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Comparative Histology of Gill and Kidney in Salt Water and Fresh Water Form of Salmo Trouta Caspius

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ABSTRACT

Salmo trouta caspius is one of the endangered fish in Iran. This species is an anaderomous fish that migrates between salt and fresh waters. This study was carried out to investigate the differences in gill and kidney tissues of salt water and fresh water forms of this species. Sea fish specimens were captured from the Caspian Sea (Tonkabon region).and fresh water specimens were provided from Salmonid Hatchery Center in Kelardasht. Different tissues including gill and kidney were fixed in Boins solution for 24 hours .after dehydration; specimens were embedded in paraffin and 7µm sections were made. The slides were stained using hematoxilin eosin. Light microscope observations were carried out with different magnification from 5 to 100 times. The result showed, in kidney, tissues of fresh water form; on the other hand, density of glumerolus was more than salt water specimens. And in gill of saltwater specimens the number of mucus and cl¯cells were relatively higher than those in fresh water specimens.

Key word*: histology, Salmo, gill, kidney.*

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INTRODUCTION

Salom trouta caspius is one of endangered fish in Iran. So is tried to preserve this species by cold water farming. This species is an anaderomus fish. After, hatching it pass different time in fresh water and then migrate to salt water for nutrition and puberty and then come back to fresh water for spawning[10].since¸ they are migratory fishes with preliminary property which has determined their wide adaptation to varying environmental conditions(Kurtovic,B.E,Teskeredzic,2006). So many studies on the physiology and ion transportati on of gill and kidney have been carried out on. (Evans,H.M,p iermarini. And W,Postts,1999; Renfro,J,1999). and these organs completely is used as the indicators of environmental stress (Matthiessen,p.JE,Thain.RJ,Law,1993). and are used to evaluate the health of fish (Marina,M.P,Camarge.and C,Martinez,2008). and one of the great advantages of using histopathological biomarker in environmental monitoring is that this category of biomarkers allows examining specific target organs, including gill, kidney and liver that are responsible for vital function such as respiration, excretion and accumulation and biotransformation of xenobiotics in the fish(Gernhofer,M.M,Pawe.M,SchramanE,Muller.andR,Triebskor n,2201; Kurtovic,B.E,Teskeredzic.AndTeskeredzic,C.Z,2006). stated that environmental salinity incre ased the densities of branchial chloride cell in gill of euryhaline teleost and Viallidescribed in salt water form of ell chloride cells are present in gill while in fresh water form is lacking(Vialli, M ,1935). Kortovic and colleges revealed that in kidney tissue of farmed sea bass ¸in compared to wild fish atrophy and lysis of glomerular tuft were more remarkable(Kurtovic,B.E,Teskeredzic.AndTeskeredzic,C.Z, 2006) .In the present study, comparative histology of gill and kidney of salt water form and fresh water form of Salmo trouta caspius have been investigated since, these organs have important role to maintain osmotic homeostasis. This result will provide a basic for future studies on the physiology, ecology and pathology of this species.

MATERIAL AND METHOD

In this study, fresh water specimen was provided from Solmonid Hatchery Center in Kelardash (mean±SD:200±/8 g N=6)) and sea fish specimen was captured from Caspian Sea in Tonkabon region (mean±SD:300±/6 N:6). At least 6 specimens were selected for histological studies .the sample of gill and kidney were fixed in Boien´s solution for 24 hours .were dehydrated in ethanol series from 50% to absolute and embedded in paraffin wax and sectioned at 7µm. After dewaxation with xylen and hydration in ethanol series of descending concentration, sections were stained for general histological purpose with hematoxilin and eosin. The sections were observed by zies digital microscope; model Axiplane 2 with different magnification from 5 to 100 xs.

RESULTS AND DISCUSSION

In this study, observation showed that anatomically gill of Salmo trouta caspius as other fish composed of 4 gill arch that is protected by gill operculum. Two series of primary lamella are attached to gill arch. And every primary lamella is composed of secondary lamella,(Hughes, G. and M. Morgan,1973). central axis of gill arch and primary lamella have made of cartilage and is surrounded by connective tissue and afferent and efferent blood vessels. Gill has been covered by squamus epithelium and mucus cells. In primary lamella 4 different cells has been diagnosed including undifferentiated cell, specialized cell such as cl^-cell, and mucus cell, eosinophilic granulocytes and lymphocytes.(fig:1a and b) The flow of water that irrigates the gills is counter-current to the flow of blood that perfuses the lamella. Maximizing gas, ionic and osmotic gradients that exit. This facilitates gas exchange, but also enhances net ionic and osmotic movements that fish must counter to maintain osmotic homeostasis (Evans, DH,1990). it has become clear that the perfusion of gill epithelium is under the control of variety of endocrine and paracrine factors(Olsen,T.l,Ellebeck.T,Fisher.A,Callaghan and M,Crane,20010). that play a role in controlling the permeability and ionic transport steps in the fish gill.

