

Histological changes of the gills of carp fish (*Cyprinius carpio*) in Winter and Summer

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Summary

Common carp fish (*Cyprinius carpio*) is a native Asian and Eastern Europe, so there are many types of teleost fishes in Iraq. This study was designed to explain the environmental effects on the tissue of gills of fish. Twenty six of carp fish specimens were collected from Tigris River of Taji region in Baghdad city during Winter and Summer in January and August months respectively. Also the samples were collected from rearing aquarium by breeders of the fishes with water temperature recorded (31°C), in summer and (8 °C), in winter season via thermometer through the specimens collection in each time. The seasonal temperature levels were considered important in the histological alterations of the gills, where the present study showed high and low temperature degrees through Winter and Summer seasons and recorded histological changes in the gills such as (thickness of gill epithelium, rupture with hemorrhage of blood vessels), in summer season. The histological changes recorded in Winter season included damage and cellular atrophy of gill epithelium, fusion of gill secondary lamellae ends and lamellar disorganization with lifting of epithelial cells. The present study showed significant variance through gills epithelium $P < 0.01$ between two seasons, where statistical measurement showed that interlamellar distance significantly increased $P < 0.01$ during summer and winter significantly ($P < 0.01$) decreased in winter.

Keywords: Histological changes, Gills, Temperature degrees, Seasons, *Cyprinius carpio*.

Introduction

Common carp fish are living organisms in the fresh water such as large river, lakes and until standing ponds in Asia and Europe, the carp fish are wide spread in the world and important from side vulnerable to extinction, but the species of fish often consider a very destruction invasion kinds (1). The gills are considered important organs which is using for the respiration, osmoregulation and excretion in order to the fishes are survived on the life inside the water. The gills function of the gaseous exchange operation through the respiratory system. The operation of gaseous exchange which occur between blood channels or called blood core (lacuna) and contents of water which are represent dissolved oxygen and carbon dioxide through medium of water (2 and 3). The gills are participated in many important functions in all the fishes such as osmoregulation and excretion to side the respiration, gaseous exchange of the gills are occurred by gills epithelium specially, and which is represented a main site for the gaseous exchange process inside the fish body when the fishes found inside the water (4-7). Gills of the fishes are important organ for numerous functions there by providing for net

to movement of salts and water down their respective gradients. Specialized cells of the gills epithelium are joined by cellular communication which is called tight junction of variable depth and express a variety of transporters and channels. These cells mediate Na^+ Cl^- extrusion in marine fishes and that ions uptake in the fresh water fishes , these transport steps also provide pathway for the extrusion of ammonia and acids (8). The gills epithelium lined the primary and secondary lamellae and is identified by the number and shape of epithelial cells, as well as by the nature of blood circulation and cell shape and type. The epithelia lined the secondary lamellae and consisted of one (simple) layer of epithelial cells (9). The epithelium of gills are a basic location for pathological lesions, the reason returns to amount of blood found in the gills epithelium , so the blood are considered a well main media of infectious lesions growth, through gaseous exchange obtained transport pollutant factors from external environment (10). The gills epithelium of the fishes are included some components such as epithelial cells, endothelium (simple squamous epithelium) which lined the blood vessels in the gills, the connective tissue represented

fibrous and cartilaginous tissue, stroma and cells are found in the filaments and secondary lamellae (11). Gradually, the thickness of epithelial cells may be decreased because the divisions were obtained on epithelial surface, these divisions lead to thin epithelium in both filaments and lamellae. The epithelial cells lining the primary lamellae (filaments) have afferent and efferent margin and spaces via root (base) of secondary lamellae which is named inter lamellar space (12). The thickness of the epithelium and basal membrane in the secondary lamellae is not commonly to occur in most fishes in order to the blood to water diffusion distances are enough to obtain gaseous exchange (12 and 13). The seasonal temperature is influenced on the water stream and this lead to influence on the quality. The high temperature levels in rivers, ponds and water streams caused damage (histological changes) or harmful water due to thermal effects, even the changes of simple temperature degrees through the seasons from cold and warm weather are affected negative on the aquatic environment. High and low temperature led to variations in the behavior, physiological, morphological and histological structures and adaption obtained in the fishes during exposure (14-16). The gaseous exchange occurred in the gills epithelium are a major situation to this operation (17). When high temperature lead to histological alternations in the gills with increase in numbers epithelial cells (hyperplasia) in the filaments and secondary lamellae, occurrence of congestion in the blood channels in secondary lamellae, large size of pillar cells (hypertrophy), increasing mucous secretion and bleeding during secondary lamellae, while when the fish are exposed to a low temperature levels, the gills are appeared increase of the numbers of epithelial cells in root (base) the secondary lamellae (hyperplasia), collapse of blood vessels, union the margins (ends) of secondary lamellae, rupture in some secondary lamellae and showed disorganized secondary lamellae and atrophy of epithelial cells in secondary lamellae through decline of the temperature levels (18).

