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RESEARCH PAPER

Change in plasma cholesterol level of *Clarias batrachus* due to starvation stress

SWEETY, MRIDULA RENU SINHA AND ANIL KUMAR

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See end of the article for authors' affiliations

Correspondence to :
SWEETY
Department of Zoology, Magadh Mahila College, Patna University, PATNA (BIHAR) INDIA

ABSTRACT

Lipids in fishes differ in composition from that of warm blooded animals probably because fishes live in lower temperature. The present work deals with the evaluation of cholesterol level of a freshwater *Clarias batrachus* (Linn) with reference to age, sex, and starvation. It appears from the finding of the present investigation that age, sex and starvation causes significant variation in cholesterol constituents and that a more pronounced and marked alterations was observed in female fishes than the male fishes. While starvation causes more variation in cholesterol constituents of the fishes, thereby suggesting that prolonged starvation impairs normal physiology of female fishes more than male fishes and therefore, the maturation in female fishes are unlikely to proceed normally in starved fishes.

Key words : *Clarias*, Cholesterol, Starvation, Age

In fish, cholesterol constitutes to the extent of about half of the lipid stores. Cholesterol is an important constituent of cell walls in fishes, it is also a direct precursor of bile, salts and bile acids and an important precursor of steroid hormones.

The requirement of energy varies in the two sexes of fish. It is well demonstrated as female fish is found to carry a larger amount of lipid in its liver than male fish. Sorvachev (1957) observed that female fishes accumulate more protein than lipid during the period of maturation, while male fishes accumulate lipid. The reason behind this is that male gonads need less protein than females and male fishes spend more energy during spawning period due to vigorous swimming.

In the maturation of fishes lipid store of various tissues showed marked variation because, it affects physiological anatomical and biochemical changes in fishes. Siddiqui (1975) observed an increase in blood cholesterol content in *Clarias batrachus* in relation to age. The biochemical constituents of blood in fishes also exhibit marked variation in relation to age, size, season and maturity.

Starvation causes impairment in metabolic activities and its reglation in fishes. Kluytmans and Zandec (1974) reported that due to starvation, depletion of various nutritional substances starts but synthesis of certain lipid fractions does take place quite independently of level of starvation. However, Newsome and Leduc (1975) reported that fishes maintain a minimum level of structural lipid intact even in extreme physiological conditions of starvation to keep itself alive.

The present research paper has been under taken to evaluate cholesterol constituents in a fresh water air breathing siluroid fish *Clarials batrachus* under certain physiological stress. The scholar is of the opinion that the findings of the present work will be useful in determining the ability and suitability of fishes as a food resource.

MATERIALS AND METHODS

The experiments were carried out on a freshwater air breathing teleost *Clarias batrachus*(Linn), which belongs to order Cypriniformes, Division – Siluri and Family – claridae. This is commonly known as Mangur which inhabits fresh water rivers, swamps and ponds.

Live fishes of 16 cms to 230 cm size were collected from the ponds located in and around Patna town. The fishes were kept under laboratory condition for a week for acclimatization. The acclimatized fishes of the stock were divided into two groups, the experimental group and the control group for conducting different physiological experiments. For ascertaining the sex of the fishes, the fishes were dissected.

For the determination of fish age, the length of the fish was taken into consideration and as such, fishes were grouped as follows –

- Small age group – 16 cm to 78 cm
- Middle age group – 80 cm to 138 cm.
- Higher age group – 158 cm to 230 cm.

For estimation of plasma cholesterol level under starvation, the fishes of experimental group were observed for 330 days (48 weeks) and the days on which fishes were starved were marked "O" days of experiment.

The blood from the fish was collected by severing off the caudal region of the fishes a little behind the anus

with a sharp scalpel. The blood was used by the method of Henly (1957) for quantitative estimations were done calorimetrically by spectrophotometer (Systronics).

RESULTS AND DISCUSSION

The results obtained from the present investigation are presented below :

Effect of age on plasma cholesterol:

The cholesterol content in different age groups of the fish was analyzed in both sexes of the fish. For evaluating the effect of age, fishes representing lower, middle and higher age group of both sexes were taken into consideration. Six numbers of fishes from each age group were investigated. In the lower age group of the fish, the mean value of plasma cholesterol in male fishes was 329.29 mg/100 ml and in female fishes it was 340.70mg/ 100ml. In middle age group fishes, the plasma cholesterol level in male and female fishes was 351.70 mg/100 ml and 360.60 mg/100 ml respectively. While in the higher age group of male and female fishes, the mean plasma cholesterol level recorded was 361.20 mg/100 ml and 384.90 mg/100 ml (Table 1).

Effect of starvation on plasma cholesterol:

The plasma cholesterol level in male fishes during early days of starvation showed an insignificant rise from the control value up to 60 days of starvation. The rise was less that 1%. Subsequently a gradual depletion in the plasma cholesterol level continues till 150 days of starvation. The value of plasma cholesterol recorded after 150 days of starvation was 345.62 mg/100 ml, which was 6% less than the control value (380.30 mg/100 ml).

In the prolonged starvation, the plasma cholesterol level in male fishes showed marked and significant fall from the control value (380.30 mg/100 ml). The ultimate depletion in the plasma cholesterol level recorded after 330 days of observation was about 38 % from the control value, as the plasma cholesterol level recorded on this day was 159.20 mg/100 ml (Table 2).

In female fishes, the plasma cholesterol level exhibits a significant increase up to 60 days of starvation from the control value (372.0 mg / 100 ml). The value recorded after 60 days of starvation was 390.20 mg/100 ml. Thereafter, the plasma cholesterol level starts declining and after 150 days of starvation, the plasma cholesterol level falls to 336.55 mg/100 ml, showing approximately 9.5% fall from the control value.

