

COMPARATIVE HISTOLOGICAL STUDY OF GILLS OF TWO SPECIES IN FRESH WATER(*CYPRINUS CARPIO*) AND SEA WATER FISH (*OTOLITHES RUBER*) OF IRAQ

Alia M. Khuder Majdi F. Majeed Alaa A. Al-Sawad
Department of Anatomy and Histology, Collage of Veterinary Medicine, University
of Basrah, Basrah, Iraq.

(Received 24 November 2015 , Accepted 16 December 2015)

Keywords: Gills, (*Otolithes ruber*), Arabian Gulfs.

ABSTRACT

In present study investigated of the histological structure of the gills of two fish species: *Cyprinus carpio* and *Otolithes rubber* which represented fresh water and seawater fish respectively. A total 20 specimens of freshwater fish (*Cyprinus carpio*) collected from Shatt-Al-Arab and 20 specimens of seawater fish(*Otolithes ruber*) were collected from Arabian Gulfs. The histological examination of gill samples showed that the seawater samples had a larger number of the chloride and pavement cells, compare with *C. carpio*. Also the gill raker of the *O. rubber* was appeared a cartilage and osseous tissue in the external side, while fibrous connective tissue, skeletal muscle layer and large amounts of adipose tissue was noticed in internal side, while the rake gills of the freshwater fish *C. carpio* was showed lake of the bone and skeletal muscle as well as adipose tissue.

INTRODUCTION

The aquatic animals, including fishes, the gills are respiratory organs, which are very efficient in removing oxygen from water. Each of freshwater and seawater ecosystem have individuality and peculiarities in physical, chemical and biological features characteristic (1). So that the gills are highly sensitive to environmental stress and disease (2 ; 3). Gills formed by four holo branches each one consisting of two hemi branches with primary filaments which, projecting from it the secondary lamellae (3), each primary lamellae has an efferent and afferent blood vessels, which supplies blood to the secondary lamellae (4). Each secondary lamellae is made up of

two sheets of epithelial cells with pillar cells that hold them apart, also showed a Chloride cell was found in epithelia of the gills (6).

(7) reviewed the mechanism of ion exchange across the gills. Depending on the salinity of the external medium the gill epithelium has to pump salt from or to the body against a varying osmotic gradient. This represents an adaptation challenge that requires structural changes at the cellular level, the gill has a rake, which morphological differences depended on habitat choice and trophic ecology (8). The gill rakers appear to serve as a filter framework positioned parallel to the water as it flows into the oral cavity (9). The present study has been taken to know the morpho-histological difference of the gills between freshwater fish and seawater fish which used *C. carpio* and *O. rubber* as model respectively.

MATERIALS AND METHODS

A total of 20 sample for carp collected from Shatt-Al-Arab and 20 sample of tiger tooth croaker collected from Iraqi coast of the Arabians Gulf, during the period from October 2014 to February 2015. Fish specimens were dissected and isolated of gills organs, which prepared for histological examination according to a standard procedure. The gills of carp were fixed in formalin 10% for 24 hours, and the gills of croaker fixed of Bouins solution with change at once. Fixed tissues were dehydrated in a graded ethanol series, cleared with xylene and embedded in paraffin wax. Sections of (5 μ m) were obtained with a rotary microtome, and stained with hematoxyline and eosin (H&E) for routine histological examination and molars stain for connective tissue and mounting with Canada balsam (10).

RESULTS

The fishes gills structure is very complex and are suited for gaseous and ionic exchanges in extreme conditions of their habitat. The limnological characteristics of habitat are responsible for various modifications in histological and functional organization of fish gills. In freshwater and marine fish the gills consist of a gill rakers, primary filaments and secondary lamellae. The gills of *C. carpio* showed that the external side the gill raker consist of the layer of connective tissue, which is thicker than the croaker gills, also showed that the cartilage of *C. carpio* gills contain

of large numbers of chondrocytes cells were distributed randomly, and a few of adipose tissues, while the external side the gills in seawater fish *O. rubber* was consisted of cartilage and bone, which support a layer of connective tissue, the cartilage was appeared numerous of chondrocyte cells, a large amount of adipose tissue which melted through microscopic preparation (Fig 1 and 2).

