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Effect of different salinity levels on some physiological parameters of the blood of juvenile common carp fish *Cyprinus carpio* L.

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Abstract - The current study was designed to evaluate the effect of different salinity levels on the juveniles of the common carp (*Cyprinus carpio* L). the fishes were acclimatized and fed on commercial fish diet for one week before starting the experiment which lasted for 75 days. Four salinity levels were used as 5 NaCl, 10 NaCl and 15 NaCl PSU in treatment 1, 2 and 3 while the salinity level of control was 2.5 NaCl PSU. Each treatment was replicated thrice with 8 fishes. Other parameters such as sodium ions were significantly higher and the potassium were significantly lower in 5 NaCl, 10 NaCl and 15 NaCl PSU compared to the control Group. While the highest value for total protein and globulin was in salinity 2.5 PSU and the highest value for albumin in salinity (15) PSU, while cholesterol and glucose concentrations were the highest values at salinity 2.5 with regard to enzymes ALT and AST, the highest value were in salinity 15 PSU.

تأثير مستويات الملوحة المختلفة على معايير الدم في صغار اسماك الكارب الشائع (*Cyprinus carpio* L.)

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المستخلص - صممت الدراسة الحالية لتقييم تأثير الملوحة المختلفة على مقاييس الدم لصغارا لكارب الشائع *Cyprinus carpio L.* اقلمت الأسماك لمدة أسبوع وتم تغذيتها بغذاء مصنع تجاري قبل البدء بالتجربة التي استمرت لمدة 75 يوماً. حضرت ثلاث تراكيز ملحية 5 و 10 و 15 غم/لتر لثلاث معاملات T1 و T2 و T3 على التوالي، بينما كانت ملوحة معاملة السيطرة 2.5 غم/لتر و كل معاملة لها كانت بثلاث مكررات، وكل مكرر يحتوي على 8 أسماك. لوحظ أن المعايير الأخرى مثل ايونات الصوديوم كانت معنوياً اعلى وايونات البوتاسيوم كانت معنوياً اقل في التراكيز الملحية 5 و 10 و 15 غم/لتر مقارنة بمعاملة السيطرة، بينما كانت اعلى قيمة للبروتين الكلي والكلوبيولين في ملوحة 2.5 PSU واعلى قيمة للألبومين في ملوحة 15 PSU، اما تركيز الكولسترول والكلوكوز فكانت اعلى قيمة لهما في ملوحة 2.5 PSU. بلغت أعلى قيمة للأنزيمات ALT و AST وذلك في ملوحة 15 PSU.

الكلمات المفتاحية: كارب، معايير فسيولوجية، يافعات، ملوحة.

Introduction

According to lwama *et al.* (2006) fishes were exposed to stress in natural and artificial conditions, during culture or in laboratory during the experiment. Thus, any environmental change can be one of the sources of stress, which stimulates several responses in fish to deal with their physiological changes due to changes in their external environmental factors (Eddy, 2005). The responses can be determined in fish in the form of changes in hormones or the concentration of basic substances in the plasma or changes in the measurements of blood cells size and numbers, or changes observed in the organs of osmotic regulation such as gills, kidneys and intestines (Arjona *et al*., 2009). The previous studies also showed a high oxygen consumption rate when fish were exposed to salt stress resulting from high salinity levels, which indicate increasing in metabolic rates. However, the oxygen consumption in the fish is considered to be a good indicator of metabolism (Tsuzuki *et al*., 2008). A decrease in the level of plasma proteins in the blood of fish

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exposed to salt stress in order to increase their requirment for energy. However, the decrease in the levels of proteins in the blood plasma and the increase in oxygen consumption rates are considered as increase in energy consumption rates in fish exposed to salt stress Luz *et al.* (2008). Previously, David *et al*. (2005) reported that blood glucose is used as an indicator of the secondary response to stress in fish, where it has been proven that high blood sugar is usually associated with high levels of salinity to meet the increasing need for energy for organizing purposes. they also showed that ionic and osmotic resultted from different salinity levels or exposure to other stress factors such as pollutants.

