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Research Article

Seasonal Changes in the Biochemical contents of Fresh water Fish *Notopterus chitala* (Gunther, 1839)

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Abstract

Freshwater fish *Notopterus chitala* collected from Krishna River near Audumber during Jan 2013 to Dec 2014. The seasonal changes in the Protein, Glycogen, Lipid and Ascorbic Acid of the muscles were analyzed. Biochemical constituents of body of the freshwater fish *Notopterus chitala* were greatly influenced by the breeding activity. Protein level increases from the month of October (Preparatory Phase 13.6756 ± 0.0274) and reach maximum level in the month of April (19.975 ± 0.0286). Glycogen level also increases from the month of October and reaches peak value in the month of Feb (0.6361 ± 2.1531^{-3}). Ascorbic acid content is maximum in the month of June (0.5725 ± 7.4283^{-3}) and lowest in the month of January (0.0774 ± 7.3521^{-3}). Maximum lipid content in the muscles is found in the months of January (0.6743 ±0.04535), September (0.65427 ±2.4842^{-3}) and December (0.4891 ± 2.8295^{-3}). The depletion in the Protein, Glycogen and Lipid contents is may be due to transfer towards gonads during maturation.

INTRODUCTION

Fish provide a good source of readily digested high quality animal protein, fat, mineral and vitamins specially vitamin A, D and E. Also, fish plays important roles in the prevention and management of many human diseases such as heart disorders, neurological diseases, mood swings and when fish is substituted for beef, the nitrogen is utilized better resulting in a decreased excretion of uric acid in the urine (Thilsted and Roos, 1999 and Conquer and Holub, 2002). Fish protein produces a good influence on the assimilation of magnesium, phosphorous and iron. Fat in aquatic organisms is associated with a variety of function reflecting special biochemical and environmental conditions, fats are the major metabolic reserve in most fish (Lovell, 1989).

Glycogen is a vital source of muscle energy of live animal and it is utilized during muscular action and stored up during rest. Glycogen in different tissues shows remarkable difference Nutritive value of fish is recognized all over the world. The lipids are the most important biochemical compounds of fish (Akpınar, 1986). Fish store the lipids in various organs; particularly in muscles and liver. On the contrary, the mammals store in adipose tissue. Generally, fish lipids are known to contain n-3 series unsaturated fatty acids which reduce the level of serum triglyceride and cholesterol. As a result of this sudden heart attacks ratio and the risk of thrombosis, which is mainly the reason for heart attacks are reduced. Some researchers reported that the n-3 fatty acids facilitate some cancer treatments such as breast tumours (Konar *et al.*, 1999; El-Sayed *et al.*, 1984). Ascorbic acid acts as an essential factor for normal growth in rainbow trout *Salmo gairdneri* (Tucker and Halver, 1986). The accumulation of ascorbic acid at the site of wound healing was found by Gould (1963).

Therefore, the fish is an important source of food for mankind all over the world from the times immemorial. So, they are beneficial nutrition sources (Weatherley and Gill, 1998). In general, the biochemical composition of the whole body indicates quality of the fish. Therefore, biochemical composition of a species helps to assess its nutritional and edible value in terms of energy units compared to other species. The seasonal changes occur in the biochemical contents of fresh water fishes this indicates that biochemical constituents in any organism vary with the variation of environmental changes. Similarly, variation of biochemical composition of fish flesh may also occur within same species which depends upon the fishing ground, fishing season, age, sex and reproductive status of the individual. The spawning cycle and food supply are the main factors responsible for this variation (Love, 1980).

A number of workers have studied the depletive effects of maturation and spawning in the chemical composition of fish (Pandey et.al.,1976; Piska and Prasad, 1991 and Kiran and puttaiah,2005). Some workers have studies seasonal variation in the biochemical composition of freshwater fishes (Rezan, 2011; Jan *et al.,* 2012; Venkatesan *et al.,* 2013 and Ganeshwade, 2017). *Notopterus chitala* is a commercially important fish having high protein contents and taste. Therefore, the present study was undertaken to understand the seasonal variations in the biochemical components of muscles of *Notopterus chitala.*

MATERIALS AND METHODS

The fish *Notopterus chitala* were collected from Krishna River during January 2013to Dec 2014. They were brought in to the laboratory and then scarified for furthers studies. The tissue was processed for Protein, Glycogen, Lipid and Ascorbic Acid estimations. The protein was estimated as method described by Lowry *et al*., 1951. Glycogen was estimated by Anthrone Reagent Method (De Zawaan and Zandee, 1972). The total Lipids was estimated by Vanillin Reagent Method (Barnes and Black stock, 1973) and Ascorbic Acid by Roe J.H. ((1958).

