J. Agric. Sci. Mansoura Univ., 34 (10):9941-9945, 2009

EFFECT OF STARVATION ON GROWTH AND SOME METABOLITES IN BLOOD ,LIVER AND MUSCLE TISSUES Of COMMON CARP (*Syprinus Carpio)*

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ABSTRACT

The effects of starvation for 60 and 135 days on some metabolites in blood, liver and muscles were studied in common carp(*Cyprinus carpio*). During the first 60 days, the common carp apparently tended to utilize liver triglycerides as energy source. An increased liver aspartate amino transferase (AST),alanin amino transferase (ALT) activity and maintenance of glycogen levels suggested a stimulated gluconeogenesis. Between 60 and 135 days, the common carp utilized great amounts of both liver and muscular triglycerides .There was also a marked decrease in liver glycogen during this later phase of starvation. The starvation also resulted in a significant decrease in blood glucose, after 60 and 135 days.

Keywords: Common carp –Starvation –Metabolism.

INTRODUCTION

Intensive fish culture is often accompanied by increased incidences of stress related maladies. Analysis of hematological parameters can be beneficial in assessing fish health (Blaxhall and Daisley,1973)but the variation in fish hematological parameters has been concerned by researchers and health specialists. The sources of variation enclued season (Sandnes *et al.*.,1988), temprature and salinity (Smit *et al.*.,1981),sex (Ezzat *et al.*.,1974), disease(Waagho *et al.*.,1988),handling and transport(Ellsaesserc and Clem ,1986), sampling conditions(Koreock *et al.*.,1988), and type of anesthesia and laboratory techniques used (Hoffnan *et al.*.,1982 and Hardig and Hogland,1983). Many fish species are subjected to a natural starvation period during parlance years. They have therefore developed an impressive ability to withstand long periods of starvation. At low temperatures some fish species have been reported to be able to survive for several month or even years without food(Love,1970 and Cnaani *et al.*.,2004). Many works concerning the effects of starvation in different fish species have been published . Most of them have shown that carbohydrates ,above all the glycogen stores ,are the most readily utilized energy reserves (Swallow and Fleming ,1969). The protein and lipid reserves are also affected ,but in a smaller degree and at a later phase of starvation (Love,1970). In a study on the Japanese eel (*Anguilla japonica*),Inui and Ohshima(1966) found a pronounced decrease in glycogen and fat in the liver, especially in the early stages of a 3 month starvation period. Smit *et al.* (1981) observed that the common carp (*Cyprinus carpio*)lost weight mainly as a result of protein utilization during starvation ,while strangely enough the lipid content was not depleted . The purpose of this study was to evaluate the effect of starvation

on some metabolites in blood ,liver and muscle in this study. The experiment was performed from 15 November, 2006 to 30 March, 2007 (135 days),a period which approximately coincides with the natural seasonal starvation of the common carp. Sampling for metabolic analysis was taken in tissues of common carp (*Cyprinus carpio*) reared in earthen ponds under natural conditions.

MATERIALS AND METHODS

Common carp(*Cyprinus carpio*),with an average weight of 180 g reared in three earthen ponds (1000 m^2), located at the Central Laboratory for Aquaculture Research (CLAR) Abbasa, was used in the initial study and after 60 and 135 days . Five fish were transported to the laboratory, where they were placed in aquaria with fresh water. At the sampling, the fish were removed from the water immediately, bodyweight was recorded and blood was collected from the caudal ventral sinus into tubes using syringe. Approximately 5 ml of whole blood were withdrawn from each fish . A 2 ml portion was placed into an EDTA tube for determination of packed cell volume (hematocrit), hemoglobin and glucose . The remaining blood plasma was deep frozen until analyzed for inorganic phosphate, total protein, total cholesterol, triglycerides, aspartate amino transferase(AST) and alanine amino transferase(ALT). Hematocrit was determined by the microhematocrit technique of Blaxhall and Daisles(1973). Hemoglobin was determined spectrophotometrically (540nm)using the cyanmethemoglobin method (kit 525-A,Sigma Diagnostics,P.O. Box 14508,St. Louis,Mo,USA).The whole liver was removed and weighed for determination of hepato –somatic index(=liver weight *100/ body weigh). Muscles tissue was excised from the skeletal muscle just behind the level of the anus , weighed samples of liver and muscles tissue were immediately deep frozen and stored at – 20 ^oC until analyzed for glycogen ,triglyceride , cholesterol , (AST)and(ALT) . A sample of fish livers was weighed, homogenized and centrifuged at 3000 rpm for 15 minutes at 5 ^oC. The supernatant was used to determine AST and LT activity colorimetrically according to Reitman and Frankel (1957). The other analytical methods used have been described by (Holmberg *et al.*., 1972). Analysis of variance was conducted to determine if there were significant differences among periods according to SAS (1985).

