pathogens [6-18].

The thickness of epithelium in *S. triostegus* was bigger than in *H. fossilis*. These results agree with [19,20]. Barbels with taste buds in the epidermis, is means that barbels used as taste organ beside tactile [21]. In both species, beneath the epithelium, there was the dermis which contain nerve fibers, collagen fibers with fate pink color and high vascularization of blood vessel in different size, black color showed in the dermis defiantly under the epithelium, the melanocytes that responsible for the color of the skin in fish (Figure 3 A and B).

Two types of muscle were distinguished in both fishes *S. triostegus* and H.fossilis, smooth muscle that surrounded the cartilage with thick layers and skeletal muscles that diffuse in different location of barbels tissue (Figure 4 A and B).

Kapoor and Bhargava classified the barbels into 2 types the first is tender that lack an axial rod (cartilaginous), the second is stiff with cartilaginous or bone axis [22]. The core of the barbels in this study contain cartilage for both two species, these results agree with [23,24], the axial rod of the barbel different from species to another while one contains cartilage, the other has bone or muscle [7-25].

The axial rod of both barbels contain cartilage, the closely packed round chondrocytes with dark blue nucleus are the main content of the cartilage, the cell lies in cavity called lacuna, and due to preparation procedure of tissue slides the space appear between lacuna and cell, There is a variation in chondrocyte size within the same piece of tissue the cells diffused between the matrix with fibers, matrix neither innervated non vascularized (Figure 5 A and B), table 1 noted the measurements of the tissues in both of two species, according to this table it was seen that the thickness of *S. triostegus* barbel was bigger than the other and that led to make the other cells in this barbel have been large in measurings.

The cartilage in *S. triostegus* and *H. fossilis* considers to be a very primitive type which called the hyaline-cell cartilage, also called pseudo-cartilage in this study the muscle was surrounding the cartilages, while in *Corydoras paleatus* the cartilage framing with nerve fibers [26].

The dermis of *S. triostegus* and *H. fossilis* had two types of muscle smooth and skeletal while and this result disagree with [27]. The muscles involved in moving the maxillary barbels are simple in the channel catfish compared to some other siluroids such as *Rita rita* in which several muscles are involved [28].

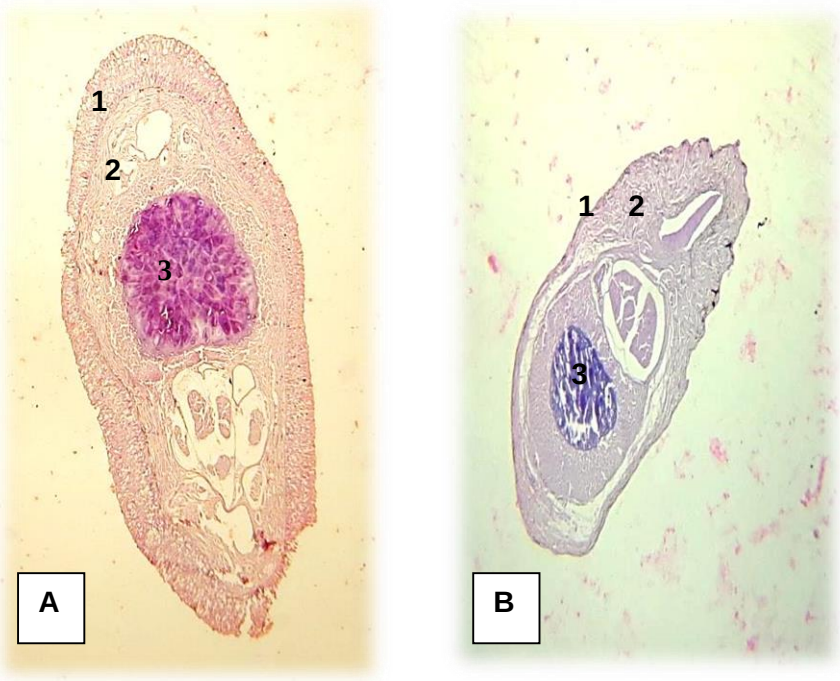

Fig. 1: *Cross section of maxillary barbel in A: S. triostegus B: H. fossilis. 1: epithelium, 2: epidermis, 3: cartilage. 40X, H & E.*

