Effect of Sodium Chloride on Hematological and Biochemical Profile in Common Carp (*Cyprinus carpio* L.)

Eqbal Salman Najem

Department of Pathology- College of Vetetinary Medicine-University of Diyala- Iraq

Zenamon2014@gmail.com

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Abstract

This study was carried out to examine the effects of different concentrations of sodium chloride (0.1, 6, 9 and 12g/l) on hematological and biochemical picture of Common Carp (*Cyprinus carpio*) for 30 days. For this purpose, 80 fish at average weight of (125± 2 g) were randomly distributed into four treatments groups and exposed to four concentrations of sodium chloride treatments with two replicates /treatment (10 fish / replicate) and were fed with pelleted feed at 3% of their body weight twice daily. After 30 days of exposure hematological parameters (Hb, PCV, RBC, MCV, MCH and MCHC), glucose, lactate and total protein were also determined. Hematological and biochemical parameters showed significant increases (P≤ 0.05) with increases sodium chloride concentrations except MCV, MCH and MCHC .The results of this study indicated that hematological and biochemical parameters can be used to evaluate the responses of common carp to different levels of environmental salinity.

Keywords: Salinity, Hematological Parameters, *Cyprinus carpio*

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تأثير كلوريد الصوديوم على الصورة الدموية والكيموحيوية في اسماك الكارب الشائع *Cyprinus* (*carpio* L.)

اقبال سلمان نجم

فرع الامراض - كلية الطب البيطري - جامعة ديالى- العراق

الخلاصة

اجريت هذه الدراسة لاختبار تأثير تراكيز مختلفة من كلوريد الصوديوم(0.1 ، 9,6 و12غم/لتر) على الصورة الدموية والكيموحيوية لأسماك الكارب الشائع Cyprinus carpio لمدة 30 يوم . استخدم في الدراسة 80 سمكة من اسماك الكارب الاعتيادي معدل اوزانها 125 غم ±2 تم توزيعها الى 4 معاملات وعرضت الى 4 تراكيز من كلوريد الصوديوم بواقع مكررين/ معاملة (10 اسماك / مكرر) وغذيت مرتين في اليوم الواحد بنسبة 3% من وزن الجسم. بعد مرور 30 يوم من التعرض لكلوريد الصوديوم اجريت الفحوصات الدموية (MCHC, MCH, MCV, RBC PCV, Hb) والسكر واللاكتيت والبروتين الكلي. اظهرت نتائج المعايير الدموية والكيموحيوية زيادة معنوية ($P \leq 0.05$) مع زيادة تركيز كلوريد الصوديوم ماعدا (MCHC, MCH, MCV) . من ذلك نستنتج ان المعايير الدموية والكيموحيوية ممكن ان تستخدم لتقييم استجابة اسماك الكارب الشائع الى مستويات مختلفة من الملوحة.

الكلمات المفتاحية: الملوحة ، الصورة الدموية ، اسماك الكارب الشائع .

Introduction

One of the most important environmental factors effects the osmotic pressure and metabolism is salinity (1) which causes alterations to the structure, activity and physiological function of digestive enzymes of fish; and also affects growth, habits, and survival of fish (2). Any changes in the salinity concentrations cause imbalance in the homeostasis, therefor fish required numerous of the physiological responses to return to stability as they were before exposure to the stress (3). The effect of salinity on fish are via the prompting on osmoregulation pathway by loss of ions at excessive or little salinity in order to sustain the ions levels and liquids in the fish through the roles of the organs that are responsible for osmoregulation processes such as gills, intestine and kidney. Blood is the most sensitive for

the alterations in salinity.Blood picture is a good indicator of physiological disorder as there is a close association between circulatory system and surrounding environment (4). It give information about fish health status and the chemical and physical parameters of water where fish live as well as evaluate the correlation between these factors and know the susceptibility of fish to alterations in environmental conditions (5, 6).

The physiological response to mutable salinity levels in an aquatic environment has been studied in numerus species of fish (7 , 8, 9).One of the most important cultured freshwater fish species in the world is *Cyprinus carpio* (10). Also, it is one of the first domesticated species of fish in Asia and Eastern Europe, it plays a vital role in polyculture systems in seasonal reservoirs and ponds. This species can tolerate a range of various salinities from freshwater up to 12 g/ l (11) but the physiological mechanisms that cause the salinity tolerance of this species are not well understood.