RESULTS AND DISCUSSION

The effects of starvation on blood metabolites.

The effects of starvation on different blood plasma metabolites are given in Table (1) . The data after 60 and 135 days were tested against those in initial . During the first 60 days the starved fish had lost about 9.3 percent of their initial body weight . The same wight loss continued to the end of the experiment days(135). At this period, the body weight had decreased by about 20.2 percent .The weight loss in the present study might therefore be due to a lower metabolic rate (Sandnes *et al.*., 1988).Weight loss in the fish in the present study is slightly lower than that observed by Love (1970) worked

on the common carp , They found a decrease in body weight of about 15 percent after 65 days starvation during the winter. There were significant changes in the packed cell volume and the content of hemoglobin following starvation. The results shown that starvation causes a decrease in hemoglobin content and hematocrit. This effect is probably due to a reduced ability to produce new red blood cells or a decreased activity of the fish under conditions of starvation.

These results agree with those obtained by Kristofferson and Broberg(1971). No changes were observed in the protein content and inorganic phosphate in blood plasma during the whole starvation period. These results agree with those obtained by Waagho *et al..*(1988). The starvation resulted in a significant decrease in total plasma cholesterol. Since cholesterol is a precursor for period hormones , it may be possible that also the observed decrease in plasma cholesterol is due to increased activity of adrenocorticoids (Holmes and Donaldson,1969). The present study on common carp showed that the starvation resulted in a marked reduction in blood glucose. A similar effect of fasting on blood glucose was observed by Kamro(1966)in *Gadus morhua*. It might be possible that such a response is due to an increased uptake and utilization of glucose in different tissues.

Table (1): The effects of starvation on blood metabolites (Mean ±S.E.)

Parameters	Periods of starvation		
	Initial	6o days	135 days
Decrease in body weight (%)	_	9.3±0.9[b]	20.2 ± 0.7 [a]
Packed cell volume (hematocrit, %)	32.1 ± 1.3 [a]	31.5 0.5 [b]	30.1 0.3[c]
Hemoglobin (g / 100 ml)	8.5 ± 0.2 [a]	7.6 ± 0.21 [b]	7.3 ±0.6 [b]
Plasma inorganic phosphate (g / 100 ml)	10.5 ± 0.8 [a]	11.3±0.7 [a]	11.7 ± 0.5 [a]
Total plasma protein (g\100 ml)	3.9 ±0.1 [a]	4.3 ±0.3 [a]	4.0 ± 0.6 [a]
Total plasma cholesterol (mg\100 ml)	530 ± 65 [a]	510 ± 44 [b]	456 ± 21 [c]
plasma triglycerides (mg / 100 ml) /	1190 ± 80 [a]	1050 ± 95 [b]	1100 ± 56 [b]
Blood glucose (mg / 100 ml)	78.9 ± 8.1 [a]	40.1± 4.6 [c]	65.7 ± 6.8 [b]
AST(u / l)	56 ±15 [c]	76 ± 12 [b]	90 ± 20 [a]
ALT(u / l)	15.1 ± 10.1 [c]	18.2 ± 8.2 [b]	22.6 ± 6.5 [a]

Means in a row followed by the same letter are not significantly (P ≥0.05) different (Duncan's multiple range test).