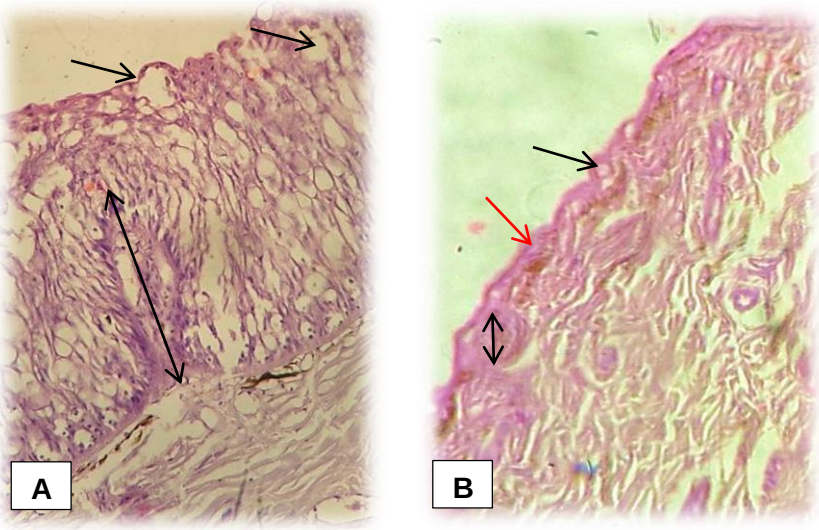

Fig. *2: Cross section of maxillary barbel through the epithelium A: S. triostegus 400X, B: H. fossilis 1000X. taste bud: mucus cell ↔ : → , squamous epithelium: →, H& E*

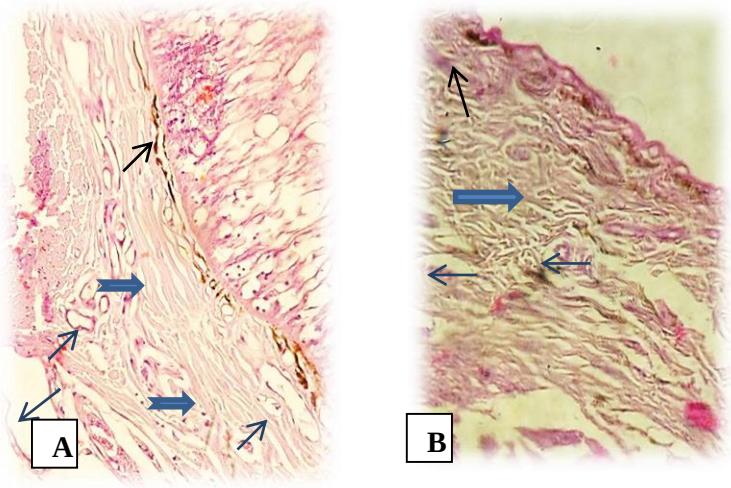

Fig. 3*: The dermis in A: S. triostegus 400X, B: H. fossilis 1000X. collagen fibers:* ➡*,blood vessels:* ⟵*,melanocyte:* ↗ *, H&E.*