Materials and Methods

The study included twenty six male common carp fish (*Cyprinus carpio*) within age was recorded two months of each season during the specimens collection. The specimens were collected from one aquarium of Tigris River by commercial fish breeders of Taji region in Baghdad Iraq. The fish were captured during two seasons (Winter and Summer). In Winter, the specimens were collected through January, whereas Summer, the specimens were caught through August months. Temperature degrees of the weather condition in Baghdad city were recorded in January and August months range average between (11–42°C), through every season, while the temperature levels of water environment (aquarium) were observed through the specimens collection in two seasons range average between (8–31°C). Fish were sacrificed and fixed in 10% neutral buffered formalin solution. Routine histological technique was carried out. hematoxyline and Eosin and Periodic acid/Schiff stains were used (19). Oculometer were used for measurements. Light microscope was used. High magnification in analysis of data was done

Results and Discussion

There were many changes take place due to increasing and decreasing temperature degrees during winter and summer in Baghdad city (Table, 2), When the temperature degrees were high in summer.

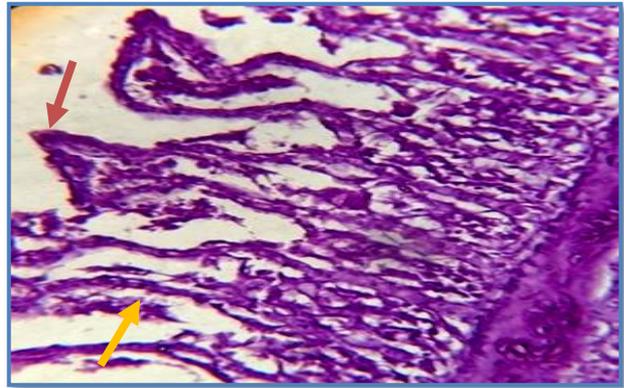
Table, 1: Explained alterations of the Carp’s gill during winter and summer.

Seasons	Thickness of gills epithelium	Cellular atrophy with lifting epithelium	Fusion of lamellar ends	Rupture with hemorrhage of secondary lamellae
Winter	0	+	+	0
Summer	+	0	0	+

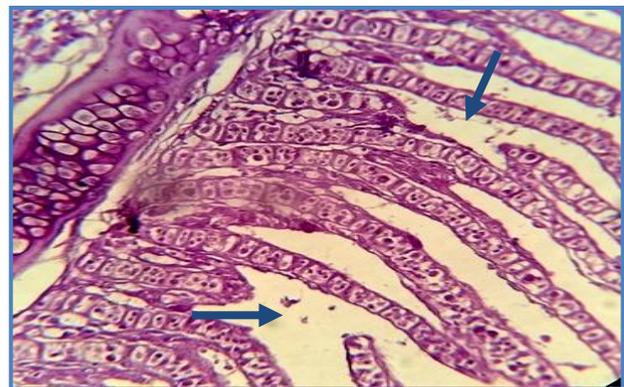
When the temperature degrees were high in summer and lead to alterative occurrence of the tissues during that season and so when temperature levels were gradually low through other season. Under low temperature degrees through winter season appeared some