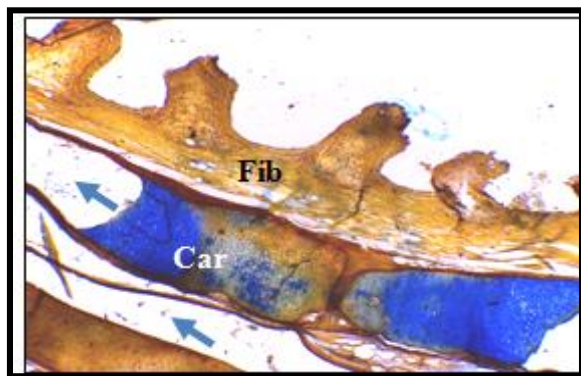


Fig. 1: Raker of *C. carpio* show the fibrous layer (Fib), cartilage (car) and the adipose (arrow) tissue mallory's stain, 100X.

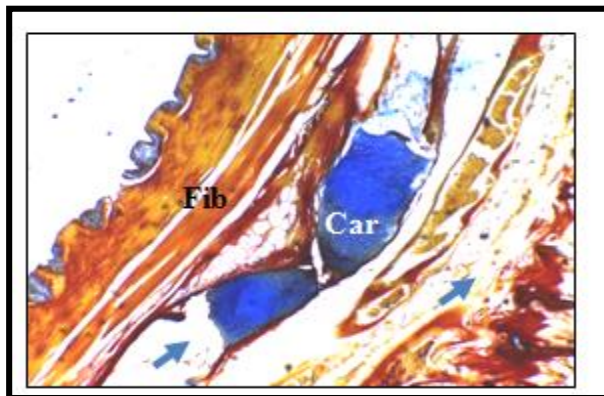


Fig. 2: Gill raker of *O. rubber* showing the fibrous layer (Fib), cartilage (Car) and adipose tissue (arrow) mallory stain, 100X.

The gill raker being absent in the *C. carpio* fish while of *O. rubber* was appeared presents of skeletal muscle covering of cartilage. Also the chloride cells of carp appeared a little in compared with croaker were recorded a high numbers, more abundant and spherical shape, as well as large, rounded and centrally located nucleus . In two species the chloride cells are found more in the bases of secondary lamellae. The pavement cells also appeared a little in carp were more abundant in croaker. The primary filaments in carp absent to the chondrocyte cell, while they presented a high number in the middle of primary filaments of croaker, extending along the filaments, (Fig. 3, 4, 5).

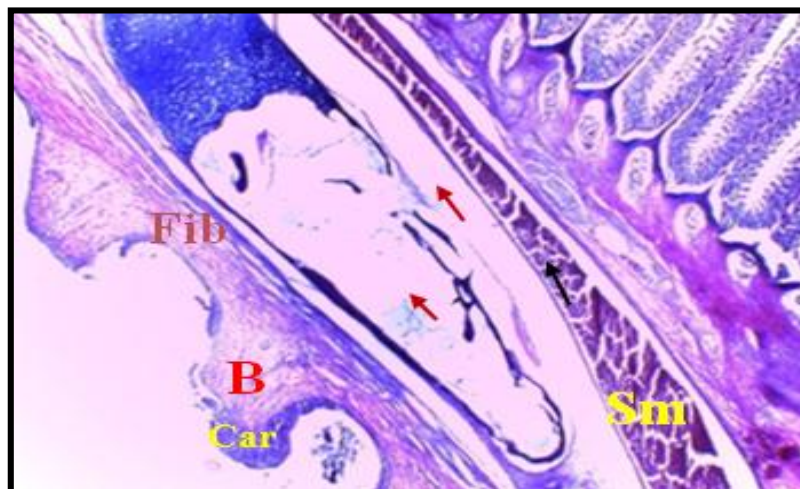


Fig. 3: Gill raker of *O. ruber* showing the cartilage (Car), bone (B), adipose tissue (arrow), skeletal muscle (Sm), mallory stain, 100X.