In prolonged starvation, the decreasing trend of plasma cholesterol content in the female fishes continues and after 330 days of starvation the level falls to 254.60 mg/100 ml showing about 31.6% fall from the control value. Thus, in both male and female fishes, the depleted level of plasma cholesterol from 120th day onward of starvation which was found statistically significant (Table 2).

Cholesterol is an important constituent of cell walls, a precursor of bile salts and bile acids, precursor of steroid hormones and is utilized maximum during sexual activities of fishes. The cholesterol constituents were analyzed with reference to age, sex and starvation to show their utility in the present fishes under different physiological stresses. Booth *et al.*(1999) have observed changes in body composition with age in Hiodon alosoides. Ross (1988) has reported change in different constituents of lipid in Godus morhua under various physiological activities of the fish. Many more investigators have reported variation in lipid profile of the fishes in relation to age, sex and maturity (Kohli, 1989, Siezen, 1989). Spencer *et al.* (1989) reported changes in the blood volume of fishes in relation to age. Love (1980) was of the view that in fish's maturation involves transfer of lipid from the liver, muscles and gut to the gonad. As fish matures every successive year they accumulate bigger and bigger stores of lipid. It has also been reported that mature of lipid is well as its quantity changes with increasing age. Paviov *et al.*, (1935)

Table 1 : The cholesterol content in the plasma of male and female Clarias batrachus (Linn) in relation to age (Unit of measurement – mg / 100 ml)

Sr. No.	Lower age group		Middle age group		Higher age group	
	Male	Female	Male	Female	Male	Female
1.	342.50	348.90	355.50	378.00	378.30	390.20
2.	337.20	344.50	353.20	366.50	363.20	392.70
3.	330.00	341.20	350.50	365.20	360.40	387.60
4.	328.50	340.70	352.20	353.50	357.50	383.50
5.	320.70	338.60	347.30	353.00	356.60	380.20
6.	317.30	331.00	350.30	349.60	355.40	378.50
Mean	329.29	340.70	351.70	360.60	361.20	384.90
	9.52	8.28	4.60	10.60	6.49	6.20

Table 2 : The plasma cholesterol content in well fed control and starved male and female Clarias batrachus (Linn) (Unit of measurement – mg / 100 ml)

Days of starvation	Plasma cholesterol content in male fishes			Plasma cholesterol content in female fishes		
	Control fishes	Starved fishes	P.V. of mean	Control fishes	Starved fishes	P.V. of mean
0	380.30	380.25	-	372.00	372.00	-
	2.08	2.05	-	2.21	1.82	
30	379.20	388.50	+ 1.33	375.20	380.50	+2.27
	1.88	2.03		1.29	1.99	
60	385.20	382.30	+ 0.34	380.70	390.20	+4.88
	1.23	1.65		1.81	1.97	
90	388.20	362.90	- 2.99	405.30	366.30	-1.97
	2.16	1.92		2.51	1.65	
120	396.20	253.90	-4.54	376.50	344.30	-7.46
	1.46	1.53		1.68	1.82	
150	398.50	345.62	-5.96	382.50	336.55	-9.54
	1.86	1.57		1.68	1.28	
180	380.60	293.5	-15.03	380.50	332.70	-5.20
	1.42	1.06		1.68	1.98	
210	375.20	264.60	-16.40	380.40	330.50	-10.70
	1.87	1.46		1.58	1.81	
240	370.20	253.60	-21.80	385.60	330.50	-10.70
	1.93	1.43		1.82	1.57	
270	371.30	221.50	-27.40	395.50	315.30	-15.30
	1.77	2.054		1.29	2.37	
300	374.90	203.20	-32.60	375.30	292.80	-21.30
	2.86	2.52		1.83	1.38	
330	377.80	159.20	-38.00	380.40	254.60	-32.60
	1.99	1.93		1.56	1.63	

Percent variation of mean in starved fishes greater than 2.72 was considered significant

observed that lipid stores of the fishes were utilized to provide energy to the growing fishes due to antioxidant depletion. The present finding also shows that the lipid constituents are progressively proportional to age and that in female fishes lipid stores were more than the male fishes. It has also been reported that fatty acid metabolism has direct bearing with the process of growth of the fishes (Figueroa *et al.*, 2007). As such, the findings of present research work are in conformity with the observations of the earlier investigators.

During starvation after an initial rise, the plasma cholesterol level of *Clarias batrachus* declines continuously throughout the experiment with a net loss of 40.25 % in females and 39.76 % in males. An increased plasma cholesterol level was followed by a fall in starving *Clarias batrachus* (Siddqui, 1975). Larson and Lewander (1973) observed a continuous decrease in the plasma cholesterol concentration in *Anguilla anguilla* during a starvation period of 145 days and this has also been confirmed by Denton and Yousef (1975). The observed decrease in plasma cholesterol level after 45 days in the present study may be probably due to lowered activity of liver HMG – COA – reductase. Studies on rats have confirmed a marked decrease in the activity of HMG – COA – reductase during starvation (Wieland *et al.*, 1960). It is likely that a similar control of cholesterol synthesis may be present in the fishes during starvation. The decreasing effect of starvation on cholesterol biosynthesis in liver has been observed in the catfish Heteropneustes fossils, starved for 50 days (Shaffi, 1979). In the light of present findings, therefore, it appears that in *Clarias batrachus*, the function of liver was not only seriously affected but it was also altered to a great extent by prolonged starvation. The early phase of starvation favours a high cholesterol synthesis, while the later phase reduces the activity of liver so that the cholesterol synthesis was inhibited.

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Authors' affiliations

MRIDULA RENU SINHA AND ANIL KUMAR, Department of Zoology, Magadh Mahila College, Patna University, PATNA (BIHAR) INDIA

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