

Feeding and macronutrients in the tissues of the fresh water fish, *Notopterus notopterus* from a aquatic body

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Abstract

The micronutrients and their requirements for proper growth, survival, reproduction and physiological activities and their presence in some tissues of the fresh water fish, *Notopterus notopterus* were determined and assessed for the health condition of the fish in the aquatic body from where the fish was collected and reported in the present report. The fish, *N. notopterus* is available in large numbers in the aquatic bodies of Kalaburagi area. The availability of a particular fish species in wild in large numbers reflects that the fish is thriving well in the local aquatic environment. This fish is being consumed as food fish in the local rural area. The fish feeds on insects, small fishes, crustaceans, young roots of aquatic plants and is considered as corni-omnivorous. This fish is a bottom feeder and comes to the surface for gulping air. The fish *N. notopterus* feeds by sight and mouth taste and hence brain centre of this fish concerned with vision and taste which are well developed. The fish *N. notopterus* has prominent optic lobes, facial tube as well as large vagal lobes as found in other fishes. The fish *N. notopterus* has well developed facial lobe and is capable of recognising food as observed during feeding under laboratory condition, it seems to be possible that the fish exhibits proper correlation of tactile and gustatory impulses and good gustatory sense. The condition of the fish including the length of the fish varies from 21 to 25 cm, and lays eggs from 1200 to 3000, spawning occur at night and this fish relished both in fresh and dried state and has high economic importance as food fish in South and Southeast Asia. The biochemical nutritional components such as protein, glycogen, fat (lipid) and cholesterol and their requirement for the fish to live healthy were reported in some species of fresh water fish and these data were compared with our data for the tissues such as muscle, liver brain and blood of the fish, *Notopterus notopterus* to assess health condition of the fish in a specific aquatic environment. The results indicated that all the biochemical nutritional compositions were normal at required level in the tissues studied, suggesting that the fish is able to get required nutritional compositions from the natural environment for keeping proper health conditions and thriving well in the aquatic body from where it is collected.

Keywords: nutritional compositions, fish tissues, *notopterus notopterus*

1. Introduction

Fish being a important major source of nutrition for human beings. Now efforts are made to exploit natural source of fish as important diet for both rural and urban populations in India. The efforts are also being undertaken to protect natural aquatic bodies for culturing some specific fish species and also protecting wild fish species available in the aquatic body. Hence, a study on different sources and nutritive values of wild fishes is necessary. The fish, *N. notopterus* is available in large numbers in the aquatic bodies of Kalaburagi area. The availability of a particular fish species in wild in large numbers reflects that the fish is thriving well in the local aquatic environment. This fish is being consumed as food fish in the local rural area. The biochemical nutritional components such as protein, fat (lipid) and cholesterol and their requirement for the fish to live healthy were reported in some species of fish, these data were considered in the present study and compared with their presence in the tissues such as muscle, liver, brain and blood of the fish, *Notopterus notopterus* to assess health condition of the fish in a specific aquatic environment and nutritional status of the fish. Bhagowati and Ratha (1982) [3]. reported the biochemical compositions and nutritional value of some wild fish species collected in the hill stream area of North-Eastern India reported that the fish species belonging to the genus *Garra* (*G. gotyla gotyla*, *G. annandalei* and *G. lissor hynchus*) nutritionally are as good as other important

fishes and have served the hilly people with good source of protein nutrition and suggested exploitation for commercial purposes. Principles of fish nutrition (Gatlin D.M.2010) [6], significance of fish nutrition in aquaculture industry (Prabhu *et al.*, (2017) [15]. and fish in human health and nutrition (Mohanty *et al.*, 2019) [13]. have reviewed recently considering importance of study related to nutritional compositions of fish and their requirement for fish growth needed for human consumption. Hence, a study has been undertaken to understand the tissue nutritional compositions and their requirement for the locally available fresh water fish, *Notopterus notopterus*.