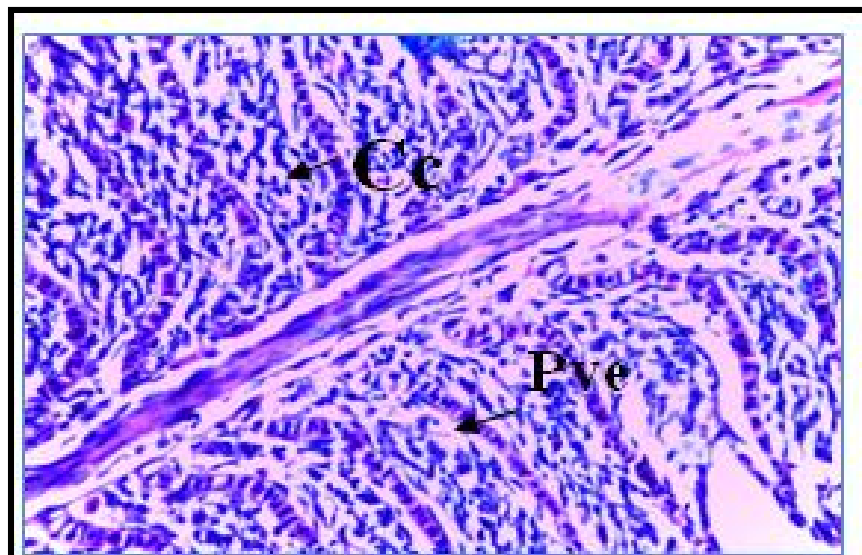


Fig. 4: Chloride cell (Cc) and pavement cell (Pvc) of *C. carpio*. (H&E) 400X

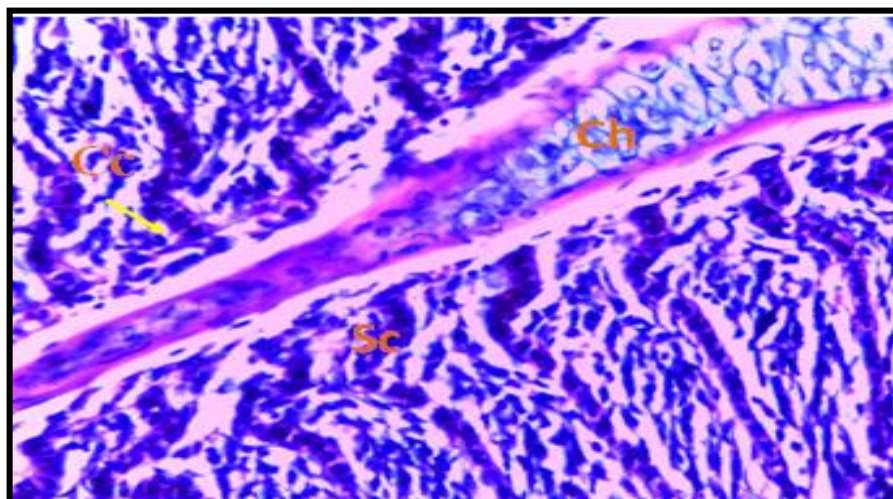


Fig. 5: Primary filaments of *O. rubber* showing the pavement cell (Pve), chondrocyte cell (Chc) and the chloride cell (Cc) with (H&E) stain 400X

DISCUSSION

The histological examination of gill tissues revealed that presents of major differences in gill raker between freshwater fish (*C. carpio*) and seawater fish (*O. rubber*), the external side of raker of *O. rubber* consist of cartilage and bone, which support a layer of connective tissue, this layer is followed by cartilage with numerous of chondrocyte cell, while the *C. carpio* was showed absent the bone of the gill raker is absent.(5) showed that the cartilaginous rods in gill arch and gill rakers are present towards the buccal sides, which were covered by an epithelial layer.

Also in the present study showed that the gill raker of *O. rubber* is contain a layer of skeletal muscle and the large amount of the adipose tissue melt through microscopic preparation, and we believe that the skeletal muscle layer may act as a protection matter. While in the *C. carpio* was showed the adipose tissue appear few amount in the present study. Number of chloride cells is higher in *O. rubber* then that of freshwater fish (carp) The pavement of croaker gills fish in a higher number than that in carp gills fishes. This result agreed with some study such as (11; 12 and 13) . the predominance of the relatively small cell with a lower electron density and the small number of mitochondria as observed in such fresh water fish contrasted with the

big well-developed cells with highly active organelles observed in the seawater-adapted fish, a fact also observed by (14).

دراسة نسجية مقارنة للغلاصم في سمكة المياه العذبة الكارب وسمكة المياه البحرية النوبيي في العراق

عليه محمد خضير مجدي فيصل مجيد علاء عبد الخالق السواد
التشريح والأنسجة، كلية الطب البيطري ، جامعة البصرة ، البصرة ،العراق.