The aim of current experiment is investigating the effect of gradual increasing of salinity on blood parameters for common carp, *Cyprinus carpio.*

Materials and Methods

One hundred and fifty of young fish (mean body weight= 20.60±8.33g) were brought from earthen ponds of the aquaculture unit of Al-Hartha station for Agricultural Researches, North Basrah and transported to aquaculture laboratory at the Marine Science Center.

The fish were acclimatized to fresh water in recalculating tank for one week and fed on lab-made standard diet. Following acclimation, the fishes were divided into four groups with salinity levels of; 5g NaCl, 10g NaCl and 15g NaCl/l in Treatments 1, 2 and 3, respectively, while in the control the salinity level was 2.5g NaCl/l). Each treatment included three tanks 40 x 30 x 60 cm as three replicates with 8 fish in each tank. Water salinity was measured every day to avoid any change in it.

The experiment was carried out for 75 days in natural photoperiod and the fishes were fed twice per day by 3% of the total stock biomass. Blood samples were taken from the heart area of the fish at the end of the experiment then transferred to sterile tubes and the serum was separated by centrifugation (1000 rpm for 10 min). To measure the percentage of total protein, (globulin, albumin), ALT serumenzyme was determined by using ALT kit supplied by Randox (French Company) depending on the concentration of pyruvate hydra zone in 2, 4- dinitrophenyl Hydrazone formula. AST serum enzyme was determined by using AST-kit depending on the concentration of oxaloacetate hydra zone in 2, 4 Dinitro phenyl-hydrazine (Duncan, 1955). The concentration of sodium and potassium ions, glucose and cholesterol were also determined during this investigation.

Data Analysis:

Analysis of variance (ANOVA) was used to calculate the effect of different Salinity levels on the blood parameters of the juvenile common carp. If ANOVA showed significant effects, the least significant difference (LSD) test was applied to estimate differences between individual treatment means (Snedecor and Cochran, 1989).

Differences were considered significant at $P \leq 0.05$. The SPSS Statistics software (Version 20) was employed for the data analysis.

Results and Discussion:

The results showed significant changes in all values for all parameters decreased from control, except for ALT, AST, albumin and sodium ions. The results indicated that total protein decreased from 47.27 ± 0.97 to 23.69 ± 0.81 as the salinity level increased (Table 1). This decrease was related to their response to high osmotic regulation (Al-Khashali and Al-Hilali, 2017).

However, Herrera *et al.* (2012) found that the cyclic nature of the total proteins in the blood is considered to be as an indicator of the changes that occur in the globulin of the blood, previous

result is in agreements with other studies that reported the absence of changes or a decrease in the level of total proteins with an increase in salt concentrations. The present results support those of Soltanian *et al.* (2016), who showed a decrease in total protein when salinity reached 17%.

Table 1. Concentrations of total protein, albumin, globulin, glucose and cholesterol in the blood of the common carp juveniles after 75 days.

Standards (mg/100ml)	Parameters			
	Control T0 (2.5) PSU	T1 5 PSU	T2 10 PSU	T3 15 PSU
	Average ± Standard Deviation			
Total Protein Concentration	47.27 ± 0.977929 a	44.54 ± 1.13844 b	24.98 ± 2.90621 c	23.69 ± 0.81317 d
Albumin Concentration	27.53 ± 0.51619 a	27.66 ± 0.89803 b	28.76 ± 0.26870 c	29.11 ± 0.89803 c
Globulin Concentration	27.35 ± 3.37997 a	25.43 ± 2.22739 b	23.57 ± 0.61518 c	17.7 ± 0.49497 d
Glucose Concentration	155.39 ± 26.01446 a	150.58 ± 1.06773 b	81.66 ± 1.37886 c	43.4 ± 0.53740 d
Cholesterol Concentration	138 ± 4.24264 a	102 ± 1.41421 b	98 ± 0.0000 c	72 ± 1.41421 d

Values of different letters in the same row differ significantly ($p<0.05$)

Table (1) showed that the albumin was incresed as salinty level increased and globulin decrease as salinty level increased and this in accordaing with the result to Ahirwal *et al.* (2021). However, albumin was found in the liver in general and such increase of albumin in the level of total proteins can be attributed to protein synthesis in order to meet the increased demand for energy (Javed and Usmani, 2015).