2. Material and Methods

Fresh water fish *Notopterus notopterus* caught 30 fishes by a local fisher man from Bheema river (16° 24' 36" N, 77° 17' 6" E) near Kalaburagi and brought to the laboratory. They were kept in 30L fiberglass tanks containing 30 liter aerated water. The fish were allowed to acclimate for a period of one week before start of the determination of tissue compositions. Biochemical determination of protein, lipid, and cholesterol in the tissues such as muscle, liver, brain and blood has been carried out during spawning phase. The biochemical contents were determined by using the following methods. Estimation of protein by Lowry's method (1951), glycogen estimated by Anthrone method (Carroll *et al.*; 1956) [4], estimation of lipid by Barnes and

Black stock (1973) ^[1]. and cholesterol by Libermann and Burchard method (1952).

Blood samples obtained from caudal circulation with the aid of heparinized 2cm disposable plastic syringe and 21 gauge hypodermic needle. The blood serum obtained by centrifugation used for determination of protein using modified Biurate method as described by Lawrence (1986) ^[12]. and lipids (triglycerides by GPO-PAP method and cholesterol by oxidase-phenol aminophenazone method using commercial kit. The total muscle content of the fish was determined by removing outer skin and fins, the total muscle content taken and weighed on the 'Decobal Balance' instrument. The moisture content of the fish was determined by drying the fish for two days and percentage of moisture calculated using the formula: Wet weight of fish – Dry weight of fish.

3. Stastical analysis of the data

In all the cases six observations were made and the results are expressed as arithmetic mean with their standard deviation, standard error and student "t" test.

4. Results

The fish *N. notopterus* is available in large number in the aquatic bodies in and around Gulbarga and are quite common in the aquatic bodies throughout the year. They can be collected using caste net with the help of fisherman. The maximum contribution to the fisheries from the aquatic body was made by the presence of this fish *N. notopterus*. The presence of the fish in the aquatic body can be identified through its surfacing action. The feeding of this fish comprises of some aquatic insects, weeds, small fishes, feeding activity increases during spawning. This fish is a bottom feeder and comes to the surface for gulping air. The fish *N. notopterus* feeds by sight and mouth taste and hence brain centre of this fish concerned with vision and taste which are well developed. The fish *N. notopterus* has prominent optic lobes, facial tube as well as large *vagal* lobes as found in other fishes. The fish *N. notopterus* has well developed facial lobe and is capable of recognising food as observed during feeding under laboratory condition,

it seems to be possible that the fish exhibits proper correlation of tactile and gustatory impulses and good gustatory sense. The condition of the fish including The fish builds nests and spawns among the aquatic weeds including submerged branches of acacia plant. The biochemical constituents such as, protein, glycogen, lipid and cholesterol were estimated in muscle and liver and brain during spawning phase (August-October).

The protein content of tissues such as muscle, liver and brain was found to be different. in the present study (fig-1). The amount of protein is higher in the hepatic tissue compared to muscle and brain. However, the amount of protein content in the brain is higher as compared to the muscle. The degree of glycogen content was brain > liver > muscle. The muscle and brain lipid are higher in values as compared to hepatic lipid (fig.1). The reduction of hepatic lipid may be because of its contribution to gonads for promoting growth. Cholesterol and other components always in minor amount modify the basic protein / phospholipids pattern of biological membrane pathways. Hence, cholesterol forms a major component of lipids. The cholesterol content is higher in liver and brain as compared to muscle (fig.1).

Total body, muscle and liver weights ranging from 50 gm to 100 gm were taken to determine the total body, muscle and liver weight. In the 50 gm body weight of the fish, the total muscle weight was 25 gm and corresponding to this the total liver weight is 0.385 mg. The results indicate that the total muscle content of fish *N. notopterus* was found to be 50% of the total body weight of the fish, as body weight increases muscle weight also increases. Similarly along with the body weight liver weight also increases. The fish ranging from 50 gm to 120 gm have been taken for determining moisture by considering wet weight and dry weight of the fish and the moisture percentage was calculated and it was found to be 55%. The blood protein in the fish ranged from 6.86 -8.33 gm/dl. With an overall mean of 7.70gm/dl.±0.15. The range of triglycerides in the blood of the fish is 212.4 – 400.0mg/dl with an overall mean of 302.96 mg/dl. ± 18. 79, the cholesterol in the blood 153.56± 8.89 mg/dl with a range of 111.5 – 211.0.

Table 1: Showing Macronutrients in The Tissues (Muscle, Liver, Brain and Blood) of The Fresh Water Fish, *notopterus notopterus*.