الخلاصة

تم دراسة التركيب النسيجي لغلاصم نوعين من الاسماك المياه العذبة والمالحة (الكارب الشائع common carp و النوبيي croaker) على التوالي. اظهر الفحص النسيجي لغلاصم اسماك المياه المالحة انها تمتلك عدد اكبر من خلايا الكلورايد وخلايا المترافضة مقارنة مع اسماك المياه العذبة. كما لوحظ وجود نسيج غضروفي وعظمي في الجزء الخارجي من القوس الغلصمي في اسماك النوبيي بينما اظهر الجزء الداخلي وجود طبقة من النسيج الرابط والعضلات الهيكلية فضلا عن وجود النسيج الدهني. بينما لوحظ فقدان العظم والعضلات الملساء في القوس الغلصمي لسمكة المياه العذبة الكارب الشائع .

REFERENCE

- (1) Cantanhêde, L. S. M. and Meletti, P. C. (2014). Histological Changes in Gills of Two Fish Species as Indicators of Water Quality in Jansen Lagoon (São Luís,Maranhão State, Brazil). Int. J. Environ. Res. Public Health, 11: 1660-4601Santos, D. M. S. ; Melo , M. R. ; Mendes, D. C. ; Rocha, I. K. B. S. ; Silva, J. P.
- (2) Raskovic, B., Polesic ,V., Zivic I. and Spasii M. (2010). Histology of carp (*Cyprinus carpio* L.) gills and pond water quality in semi intensive production. *Bulg. J. Agric. Sci.*, 16: 253-262
- (3) Oguz, A. R. (2015). Histological changes in the gill epithelium of endemic Lake Van Fish (*Chalcalburnus tarichi*) during migration from alkaline water to fresh water. *NwjZ*, 11(1): 51-57.

- (4) Calabro, C. Albanese, M. P. Lauriano, E. R. ; Martella, S. and Licata, A. (2005). Morphological, histochemical and immunohistochemical study of the gill epithelium in the abyssal teleost Fish *Coelorhynchus coelorhynchus*. *FCH histo*, 43(1): 51-56.
- (5) Bahuguna, S. N. ; Gargya, A. ; Nautiyal, U. and Upadhyay, M. K. (2014). Histological study of the gill (gill filaments and gill rakers) in post flexion to fingerling stage of *Schizothorax plagiostomus* (Heckel). *Fish. Sci. Aquaculture.*, 1(3): 10-16.
- (6) Philpott, C. W. Ph. D. and Copeland, D. E. Ph. D. (1963). Fine structure of chloride cells from Three species of *Fundulus*. *J. Cell Bio.*, 18: 386-404.
- (7) Maetz,J. (1976). Transport of ions and water across the epithelium of fish gills. In: Lung Liquids. Ciba Foundation Symposium 38: 133-159.
- (8) Amundsen, P.-A. ; Bøhn, T. and Vaga, G. H. (2004). Gill raker morphology and feeding ecology of two sympatric morphs of European whitfish (*Coregonus lavaretus*). *Ann. Zool. Fennic.*, 41: 291-300
- (9) Brainerd, E. L., (2012). Caught in the crossflow. *Nature*, 412: 387-388.
- (10) Luna, L.G. (1968) . Manual of histological staining methods, 3rd ed., McGraw-Hill Book Co., Inc., New York: 255 pp.
- (11) Carmona, R. ; Gallego, M. G. ; Sanz, A. ; Domezain, A. and Garrido, M. V. O. (2004). Chloride cell and pavement cells in gill epithelia of *Acipenser naccarii*: ultra structural modification in seawater - acclimated specimens. *J. Fish Bio.* 64: 553-566.
- (12) Al-Amoudi, M. M. and Aguis, (1991). Histology and Ultrastructure of the Chloride Cell in Freshwater and Sea Water-Acclimated Specimens of

Oreochrois mossambicus and O. spilurus, J. K. A. U. Mar. Sci., 2:123-136.

(13) Virabhadrachari, V. (1961). Structural change in the gills, intestine, and kidney of *Etroplus maculatus* (Teleostei) adapted to different salinities. *Quart. J. Micro. Sci.*, 102 (3): 361-9.

(14) Coleman, R., Yaron, Z. and Ilan, Z. (1977) An ultrastructure study of the mitochondria-rich chloride cells from the gills of fresh water and sea water adapted *Tilapia aurea* subjected to apesticide, J. Fish Bioi. 11: 589-594.

(13) Virabhadrachari, V. (1961). Structural change in the gills, intestine, and kidney of *Etroplus maculatus* (Teleostei) adapted to different salinities. *Quart. J. Micro. Sci.*, 102 (3): 361-9.