In this study, histoligically, gill of Salmo trouta caspius in both salt water and fresh water form showed completely the basic organization as other fishes but in salt water specimen, had more cl^- cell, but in fresh water form, this kind of cell wasn´t observed. Fish gill epithelium expressed large quantities of the well-known transport proteins Na/K-Atp ase, whose activity was usually, but not always, proportional to the external salinity (De Renzis,G.M,Bornancin,1984). The current model for Nacl extrusion in gill epithelium of salt water fishes. is described as if, the Na^+ gradient produced a cross the basolatral membrane by Na/K-Atp ase- driven extrusion of Na^+ from the cell, drives Na^+ into the cell coupled to cl^- and K^+ via a common transport protein, but in fresh water fish, Na^+ or cl^- can be taken up independently of each other by fish in order to maintain electrical gradient a cross the gill. And present of cl^- cell in salt water form presumably is because of net cl^- movement a cross the gill is mediated via cl^- channel in cl^- cell. (fig:1a and b)

In kidney, observation showed that in Salmo trouta caspius, in both forms, kidney structure consists of two lobes that are slender and long. So, the kidney is divided into three parts: head, body and caudal part. The head of the kidney composed exclusively of hematopoietic tissue and islets of interrenal tissue devoid of renal tubules and glomerulus.this structure changes in the body, where the hematopoietic tissue is gradually decreased, but the numbers of tubules and glomeruli are increased. In the caudal part of the kidney desperation of hematopoietic tissue is completely reduced and substituted by numerous glomeruli and convoluted tubules. The hematopoietic tissue fills among the nephrons. Each nephron consists of glomerulus that is enclosed by Bowman's capsule, the proximal, distal and collecting cells (Fig.2a and b).

Renal corpuscle: the renal corpuscle of both form of Salmo trouts caspius consist of a glomerulus and a glomerular (Bowman's)capsule . The gelumerulus is a globular network of density packed anastomosing capillaries that is invaginates Bowman's capsule .the relatively wide diameter afferent arteriole enter Bowman's capsule at the vascular pole of the renal corpuscle. The efferent arteriole drains the glomerulus and leaves the capsule at the vascular pole which is usually situated opposite the entrance to the renal tubule, the urinary pole. Bowman's capsule consist of a single layer of flattened cells resting on a basement membrane; it forms the distended, blind end of the renal tubule. Bowman's capsule has two layer :visceral and parietal layers.

The internal and visceral layer of the glomerular capsule surrounds the glomerular capillaries cells, called podocyte.at the vascular pole of the renal corpuscle, the epithelium of visceral layer reflects to form the simple squamous parietal layer of the glomerular capsule. The space between the visceral layer and the parietal layer of the renal corpuscle is called the capsular space. In fresh water specimen more glomeruli and larger gelomeruli were observed but in sea specimen the number of glomeruli was a little and even smaller(Takashima, F. and T. Hibia,2000; Agius, C,1980). (Fig2a and b).

Proximal Convoluted Tubule:

In both specimens of Salmo trouta caspius proximal tubule is the longest widest and most developed segment of the nephron. This tubule is lined by eosinophilic –grnular simple cuboidal cells with a well-developed brush border. In this cells, the nuclei are spherical and situated in lower part of the cells. There were two proximal tubule segment .In this study, histology of kidney in fresh water specimen and salt water specimen of Salmo trouta caspius was compared too. Microscopic observation showed the general basic pattern of kidney is completely as other vertebrate including nephron tubules that composed of glumerulus, proximal tubule, distal tubules and collecting duct, but in fresh water form had numerous and larger Bowman's corpuscle that is because of fresh water fish should absorb all of ions that have been taken up, and even excrete additional water (Amin, A.; Mortesen, L. and T. Poppe,1992). In salt water specimen showed a few gromerulus that is because of most of additional ion secrets by gill and it hasn't more water to uptake (Amin, A.; Mortesen, L. and T. Poppe,1992). Proximal tubules composed of primary and secondary portion, that primary part has columnar cell without brush border, but secondary part has longer columnar cell and very short brush border (Brown, J. and S Taylor ,1983) .In this study, observation showed that in salt water specimen had more advanced proximal tubules that it concern to high ionic exchange and reabsorbtion in this specimen(Oguri,M,1980). In distal tubule cells of kidney showed oval nuclei and without any brush border. This part have important role in reabsorb of Na^+ and Ca^{++}. In fresh water form had more advanced and numerous distal tubules and it is because of this specimen demand it for more ionic exchange and excretion of additional water but in salt water specimen hadn't advanced distal tubules because of low need to water excretion(Oguri,M,1980). Della porta and coworker suggested that the development in renal tubules completely depends on habitat of specimen that it was clear in our observation.