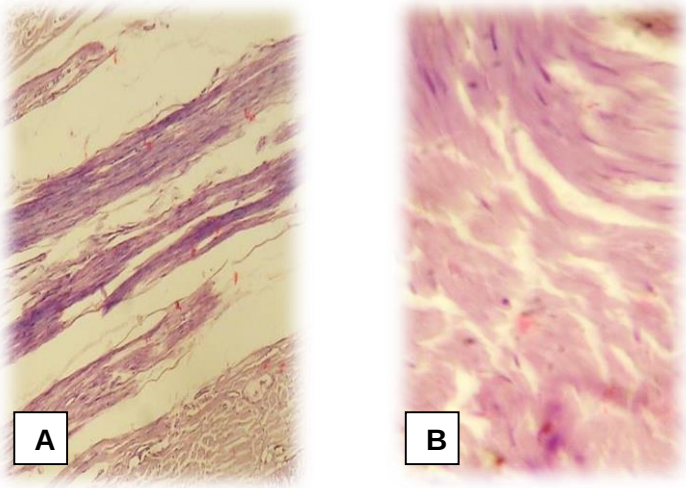

Fig. 4*: The muscle in the barbel A: S. triostegus longitudinal section of skeletal muscles 400X, B: H. fossilis cross section of smooth muscle 1000X. H & E.*

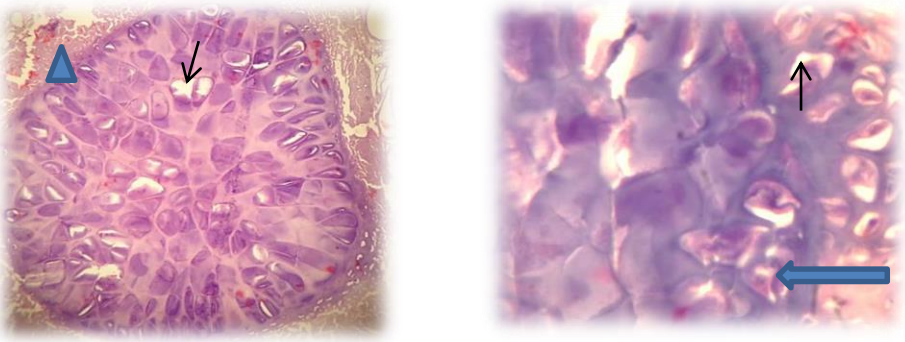

Fig. 5: *The cartilage in the barbel A: S. triostegus 400X, B: H. fossilis 1000X . chondrocyte( ),lacuna ( ), muscle ( ). H & E*

Table 1: The mean with stander deviation of barbel tissue (µ) in *S. triostegus* and *H. fossilis*

Tissue Dimension	*S. triostegus*	*H. fossilis*
Barbel length	462.857 ± 40.089	287.857± 23.248
Barbel width	232.142 ± 21.185	129.285± 6.074
Cartilage width	130.714 ± 47.908	61.428 ± 8.997
Epithelium width	39.285± 11.338	14.285 ± 7.867
Dermis width	32.857± 11.852	29.285± 13.047
Taste bud	25 ± 4.082	5 ± 0

Conclusion

The current results noted the differences between the maxillary barbel in two types of Siluriformes fish, showed that there are clear histological differences between the two species in the structure and thickness of the layers, the reasons may be due to the function that the barbel performs in the species**,** the core of the barbles in both species has cartilage and that mean these barbles were flexible and not motionless.

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دراسة نسجية للوامس الفكية في الجري الاسيوي والجري اللاسع (SILURIFORMES) من مياه مدينة البصرة

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الخلاصة:

في هذه الدراسة تم فحص اللوامس الفكية في سمكتي *Silurus triostegus* و*Heteropneustes fossilis*، والتي جمعت من مياه شط العرب في البصرة. بعد التحضيرات النسيجية اظهرت المقاطع المتسلسلة في كلا النوعين ان اللوامس تمتلك نسيج طلائي وادمة وطبقة عضلات وبراعم ذوقية واوعية دموية والياف عصبية وغضروف. يختلف سمك النسيج الطلائي بين النوعين كذلك سمك البراعم الذوقية. احتل الغضروف مركز اللامس ويعتبر كغضروف بدائي بوجود خلايا غضروفية ومادة بينية. تم تحديد وجود نوعين من العضلات في نوعي الدراسة عضلات ملساء وعضلات هيكلية.