The effect of starvation on liver and muscle metabolites.

The effect of starvation on liver and muscle metabolites are given in Table (2). During the first 60 days of starvation, the content of glycogen in liver and muscle and triglycerides in muscle seemed to be fairly constant. However, there was a tendency towards decreased liver triglyceride content and liver size (P< 0.05). Thus liver fat seems to be rather readily utilized by fish during the first phase of starvation. This result is in agreement with the findings of Stimpson (1965) ,who found a decreased lipid content in the liver of gold fish starved for 25 days. Contrary to this, Toshima and Cahill(1965) showed that glycogen of Japanese eel was more readily utilized than lipids in liver tissue during 3 months starvation. The maintenance of liver and muscle glycogen levels during the first 60 days might be due to an increased gluconeogenesis. The significant rise in liver AST and ALT activity observed after 60 days is probably also associated with a stimulated gluconeogenesis.

Table (2): The effects of starvation on liver and muscle metabolites (mean ± S.E.)

Parameters	Periods of starvation		
	Initial	6o days	135 days
Hepato-somatic index [(liver weight x100)] / body weight	1.42 ± 0.04[a]	1.21 ± 0.06[b]	1.15 ± 0.07[c]
Liver triglycerides (mg / 100 mg wet weight)	7.3 ±1.2[a]	4.5 ± 0.9[b]	2.3 ± 1.4[c]
Liver glycogen (mg / 100 mg wet weight)	3.1 ±0.4[a]	3.7 ±0.6[a]	2.2 ±0.7[b]
Liver AST (u / 100 g tissue)	75.9 ±2.4[b]	125.1 ±5.6[a]	136.4 ± 6.5[a]
Liver ALT (u / 100 g tissue)	17.2± 6.6[b]	30.8± 7.1[a]	32.4 ± 2.9[a]
Muscle triglycerides (mg / 100 mg wet weight)	7.9 ± 0.5[a]	8.2 ± 1.5[a]	3.5 ± 0.9[b]
Muscle glycogen (mg / 100 mg wet weight)	0.12 ± 0.01[a]	0.11± 0.04[a]	0 .10 ± 0.06[a]
Tissue cholesterol (mg / g wet muscle)	25.6 ± 0.20[a]	23.9 ± 0.45[b]	20.4 ± 0.85[c]

Means in a row followed by the same letter are not significantly (P≥ 0.05) different (Duncan's multiple range test).

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تـأثير التصـويم علـى النمـو وبعض نـواتج الميتـا بـوليزم فـي الـدم والكبـد والأنسـجة العضلية لسمكة المبروك العادي

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تم دراسة تأثير التصويم على بعض نواتج ميتا بوليزم الدم والكبد والأنسجة العضلية لسمكة المبروك العادي وذلك بعد ٦٠و١٣٥ يوم تصويم من بداية فترة التجربة ٠

خـلال فتـرة ال٦٠ يـوم الأولـى مـن التصـويم تـم ملاحظـة اسـتخدام الأسـماك للجلسـريدات الثلاثيـة الموجودة في الكبد كمصدر للطاقة وملاحظة حدوث زيادة في أنزيمات الكبد (أسبارتات أمينو ترانس فيراز – ألانـين أمينـو تـرانس فيـراز) وأيضـا ملاحظـة الاحتفـاظ بمسـتويات الجليكـوجين فـي الكبـد وذلـك نتيجـة لتنبيـه هرمونات الجليكونيوجينيسيس ٠

فـي الفتـرة مـن ٦٠ يـوم إلـي ١٣٥ يـوم مـن التصـويم لـوحظ انخفـاض كبيـر فـي كميـات الجليسـريدات الثلاثية في الكبد والأنسجة ٠

التصويم نتج عنه أيضا انخفاض في كميات الجليكوجين في الكبد وانخفاض في جلوكوز الدم وذلك خلال الفترة من ٦٠ إلي ١٣٥ يوم من التصويم