Aim of study

This study was aimed to examine the influence of various concentrations of sodium chloride on some blood and biochemical parameters of *Cyprinus carpio.*

Materials and Methods.

A total of (80) healthy fish of *Cyprinus carpio* average weight (125± 2 g) were sampled from a carp farm. *Cyprinus carpio* were acclimated to the laboratory conditions for two weeks before the experiment started . They were stocked in a bath trough filled with chlorine free tap water then the fish were randomly selected and distributed in aquaria of (100 L) at rate of the 10 fish per aquaria and exposed to four different sodium chloride treatments (0.1, 6, 9 and 12 g/l) and tested in two replicates for each salinity treatment. The fish were fed with pelleted feed at 3% of their body weight twice daily. Water temperature was 24± 2.

The concentrations of salt were made by the addition of the suitable amount of sodium chloride to chlorine free tap water and fish were exposed to salt concentration of 6, 9 and 12g/l while the tap water concentration (0.1g/l) was serves as a control group.

After 30 days blood samples were collected through caudal puncture with heparinized syringes. Haematological parameters were determined according to procedures described by

(12). The red blood cells (RBC) count were measured by the method of (13) and packed cells volume (PCV) was done by micro haematocrit method while Hemoglobin (Hb) using the cyanomethaemoglobin method. The mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV), and mean corpuscular hemoglobin concentration (MCHC) were also counted according to the following formulas (14).

MCH = (Hb in g/RBC in millions) × 10 (pg)

MCV = (% of Hct/RBC in millions) × 10 (μm^3)

MCHC = (Hb in g/ (% of Hct) × 100 (g /100 ml).

Serum glucose and lactate were also determined using glucose and lactate kits. Total serum protein was measured using Biuret method (15).

Statistical Analysis

Statistical analysis was achieved by SAS software (16). Data were presented as average mean ± S.E. was analyzed using Duncan at level $P \leq 0.05$.

Results

Results of PCV , Hb , RBC, MCV, MCH and MCHC in blood of *Cyprinus carpio* which exposed to various concentrations of sodium chloride are shown in Table 1 .

Results of statistical analysis showed that there was no significant differences ($P > 0.05$) in PCV value and Hb content between the control group and the concentration of 6 g/l, while there were significant differences ($P \leq 0.05$) between the control group and the concentrations of 9 and 12 g/l. As well as, there were significant difference between the concentrations of 9g/l and 12g/l. For RBC, there was no significant differences ($P > 0.05$) between control treatment and the concentrations of 6g/l and 9g/l. However, there were significant differences ($P \leq 0.05$) between control group compared to concentration of 12g/l. Results of MCV, MCH, MCHC showed non- significant differences ($P>0.05$) between control treatment compared to concentrations of 6 g/l, 9 g/l and 12 g/l respectively.

On the other hand, glucose level showed no significant differences ($P > 0.05$) in between the control group and the concentration of 6 g/l, but there were significant differences ($P \leq 0.05$) between the control group and the concentrations of 9 and 12 g/l as well as there were significant difference between the concentrations of 9g/l and 12g/l (Figure 1). Lactate and

total serum protein results exhibited significant differences ($P \leq 0.05$) between control group and other concentrations of sodium chloride (Figure 2 and Figure 3).

Table 1: Blood picture of *Cyprinus carpio* which exposed to various concentrations of sodium chloride during experimental period

Salt concentration g/ l	PCV %	Hb g/dl	RBC $10^6\times$ mm^3	MCV μm^3	MCH pg	MCHC %
0.1	30.40± 0.927 c	9.76 ± 0.300 c	2.012 ± 8.144 b	150.60± 3.14 a	48.20 ±2.73 a	32.00 ±1.28 a
6	33.20 ± 0.860 c	10.70 ± 0.296 c	2.116 ± 6.472 ab	152.60± 2.34 a	48.20 ±1.24 a	32.00 ±0.89 a
9	37.80 ± 1.280 b	12.30 ± 0.386 b	2.216 ± 8.488 ab	153.00 ±1.36 a	49.80±1.39 a	32.00 ±1.39 a
12	44.20 ± 1.529 a	14.36 ± 0.511 a	2.354 ± 7.117 a	154.80±1.40 a	50.00 ±1.30 a	33.00 ±1.15 a

