

Quantities estimation of plasma phospholipid in relation to age, sex and starvation

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Abstract

The present research work deals with the evaluation of plasma phospholipids of a freshwater *Clarias batrachus* (Linn) with reference to age, sex and starvation. For the determination of fish age, the length of the fish was taken into consideration. The plasma phospholipid content was higher in male fishes than female fishes in all the age groups. The plasma phospholipid content of male fishes remain slightly increased up to 60 days of starvation and then shows a gradual depletion from the 90th days of starvation and continues till last days of the experiment from the control value (93.2 mg/100 ml). However, in the female fishes, the plasma phospholipids show an increase in its level up to 90 days of starvation from the control value (94.75 mg/100 ml). The phospholipids level starts depleting from 105th days onward of starvation and continues depleting till the last days of the experiment. The depleted value recorded was 74.8 mg/100ml.

Key words: Clarias, Phospholipids, Plasma, Starvation.

Introduction

Fish lipids can be divided into two main types: (1) Neutral lipids mostly glycerides and cholesterol and (2) phospholipids, which as the name suggests certain phosphorus. Phospholipids are thought to be essential part of the structure of tissues, particularly membranes and so are less available to be mobilized.

phenomenon or forced to starve due to ecological conditions of the habitat. Starvation causes total deprivation of food which results into a condition of absolute nutritional deficiency. Thus, starvation causes impairment in metabolic activities and its regulation in fishes. Under this extreme condition; it has been observed that lipid is readily utilized by the fishes to provide energy. Kluytmans and Zandee¹ reported that due to starvation depletion of various nutritional substances starts but synthesis of certain lipid

Fishes exhibit starvation as a natural

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fraction does take place quite independently of level or starvation. While, Newsome and Leduc² reported that fishes maintained a minimum level of structural lipid intact even in extreme physiological condition of starvation to keep itself alive. Wilkins³ has observed that at the initial state of starvation fishes mobilize its lipid reserve in preference to carbohydrate and protein sources. Denton *et al.*,⁴ reported no change in the phospholipids and cholesterol level of muscles and liver in the starving rainbow trout and concluded that these two fraction of lipid are structural element rather than sources of energy. However, Creach *et al.*,⁵ reported that fishes under extreme physiological emergency do mobilize some of its phospholipids reserve for energy. In the maturation of fishes lipid store of various tissues show marked variation because, it affects physiological, anatomical and biochemical changes in fishes. Age related variation in different fishes have been investigated by Ross⁶ and Kohli⁷.

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

Material and Method

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 cm to 230 cms size were collected from the ponds located in and around Patna town. The fish were kept under laboratory condition for a week for acclimatization. The acclimatized fishes of the stock were divided in 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
 - i. Small age group - 16 cms to 78 cms,
 - ii. Middle age rroup - 80 cms to 138 cms
 - iii. Higher age group - 158 cms to 230 cms.
- For estimation of plasma level under starvation, the fishes of experimental group were observed for 330 days (48 weeks) and the day on which fishes were starved were marked as "O" days of experiment.

The blood from the fish was collected by severing off the caudal region of the fish a little behind the anus with a sharp scalpel. The blood was used by the method of Barlett⁸ for quantitative estimation of plasma phospholipid. All the quantitative estimations were done colorimetrically by spectrophotometer (Systronics).

Observation and Results

A. *Effect of age on plasma phospholipids.*

The phospholipids level in the plasma of different age group of fishes exhibits distinct variation in both sexes. In male fishes the mean

plasma phospholipids level were recorded, in lower, middle and higher age group the mean value was 79.80 mg/100 ml, 90.10 mg/100 ml and 93.10 mg/100 ml respectively. While, in female fishes, the mean plasma phospholipids level recorded in lower, middle and higher age group were 79.20 mg/100 ml, 87.74 mg/100 ml and 95.32 mg/100 ml respectively. As such, in both male and female fishes, plasma phospholipids level shows a distinct variation in the three age groups. The level was minimum in the lower age group fishes of both sexes and, in both sexes it shows a gradual but proportional increase with the increase in the age. At the same time, male fishes have a higher level of plasma phospholipids than female fishes in all the three age groups (Table 1).