histological changes in gills epithelium such as cellular atrophy with fusion of lamellar ends of lamellar epithelium and disorganized that lamellae and also detachment which occur through secondary lamellae when the epithelium was separated from basal membrane (Fig. 1), due to rupture of epithelial cells through winter season, these results agreed with (20-23) who showed that morpho-histological alterations of fish gills epithelium may cause disorders of the function gills epithelium through winter season, also high decrease of temperature levels through winter season lead to damage of secondary lamellae (Fig. 2) occurred due to increase pathological lesions through decline temperature levels in the water environment and it is considered distinct indicator in winter season through the oxygen reduction inside the fish body, this result corresponded with (10 and 24-26) who observed that damage which obtained in some secondary lamellae due to deficiency of dissolved oxygen and later this lack lead to defect of gill epithelium with accompaniment of the functional disorder. But this study showed under low temperature degrees, fusion of secondary lamellae ends with increasing pathological lesions (Fig. 1) through winter season, these results agreed with (27) who said that decreasing and increasing temperature degrees lead to high pathological lesions and appearance some the ends of the secondary lamellae were attached, this fusion between edges of the secondary lamellae considered defense mechanism, while heavy increase of temperature degrees during summer season showed rupture of the blood channels with hemorrhage through secondary lamellae (Fig. 3), this result reconciled with (28) who stated that the rupture with hemorrhage of the secondary lamellae because of heavy increasing temperature degrees and increasing hemorrhage of blood vessels supplied primary lamellae during summer season, in same season the study observed thickness of primary and secondary lamellae epithelium due to increase of tissue layers through hyperplasia of epithelial cells (Fig. 4). Also our results agreed with (12, 13 and 29), who explained that the increase of the tissue layers in the secondary lamellae lead to thickness of epithelial cells and this thickness caused

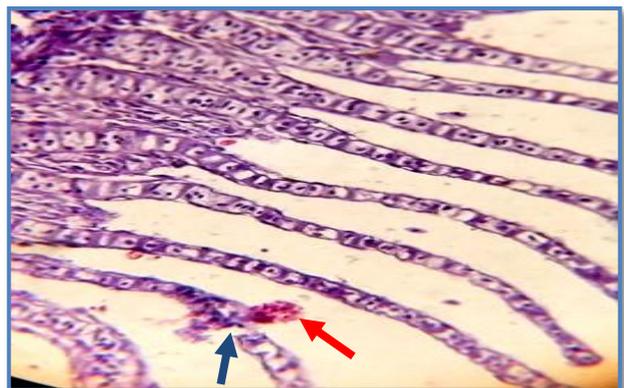
impaired filtration of oxygen and swelling of the epithelium and rarely occurrence in the gills epithelium.



Figure, 1: Longitudinal section of filament showing fusion of secondary lamellae ends with cellular atrophy during winter season (—→) and detachment of lamellar epithelium (—→), (X400 PAS stain).



Figure, 2: Longitudinal section of filament during winter season showing damage of secondary lamellae (—→), (X400 H and E stain).



Figure, 3: Sagittal section of filament during summer season showing lamellae rupture of lamellae (—→) with hemorrhage of blood channels (—→), (X400 PAS stain).

The study included histological parameters of common carp's gills through four seasons. The results showed that there was a significant increase at $P \leq 0.01$ in inter lamellar distance of *Cyprinus carpio* fish of the gills between a

vary seasons, increasing inter lamellar space through summer season ($18.87 \pm 0.02 \mu\text{m}$), but during winter season became inter lamellar space ($16.75 \pm 0.01 \mu\text{m}$), these alterations which appeared through two seasons between lamellar distance through fish gills are due to different temperature levels between the seasons (Fig. 5 and 6).

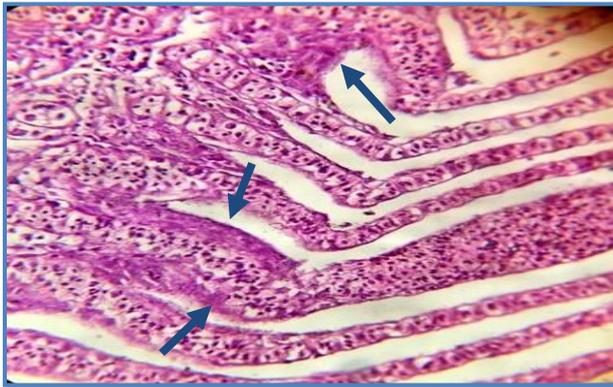


Figure 4: Longitudinal section of filament during summer season showing thickening of lamellar epithelium (→), (X400 H and E stain).