Values are expressed as mean ± SE, means having different small letters in the same column are significantly different at ($P \leq 0.05$)

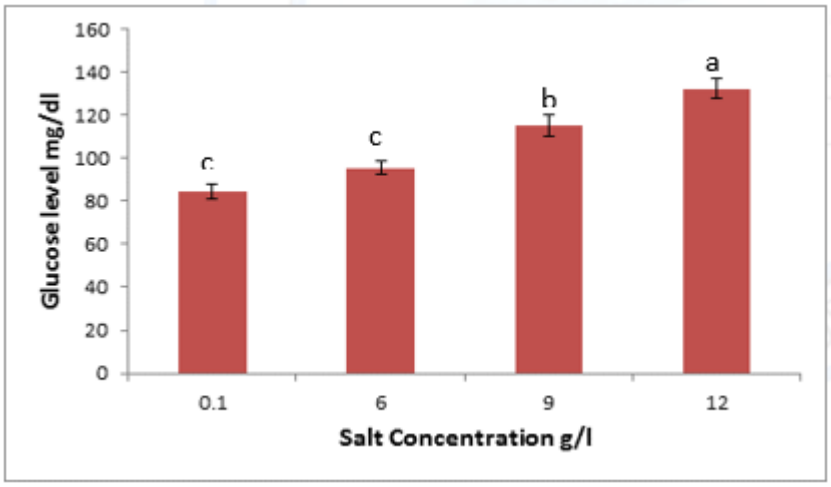

Figure 1: Glucose level of *Cyprinus carpio* exposed to various concentrations of sodium chloride for 30 days. Data are mean ± S.E. different small letters indicate significant differences from control; (n=6).

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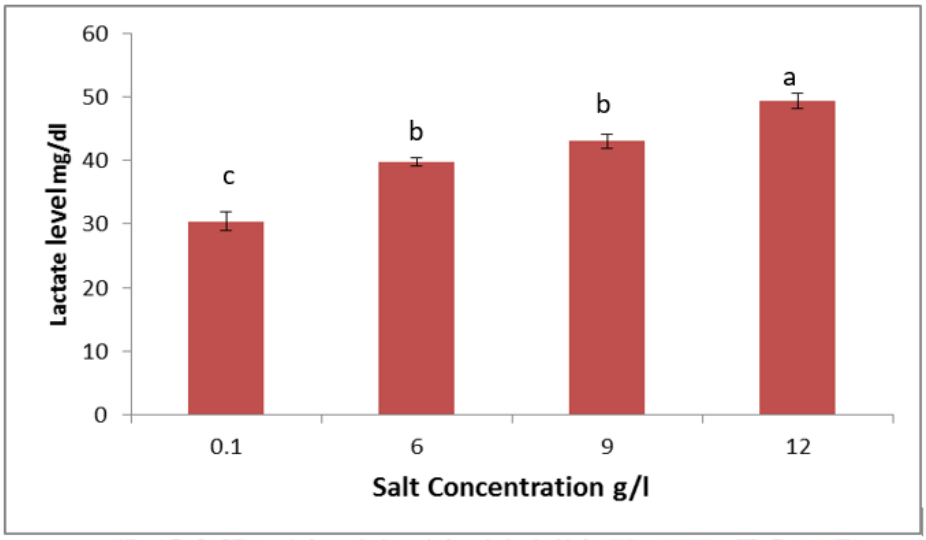

Figure 2: Lactate level of *Cyprinus carpio* exposed to various concentrations of sodium chloride for 30 days. Data are mean ± S.E. different small letters indicate significant differences from control; (n=6).

