Effect Of Sublethal Concentrations Of Cadmium On Some Physiological Alterations In *Liza Abu* Fish

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ABSTRACT:

The aim of this study was to obtain a holistic view of sublethal toxic responses of fish (*Liza abu*). After exposure to (0.1 & 0.5) $mg.l^{-1}$ Cd in water for 7, 15, 30 days. The results showed that the distribution of Na^{+} and Ca^{+2} concentrations of Gills, but not results alteration of K^{+} concentration the gills. Also these motels included chloride cells proliferation and caused the increase of chloride cells number comparison with control. Histological alternation showed hyperplasia and hypertrophy and earling of secondary lamellae.

INTRODUCTION :

The heavy metals such as cadmium are commonly present in fresh water. The natural background concentration of (Cd) in aquatic environments is generally below 0.1 $mg.l^{-1}$ (2). However through a variety of human activities such as combustion of fossil fuels, paper production, cement production and extractive metallurgy. Levels of cadmium have increased in aquatic ecosystem in number of industrialized areas of world (1), which it is water concentrations of (Cd) may be up to 100 $mg.l^{-1}$ and this led to increase susceptibility to disease (4). Cd is non-essential element and its biological function is unknown (3), and is toxic to aquatic organisms even at very low concentrations (2). In fish,

uptake of Cd occurs across the gastrointestinal tract and gills where it involved Ca^{+2} channels (23). This gills freshwater fish represent the largest part of the total body surface area, and the bronchial epithelium the distinct between the water and the blood is only few micros (5). This made gills are as sensitive target organ for waterborne pollutants (16), and this organ will allow for many toxicant such as cadmium enter to organism (18). However the exact routs by which metals pass through the gills are unknown (2). In gills they have three types of main cells which are pavement cells, mucous cells , and chloride cells (8), could be involved but attention has focused largely on chloride cells (CCS) because of their putative role in ions transport even though they occupy only about (7%) of total surface area (19). In fact, no study to date has proven conclusively that chloride cells on the gill ion transport cells strong circumstantial evidence favoring this interpretation that they have a higher metabolic rate than other epithelial cells (17).

Histological alternation in fish gills were used as a target organ for environmental chemical (5), so that the histological investigation represent sensitive tool to detect the toxic effects of environmental pollutant in laboratory experimental (23). The aim of present study was to detect the levels of Na^{+} , K^{+} , and Ca^{+2} concentrations of gills and record a number of chloride cells and show the histological alternation after exposure to two concentrations of cadmium .

MATERIAL AND METHODS:

Liza abu was collected from fish farming station at Marine Science Center in University of Basrah. Fish was acclimated in oratory for two weeks at 27C° in a large well-aired aquarium. Fish average weight was 24.9 ± 1.5 grams. The sample size for each experiment was ten fishes. The fish was divided into three groups, the first one control kept in tap water at 27C°, while two and three groups were exposured for 30 days to sublethal concentrations of Cd in water (0.1 and 0.5 $mg.l^{-1}$) respectively, after the exposure

period, fish sample were removed from aquarium and gill specimens of each individual were fixed for two days by buffer formalin (10%) and routinely embedded in paraffin wax for light microscopy, sections were cut at (7mm) and stained with hematoxline and eosin (H & E). The Na^{+} , K^{+} , and Ca^{+2} concentrations of gills were determined by flame atomic absorption (20). While chloride cells used the method of by use the left opercula were prepared for numerical chloride cells (20).

RESULTS :

Exposure to cadmium (0.1 and 0.5 $mg.l^{-1}$) during 7 , 15 , and 30 days resulted the following :-

Na^{+} , K^{+} , and Ca^{+2} concentrations of gills after exposure to various Cd concentrations are presented in table (1 , 2 and 3), furthermore, a significant decrease (P 0.05) in Sodium and Calcium concentrations treatment groups compared with control group, While no significant difference in potassium concentrations compare with control was observed in gills for fish exposed to cadmium.

Histopathological were found in the gills examined, there were some evidence of gills damage in the exposure fish. The microscopic examination revealed hypertrophy of gill filaments and hyperplasia of epithelium surface of respiratory lamellae and inter lamellar filament epithelium.

Table (1): Effect of cadmium on Na^{+} regulation in *L.abu* fish

Exposure time (Days)	Treatments groups		
	Control	0.1 mg^{-1}	0.5 mg^{-1}
7	34.5 ± 2.1 a	30.6 ± 2.3 a	28.9 ± 0.85 a
15	33.7 ± 1.8 a	27.3 ± 2.8 b	20.8 ± 2.3 c
30	30.8 ± 1.5 a	29.4 ± 1.9 a	25.6 ± 3.1 b

Table (2):Effect of cadmium on Ca^{+2} regulation in *L.abu* fish

Exposure time (Days)	Treatments groups		
	Control	0.1 mg^{-1}	0.5 mg^{-1}
7	80.4 ± 4.5 a	70.3 ± 2.3 b	68.9 ± 7.8 b
15	78.6 ± 6.4 a	74.5 ± 6.4 a	64.3 ± 8 b
30	81.4 ± 3.2 a	65.9 ± 7.1 b	60.7 ± 4.9 b