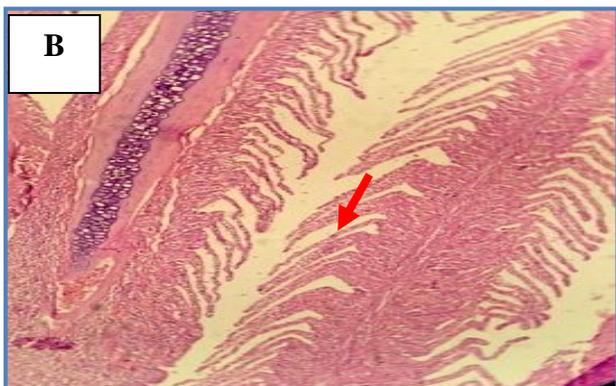
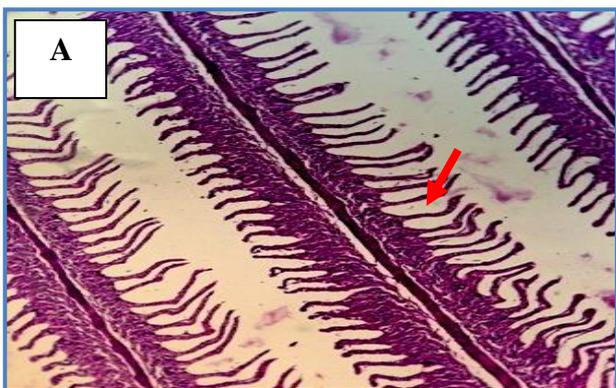


Figure 5: Longitudinal section of filaments showing decreasing of inter lamellar space in secondary lamellae (→) A Summer season, B Winter season (X100 H and E stain).

Conclusions of the present study observed high and low temperature levels of Winter and Summer were directly effected on gills

epithelium in the aquatic medium, in addition to the histological alterations were increased in the gills epithelium in winter more than summer.

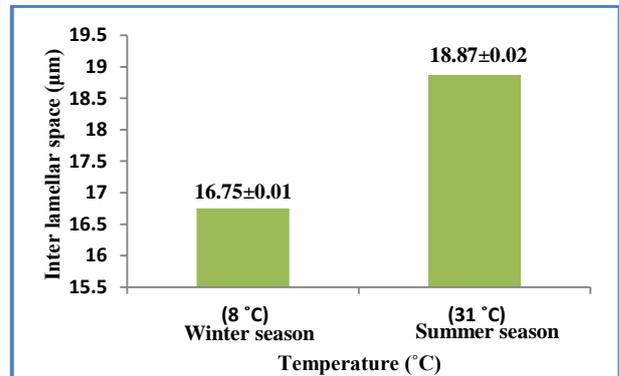


Figure 6: Relationship between seasonal temperature and inter lamellar distance through winter and summer.

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تغيرات نسجية على غلاصم أسماك الكارب في الشتاء والصيف

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الخلاصة

تُعدّ أسماك الكارب من الأسماك الأسيوية وأوروبا الشرقية على أنّ هناك العديد من الأسماك العظمية الأخرى في العراق. صمّمت هذه الدراسة لتسليط الضوء على التغيرات الموسمية وتأثيرها في أنسجة الغلاصم. جُمعت ستة وعشرون من ذكور سمك الكارب من نهر دجلة في منطقة التاجي في محافظة بغداد في أثناء الشتاء والصيف في شهري كانون الثاني و آب. كما جمعت العينات من أحواض التربية وكانت درجة الحرارة 31 °م في الصيف و 8 °م في الشتاء. مستويات الحرارة الموسمية تُعدّ من العوامل المهمة والتي تؤدي دوراً في تغيير أنسجة الجسم في الأسماك. الدراسة الحالية بينت أنّ ارتفاع الحرارة وانخفاضها في فصلي الشتاء والصيف تؤثر بصورة مباشرة على الأنسجة وتسبب تغيرات نسجية مثل (النزف في الأوعية الدموية المغذية للغلاصم وتنخن في ظهارة الغلاصم صيفاً في حين في فصل الشتاء تسبب ضمور في الخلية ومع التحام الصفائح الثانوية وعدم انتظامها، حيث سجلت الدراسة وجود فروقات معنوية بين مسافة الصفائح الثانوية في الصيف والشتاء. حيث كانت هناك زيادة في الفرق المعنوي $P < 0.01$ في الصيف وتقارب المسافة بين الصفائح الثانوية خلال الشتاء.

الكلمات المفتاحية: التغيرات النسجية، الغلاصم، درجة الحرارة، المواسم، سمك الكارب.