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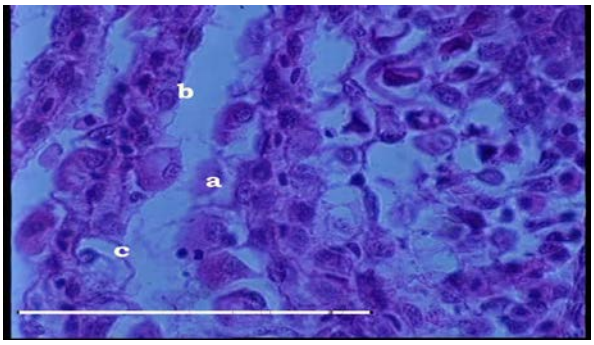

Fig1a:Salmo triuta caspius (salt water): gill 60x a:cl cell b:epithelial cell c:mocus cell scale:100µm

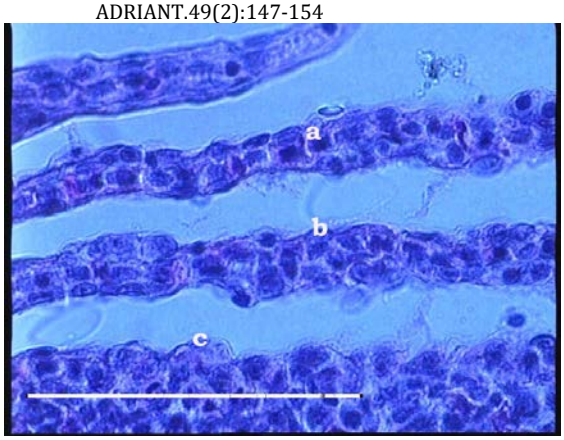

Fig1b:Salmo trouta caspius (fresh water) gill:60x a:pillar cell b:epithelial cell c:mocus cell scale:100µm

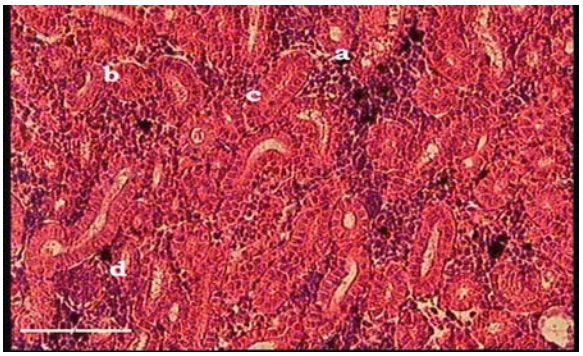

Fig2a:Salmo trouta caspius(salt water) kidney:60x a:bowmans corpuscle b:distal tubul c:proximal tubul d:melanomacrophages scale :100µm

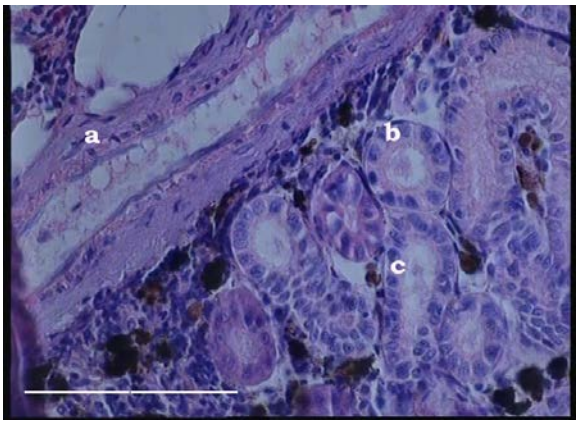

Fig2b:Salmo trouta caspius (fresh water)kidney 60x a:collecting duct b:distal tubul c:proximal tubule scale:100µm