Table (3): Effect of cadmium on K^{+} regulation in *L.abu* fish

Exposure time (Days)	Treatments groups		
	Control	0.1 mg^{-1}	0.5 mg^{-1}
7	68.9 ± 2.9 a	70.1 ± 5.5 b	68.9 ± 7.8 b
15	64.7 ± 4.1 a	64.9 ± 6.2 a	61.7 ± 4.7 b
30	67.8 ± 5.0 a	65.8 ± 5.0 b	68.9 ± 5.8 b

Table (4): Effect of cadmium on number of chlorid in *L. abu* fish

Exposure time (Days)	Treatments groups by cadmium		
	Control	0.1 mg^{-1}	0.5 mg^{-1}
7	2.5 ± 0.12 a	3.4 ± 0.41 b	4.5 ± 0.76 c
15	2.1 ± 0.22 a	5.0 ± 0.79 b	4.8 ± 0.45 b
30	2.4 ± 0.13 a	4.6 ± 0.44 b	5.6 ± 0.87 c

DISCUSSION :

The result of this study demonstrates that sublethal Cd exposure of fish *Liza abu* affects several physiological parameters, such as the Na^{+} , K^{+} , and Ca^{+2} concentrations and number oprecular chloride cells of gills addition to Histopathological of this organ.

The exposure of Cd included challenge of physiological homeostasis (13). The above mentioned aspects are well illustrated by Na^{+} , K^{+} , and Ca^{+2} concentrations of gills. The regulation and maintenance of ion-homeostasis is very sensitive to exposure metals in freshwater fish the gills are target during exposure to heavy metals and other stressors, because they play a predominant role in maintenance of ion-homeostasis and the uptake of waterborne heavy metal during increases concentrations in water (21). In this study we observed an increase in number of chloride cells, in freshwater fish chloride cells functions in ions uptake, and therefore, an increase in chloride cells numbers has been considered a compensating response to pollutants included ions-loss (14).

However, environment of endocrine system cannot be excluded. Hormone control of bronchial function enable fish to modify the ions exchanges capacity in the gills in response to metals (21). The release of cortisol, produced by internal tissue located in head kidneys of fish is stimulated as part of stress response (11). The hormone is known to affect ionic regulation and to include chloride cells proliferation (16). However, in spite of an increases in chloride cells number in groups exposure to metal, this response was not adequate to oppose these ions losses (13). Exposure to Cd resulted inhibition of the active bronchial Na^{+} , K^{+} , and Ca^{+2} transport activity (22), because these metals induced inhibition of Ca^{+2} and Na^{+} enzymes activity which its related to the free heavy metals ions available (24). Bronchial Na^{+} and Ca^{+2}

transport differ from another in many ways including the hormonal control and specific transport sites (11). This also may contribute to the meta and transport enzymes specific effects of Cu and Cd on transpithelium ion exchange (12). This was in line with previous observations in tilapia fish were active Na^{+} and Ca^{+2} uptake was inhibited in fish exposure to 200 $mg.l^{-1}$ Cd (13).

The heavy metals have a high affinity for nucteuphilic groups, in particular for SH-residues of amino acids and proteins, and heavy metals interaction with ion-ATP ase has mainly been attributed to the affinity of the metals for Sulfhydryl groups on the ion transporting enzyme (6).

Alternation of gills filaments and hyperplasia of epithelial surface of respiratory lamellae and interlamellar filament epithelium. Some authors suggested that respiratory system of teleost fish maybe damaged by cadmium, since acute concentration of cadmium was found to cauterize the gill lamellae of several freshwater fish (7).What we study has been agreed with the study of (1) and which recorded pathological alternations in gill filament and respiratory lamellae in (*Cyprinous carpio*). However, the morphological effects of metals exposure have been comprehensively reviewed (10), and fall into two broad categories :-

Accumulated damage and compensatory responses at moderate of exposure, the damage consists of separation of epithelial layers, tissue edema and clubbing of lamellae. While at more several levels, tissue necrosis and rupture and fusion of secondary lamellae become more prominent. The later compensatory responses include hypertrophy and hyperplasia of mucous cells and chloride cells which appear to be associated with a pair of gill damage, probably play an important role in recovery and acclimation.

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تأثير التراكيز تحت المميتة لعنصر الكادميوم على بعض التغيرات الفسيولوجية لأسماك الخشني(*Liza abu*)

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المستخلـــص

أجريت الدراسة الحالية على صغار اسماك (*Liza abu*) لتحديد تأثيرات التراكيز تحت المميتة في عنصر الكادميوم (0.1 ، 0.5 ملغم/لتر) على التغيرات الفسلجية الحاصلة للتبادل الأيوني لكل من Ca^{+2} , K^{+} , Na^{+} بعد فترات تعريض 7 و 15 و 30 يوم إضافة لدراسة التشوهات الحاصلة لأنسجة الغلاصم خلال هذه الفترة من التعرض .أظهرت النتائج انخفاضات معنوية في مستوى Ca^{+2} , Na^{+}

لغلاصم الأسماك ($P>0.05$) في حين لم يسجل عنصر K^+ أي تغيرات خلال هذه الفترة، فيما أظهرت أنسجة هذا العضو حالات الفرط النسيجي والتنخرات الواضحة.