	Protein	Glycogen	Lipid	Cholesterol
Muscle	3.32 ± 0.01	0.63±0.01	0.96±0.03	4.33±0.12
Liver	24.±0.14***	1.05±0.01*	1.90±0.19	4.93±0.01
Brain	13.95±0.08	3.72 ±0.04**	10.8 ±0.34***	5.5±0.16*
Blood	7.70 ± 0±.54g/dl	47.18± 8.37mg/dl	302.96 ±65.09mg/dl.	153.56±30.82 mg/dl

Tissue expressed as mg/50gm. of muscle,liver and brain tissues except blood as g/mg per dl., each value is expressed as mean ±SE, N= 6, *=Not significant, **=significant, ***-significant when compared between the tissue.

5. Discussion

The water body from which the fish *N. notopterus* was collected provides suitable ecology for its survival, growth and breeding activity as the fish is available in large numbers throughout the study period. Based on the availability of fish *N. notopterus* throughout the study period indicates that the fish has good feeding in the aquatic body with favourable environment.

The feeding of *N. notopterus* comprises of insects, their larvae, small fishes and weeds which has been identified on their presence in the stomach after opening viscera. This fish can be considered as corni-ominivorous preferring

aquatic insects. Kiran and Waghary, (1998) ^[11]. have studied the food and feeding habits of this fish at Saroongar lake (Hyderabad) and found that the fish *N. notopterus* is corni-ominivorous euryphagic and bottom feeder. Feeding intensity is maximum in summer and minimum in the winter which is related to maturity. This fish is capable of adjusting and widening its food spectrum, when preferred items becomes scare. They appear to thrive on other food easily and readily available in the area. The biochemical contents in liver, muscle and brain of the fish *N. notopterus* was studied during spawning phase of the reproductive cycle. This phase was selected considering, the availability of fish

in large number and in a good harvestable size.

Proper nutrition forms an important source for keeping good health and proper growth of the fish in an specific environment. In this context quite good number fishes have been studied and reported. Mohanty *et al.*, (2019) [13]. have reviewed fish in human health and nutrition and reported crude protein, crude fat, moisture and ash content in large number of food fishes from India. The crude protein content of some fish species particularly major carps such as *Catla catla* (16.2 ±0.5), *Cirrhana mrigala* (15.5 ±0.5), *Labeo rohita* (15.9 ±0.4) including *N.notopterus* (22.2±0.7). Prabhu *et al.*; (2017) [15]. Reported the crude protein requirement in five types of fishes Channel catfish- 32(28) %, Rainbow trout- 38 (34) %, Pacific salmon -38 (34)%, Common carp -35 (30.5)%, and Tilapia -32 (28)% as per NRC,1983. Fats serve as an important source of energy. However, no definite percentage of dietary fat can be given without considering the type of fat. Fresh water fish requires dietary source of linoleic acid and these are both 18 carbon fatty acids. The essential fatty acids requirements of fishes reported by Prabhu *et al.*: (2017) [15]. in eight types of fishes ranges from 0.5% to 2% of linoleic acid. In our study in the fresh water fish, *N. notopterus* at the tissue level of protein content such as liver, muscle and brain was found to be different. In the present study the amount of protein is higher in the hepatic tissue compared to muscle and brain during spawning period. However, the amount of protein content in the brain was found to be higher as compared to the muscle. The average tissue protein content is 41.57mg/50gm for average body weight of 78 gm of fish and the percentage of total tissue protein calculated will be 53%. Protein forms an important group of macro molecule and occupies a pivotal place in structural and dynamic aspect of living organization. They are versatile and act as biocatalyst, form important constituents of the tissue and the organ systems and also form the immune mechanism of the body (Harper, 1985). Protein is relatively non-specific form of energy. Liver utilizes protein for gluconeogenesis to replenish its store of glycogen of carbohydrate in the diet. The higher level of liver glycogen in *N.notopterus* is probably broken down to glucose transported to muscle which gets utilized for muscular activity.