B. Effect of starvation on plasma phospholipids

The plasma phospholipids content in the male fishes also shows some variation due to starvation. During the early days of starvation a significant increase in the plasma phospholipids level of the fish was observed. The value recorded after 60 days of starvation were 96.60 mg/100 ml. thereafter, a gradual fall in the plasma phospholipids level was noticed. These depleted values were insignificant when compared to the control value. The plasma phospholipids level recorded after 150 days of starvation was 89.9 mg/100 ml showing a fall of 3.54% from the control value. The depletion in the plasma phospholipids further continues. The depletion in plasma phospholipids level from 180 days to 300 days of starvation ranges from 80.70 mg/100 ml to 76.55 mg/100 ml. The decrease in the plasma phospholipids level varies from 15% to 18% during prolonged starvation from the very beginning of the experiment.

In the female fishes, also a same picture was observed. In the early days of starvation, *i.e.* up to 90 days of starvation, the plasma phospholipids remain higher than the control value (94.75 mg/100 ml). The value of plasma phospholipids recorded during this period *i.e.* up to 60 days of starvation rises from 95.60 mg/100 ml to 97.30 mg/100 ml showing an increase ranging from less than 1 % to 2.7%. Thereafter, a fall in the plasma phospholipids was recorded up to 330 days of starvation and only after 150 days of starvation a significant decrease in the plasma phospholipids level was observed. The plasma phospholipids level recorded after 150 days of starvation was 90.3 mg/100 ml, which was 5% less than control value.

When the female fishes were subjected to further days of starvation, the depletion in the plasma phospholipids level continued. The plasma phospholipids level in 180 days starved fishes recorded was 88.6 mg/100 ml which was less by 6.5% from the control value (94.75 mg/100 ml). The depletion gradually becomes pronounced as the days of starvation advances and after 330 days of starvation the plasma phospholipids registered a fall of 21 % from the control value. The level of plasma phospholipids recorded was 74.80 mg/100 ml. The depletion of plasma phospholipids in the case of prolonged starvation was found significant at 5% P- Level (Table 2).

Discussion

In fishes lipid and their constituent fatty acids along with proteins are the major organic substance which play key role as source of metabolic energy for growth and movements. Keeping this view in the present research

work, the phospholipids constituents of silurod freshwater fish *Clarias batrachus* was studied in relation to age, sex and starvation.

Booth *et al.*,⁹ have observed changes in body composition with age in *Hiodon alosoides*. Ross⁶ has reported change in different constituents of lipid in *Gadus morhua* under various physiological activities of the fish. Many more investigators have reported variation in lipid profile of the fish in relation to age, sex and maturity (Kohli, 1989, and Siezen, 1989). Spencer *et al.*,¹⁰ have reported change in the blood volume of fishes in relation to age. Love¹¹ was of the view that in fish's maturation there involves transfer of lipid from the liver, muscle and gut to the gonad, though much of lipid was used to supply energy than to make yolk. As fish matures, in every successive year they accumulate bigger and bigger stores of lipid. Paviov *et al.*,¹² observed that lipid stores

of the fishes were utilized to provide energy to 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 fish¹³. As such, the findings of present research work are in conformity with the observation of the early investigators.

The cholesterol and tissues phospholipids content of the *C. batrachus* remain unchanged in the starving fishes. A fall in phospholipids level was reported by Green¹⁴ in salmon *Oncorhynchus tshawytscha*. Wilkins (1967) reported that under the state of physiological emergency some phospholipids may be degraded to provide energy and observed a significant decrease in phospholipids content

Table 1. The phospholipids content in the plasma of male and female *Clarias batrachus* (Linn) in relation to age (Unit of Measurement mg/100 ml)