The glucose concentration decreased with an increase in salinity level (Elarabany *et al*., 2017), while the results of cholesterol did not agree with Khan *et al.* (2016), who observed a decreasing in the cholesterol concentration at the beginning and then an increase in fish phylophosphate. However, Binukumari and Vasanthi (2013) suggested that fish need energy to overcome stresses.

In order to obtain this energy, it replaces proteins and fats, which leads to a decrease in the concentration of cholesterol in the blood plasma in order to provide the necessary energy during stress conditions (Stoyanova *et al.,* 2015). The results of the current study also concites with Roohi *et al.* (2017) who observed a decrease in cholesterol concentration of common carp fingerlings under salt stress when using CSM supplement.

The concentration of sodium ions increased in the blood plasma by increasing salinity level (Table 2) and this is in support of the conclusion by Al-Khashali (2012) who suggested that there

was a rise in sodium ion concentration in the blood plasma of grass carp when treated with gradient salt concentrations of 4, 8 and 12 PSU.

The sodium concentration values of 130, 134.5 and 184 mmol/l increased compared with the control sample (113 mmol/l) and a significant increase in sodium ions occured in *Oreochromis niloticus* which was exposed to salinity of 18 g/l compared to its levels in fresh water (Karşi *et al.*, 2005).

The results of the current study are in agreement with Alkatrani *et al*. (2014) who noticed an increase in the concentration of sodium ions with an increase in salinites of 1, 5, 7, 5, 15, 30 and a decrease in potassium concentration in the blood of tilapia fish fingerlings when acclimatized to different salinity.

Yavuzcan-Yildiz and Kirkavgac-Uzbilek (2001) stated that grass carp exposed to an increase in salinity to 10 PSU led to an increase in sodium ion concentration 48 hours after salinity levels increased. Sanders and Kirschner (1983) suggested that in environments with high osmosis, fish gills are more permeable to potassium ions, and thus the amount of ions flowing to the outlet is more than the ions inside and this indicates a decrease in absorption rather than an increase in the loss of potassium ions, which is the most important factor.

The ALT and AST increased with salinity level increas (Tabel 2). AST enzyme is one of the important enzymes in the blood of carp fish, which is a specific evidence and sign of liver health in fish and the significant damage to fish that leads to a disruption in the system of this enzyme, which leads to an increase in its indicators in blood tests (Ghasemi *et al.*, 2017).

Table 2. Concentrations of sodium ions, potassium ions and transminase enzymes in the blood (AST, ALT) of the common carp juveniles after 75 days.

Standards (mmol/l)	Parameters			
	Control Parameter T0 2.5 PSU	The First Parameter T1 5 PSU	The Second Parameter T2 10 PSU	The Third Parameter T3 15 PSU
	Mean ± Standard Deviation			
Sodium Ions	113 ± 2.82843 a	130 ± 1.41421 b	134.5 ± 2.12132 c	184 ± 1.41421 d
Potassium Ions	9 ± 0.56569 a	7.4 ± 0.07071 b	4.5 ± 0.14142 c	8.8 ± 0.00000 d
ALT	38.45 ± 2.75772 a	58.35 ± 0.63640 b	69.45 ± 0.77782 c	78.55 ± 1.90919 d
AST	69.85 ± 0.21213 a	91 ± 1.97990 b	108.9 ± 12.86934 c	119.95 ± 1.20208 d

Values of different letters in the same row differ significantly ($p<0.05$).

Conclusions:

- Changes in the levels of water salinity concentrations have a significant impact on blood parameters and caused a decrease in some of its concentrations and an increase in others.
- High salinity has an effect on ions,including sodium ions and potassium ions, as high salinity led to a rise in sodium concentration and a slight decrease in potassium concentration.

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