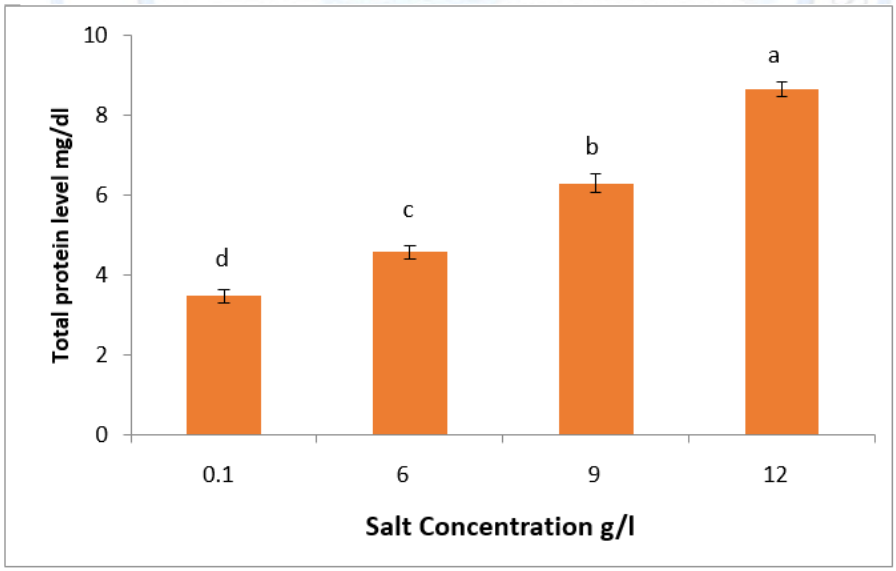

Figure 3: Total protein level of *Cyprinus carpio* exposed to various concentrations of sodium chloride for 30 days. Data are mean ± S.E. different small letters indicate significant differences from control; (n=6).

Discussion

Variation in environmental salinity can act as a stressor and causes significant increases and decreases in blood picture ,so alterations in blood picture can reflect loss of homeostasis or reveal a compensatory response to changes in salinity (17). In conformance with the preceding studies (1 , 18), there were no significant differences in MCV, MCH and MCHC values among the treatments. Increased PCV can be a pointer of response to hyposmotic stress (19) or an increase of RBC produced from the spleen (20). Also these changes could be attributed to the changes in blood water content caused by variation in environmental salinity. The increase in salinity of water is accompanied with the increase in RBC , the increase of RBC may be resulted by the increase of oxygen consumption owing to the increase of energy requirement. In addition, RBC have an essential role to transfer the oxygen, moreover, the increase in Hb is leading to increase in RBC as hemoglobin considered as protein carried by RBC and having a role in respiration (21). The results of this study are in agreement with (7) who exposed *Cyprinus carpio* to different salinity of 3, 6 ,9, 12 and 15 g/l and noticed increase of PCV, Hb and RBC on exposed fish .The increase of PCV, Hb and RBC also conformed with results of (21) who exposed common carp to salt concentrations of 5, 10 and 15g/liter. In addition to that, the increase in Hb content are in agreement with results of (22) who exposed the common carp to high concentrations of sodium chloride .

In fish exhaustive exercise or stress causes elevated blood glucose (Hyperglycemia) (23). Hyperglycemia degree may alter depending on the stress kind and the times of sampling (24). The hyperglycemia result from salinity stress is caused by catecholamines that affect the liver and release glucose from it (25). Also cortisol causes hyperglycemia by increased gluconeogenesis in peripheral tissue (26) . Glucose level is elevated to provides energy for preservation of plasma osmolarity in constant range. Anaerobic metabolism in the muscle under stressful conditions of hypoxia or strenuous exercise produced lactate and released to the plasma (27). Lactate used as an energy sources for gills, kidney and brain (28). In this study, elevated lactate levels noticed in fish exposed to different salinity suggests that this metabolite is probably used as source of energy by osmoregulatory organs. Similar results

were achieved in previous research by (7) and (18). Also serum protein levels was elevated in fish exposed to different salt concentration, this results are in line with results of (1) who attributed the increased in serum protein to use as a fuel for tissues through osmotic acclimation when stores of carbohydrate have been mobilized.

Conclusion

The results of this research showed that hematological and biochemical picture can be used to evaluate the responses of common carp to different levels of environmental salinity.

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