S.L. No.	Lower age group		Middle age group		High age group	
	Male	Female	Male	Female	Male	Female
1.	88.00	85.5	95.3	90.5	96.5	99.2
2.	85.7	83.6	93.5	89.5	92.2	95.6
3.	80.5	80.3	89.2	87.6	94.7	96.5
4.	79.3	79.8	87.4	86.7	93.5	95.2
5.	77.0	73.4	86.7	85.4	94.5	94.2
6.	69.2	74.5	87.5	86.5	93.6	92.8
Mean	79.8	79.2	90.1	87.74	93.1	95.32
	±5.52	±4.2	±2.1	±3.44	±1.72	±1.32

Table 2. The plasma phospholipids content in well fed control and starved male and female *Calarias batrachus* (Linn)
(Unit of Measurement mg/100 ml)

Day of starvation	Plasma Phospholipids content in male fishes			Plasma Phospholipids content in female fishes		
	Control fishes	Starved fishes	P.V. of mean	Control fishes	Starved fishes	P.V. in mean
0	93.2 ±1.56	93.2 ±1.26	-	94.75 ±1.66	94.75 ±1.6	-
30	93.7 ±1.75	93.2 ±1.66	-0.03	96.5 ±1.95	95.6 ±1.53	-0.95
60	94.2 ±1.96	96.6 ±1.67	+3.61	95.8 ±1.62	97.3 ±2.04	+2.69
90	93.8 ±1.62	91.6 ±1.47	-1.75	97.9 ±1.76	95.2 ±1.86	+0.47
120	94.0 ±1.76	91.8 ±1.87	-1.5	95.0 ±1.62	92.6 ±1.57	-2.27
150	94.3 ±1.86	89.9 ±1.95	-3.54	96.0 ±1.92	90.3 ±1.74	-4.7
180	94.05 ±1.86	80.7 ±2.15	-13.4	98.5 ±1.86	88.6 ±1.28	-6.49
210	93.05 ±1.98	76.0 ±1.47	-18.4	96.0 ±1.25	84.5 ±2.92	-10.82
240	94.9 ±1.66	79.1 ±1.94	-15.6	97.2 ±2.08	83.6 ±2.12	-11.7
270	94.5 ±1.64	76.45 ±1.56	-17.9	95.5 ±1.68	76.5 ±1.28	-19.3
300	93.6 ±1.36	76.55 ±1.07	-17.8	95.6 ±1.86	72.3 ±1.5	-19.2
330	94.3 ±1.86	78.6 ±1.50	-15.61	96.5 ±1.50	74.8 ±1.82	-21.10

in *Clupea harengus*. Almost constant level of phospholipids remains in the body.

In *C. batrachus* the phospholipids constituents almost shows the same fate as reported by other investigators in other fishes and as such they are considered to be mainly structural elements rather than an important source of energy. Larson *et al.*,¹⁶ also found the same status of the phospholipids constituent of the lipid in the starving *Anguilla anguilla*. Thus, the observation of earlier investigators supports the findings of present research work.

The phospholipids contents of the *Clarias batrachus* remain almost unchanged during starvation period of 330 days. A fall in the phospholipids level was observed in starving salmon, *Oncorhynchus tshawytscha*¹⁴. It has been concluded by Denton *et al.*,⁴ that under that state of physiological emergency some phospholipids may be degraded to provide energy. A significant decrease in phospholipids content was seen in starving *Clupea harengus*³. Almost constant level of phospholipids in the tissue of *Clarias batrachus* agrees with the general opinion that these lipid components are mainly structural element rather than an important source of energy. A similar conclusion has been drawn by Larson¹⁵ *et al.*, (1973) for the starving *Anguilla anguilla*. Saka *et al.*,¹⁶ reported decrease in total lipid content of muscles due to starvation in marine fish *Trachurus japonicus*. Cahill¹⁷ reported that man could withstand prolonged starvation by conserving body proteins with a preferential utilizations of lipid. Felic¹⁸ was also of the same view. Goodman *et al.*,¹⁹ also reported a similar result in starving rats. Teshima *et al.*,²⁰ observed

that the fatty acid depot of lipids in tissues was mobilized for energy production during starvation.

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