The blood serum protein, glycogen and lipid levels observed in the fish, *N.notopterus* was found to be on higher side as compared to other fishes and this increase may be due to the fish being corni-omnivorous. Protein plays an important role in biological process in enzymatic catalysis in transport or mechanical support, for control of growth and differentiation. The depletion of muscle protein levels in the present study indicates rapid utilization of energy stores to meet the energy demands warranted by the environment. and it is reported that the degradation of protein content may be due to enhanced proteolytic activity (Gita and Yeragi, 1998) [8]. or by alteration of membrane permeability. Decrease in content has been observed in *Heteropneustes fossilis* and *Anabas testudineus* (Geeta Bhaskar, 1997) after various pollutant treatments.

The crude fat content of some fish species particularly major carps such as *Catla catla* (2.8±0.3), *Cirrhana mrigala* (2.8±0.3), *Labeo rohita* (2.7±0.2) including *N.notopterus* (4.0±0.7). In our study in the fresh water fish, *N. notopterus*. The muscle and brain lipid are higher in values as compared to hepatic lipid. The reduction of hepatic lipid may be because of its contribution to gonads for promoting growth.

The fat (lipid) content found to be less in hepatic tissue in comparison to muscle and brain the decrease in hepatic lipid may be because of its contribution to gonads for promoting growth. The average tissue fat (lipid) content is 13.66mg/50gm for average body weight of 78 gm of fish and the percentage of total tissue fat (lipid) calculated will be 17.51%. While a study depletion of lipid characterizes substances without food in almost all cases, the lipid content cannot necessarily be taken as a reliable index of the nutritional status of the fish. The selectivity of the fish in utilizing its lipid stores is more interesting, although the information is scanty. Lipids are of utmost importance in maintaining the structural and physiological integrity of cellular and sub cellular membranes. Under stress conditions, stored lipids undergo catabolism, releasing energy in the form of ATP. Since the calorific value of fats is more than twice that the carbohydrates or proteins, the storage of fats as a source of energy to the body is most important. The cholesterol forms a major component of lipids. It plays a major important role in the physiological and metabolic process of the animal. The liver, muscle, gonads, nervous tissue of fishes containing certain large quantities of cholesterol. Cholesterol precursor for steroid hormone production i.e., steroidogenesis. Fatty acids are required as an alternate source of relatively high energy in the place of carbohydrate as a constituent of growing cell particularly in spawning period. It is notable that the decrease of cholesterol from liver and leads to increase of cholesterol in gonads through circulation depends on spawning phase (Joshi, 1988) [10]. In the present study the average tissue cholesterol content 14.76 mg/50gm for 78 gm of fish and it will be 18.92%. The lipids are the economical usual form used by fishes to stock energy and can be stored in many organs (Gujarro *et al.* 2003) [9]. The plasma levels of cholesterol and triglycerides are found to have difference and possibly this difference may be because of age and general health conditions and also depends on feeding diet. The moisture content of some fish species particularly major carps such as *Catla catla* (76.2± 0.3), *Cirrhana mrigala* (75.3 ± 0.6), *Labeo rohita* (75.6 ± 0.5) including *N.notopterus* (74.2 ± 1.2) (Mohanty *et al.*, 2019) [13]. In our study in the fresh water fish, *N. notopterus* total body, muscle and liver weight of the fish ranging between 50 gm to 100 gm were taken to determine total body, muscle and liver weight. The total muscle contents of the fish *N. notopterus* was found to be 50% of the total body weight, as body weight increases muscle weight also increases similarly along with the body weight liver weight also increases. As the protein decreases, the water increases and this change is mainly brought about by the shrinkage of the cells and a corresponding increase in the fluid between them (Ottow Nehaus and Halver, 1989). In the present study the moisture was estimated in the freshwater fish *N. notopterus* it was found to be 55%. Since the fish, *N.notopterus* thriving well in the aquatic body, it indicates that the required nutritional components are available along with efficient feeding by the fish on plant and animal origin under natural conditions.

6. Conclusions

The fish *N.notopterus* is corni-omnivorous fish consume almost any food source, either plant or animal origin and it is a predator and selects by taste and eye sight, teeth are well developed and act as a means of grasping and holding the

praying on sight to hunt and also rely on the senses of taste and touch gets all nutrients from the natural environment and hence surviving well and promotes growth and reproduction.

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7. References

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