RESULTS AND DISCUSSIOON

Monthly biochemical variation in the muscles of *Notopterus chitala* is given in the Table No. 1 and Graphs Numbers 1- 4 shows the variations in the Protein, Glycogen, Ascorbic Acid and Lipid contents respectively. Protein level in the present fish shows an increase from October (13.6756 ± 0.0274) and reach maximum level during April (19.975 ± 0.0286) May (19.270 ±0.0437) and June (19.4555 ±0.0734). Glycogen level is also increases from the month of October (0.1237 ± 3.4576^{-3}) to reach maximum in the month February (0.6361 ± 2.1531^{-3}). Lowest level was observed in the month of October and highest level in the month of February.

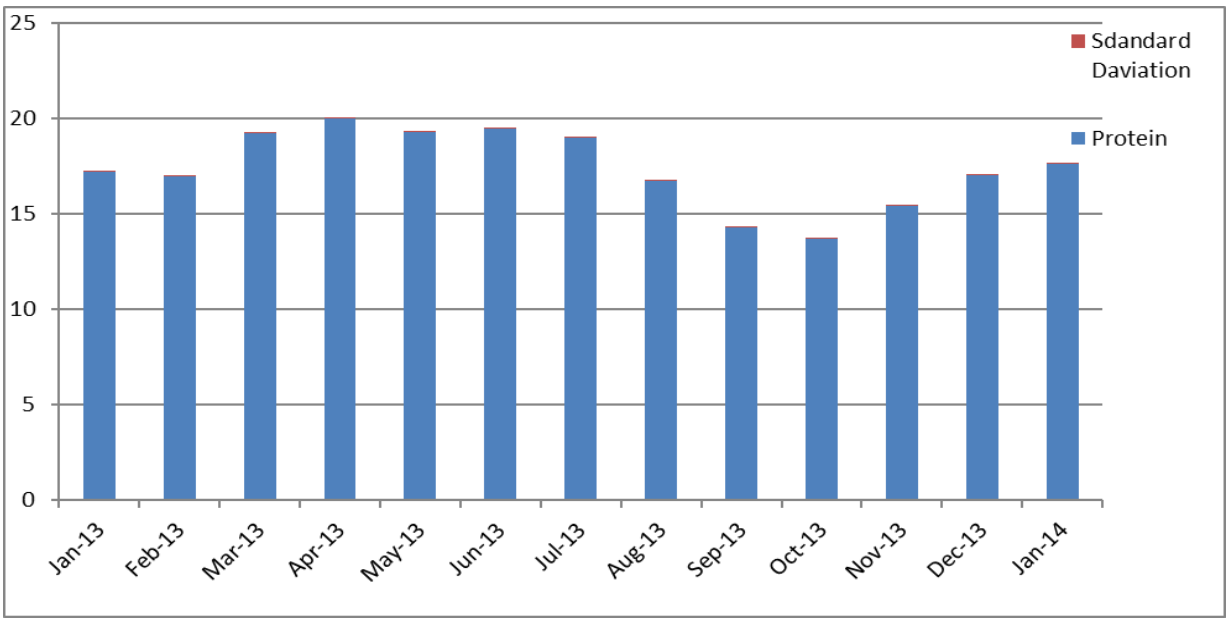
Maximum level of Ascorbic Acid was observed in the month of June (0.5725 ± 7.4283^{-3}) and lowest level was observed twice in the year i.e. in the month of January (0.0774 ± 7.3521^{-3}) and July (0.07867 ± 5.6153^{-3}). Generally, there are two peak values in the month of June and December and two low values in the month of January and July. The depletion in the protein, Glycogen, Ascorbic acid and Lipid is may be due transfer of these contents towards gonads during maturation. Lipid content in the muscles shows three peak values in the months of January (0.6743 ±0.04535), September (0.65427 ± 2.4842^{-3}) and December (0.4891 ± 2.8295^{-3}). The lowest values are seen in the months of June (0.0731 ± 3.2416^{-3}), October (0.06951 ± 2.1221^{-3}) and November (0.0521 ± 3.1697^{-3}).

In the fish *Notopterus chitala protein* level increases during preparatory phase i.e. from the month of November to June and it was decreased in the spawning period i.e. in the months of July to October. Drop in the protein level among Cyprinidae may be attributed to the utilization of protein for gonads development and maturation during spawning. A similar result was also observed by Mahdi *et al*., (2006). Jan *et al*., (2012) studied seasonal variation in the protein content of the muscles of *Schizothorax esocinus* and observed highest protein content was observed in summer season and lowest in winter season. During spawning, muscle protein started declining gradually due to its transfer in to ovaries to meet energy requirement of fish. Similar results were observed in the *Notopterus chitala* during present investigation. The highest value of muscle protein is observed in summer season as gonads of fish are in the recovery stage and without any gonadal elements; the food that is consumed by the fish is used in the building up of the muscle. These observations confirm the earlier findings of Bruce (1924).Jyotsna *et al.,* (1995) also reported that protein content during spawning season changes due to change in the endocrine system that monitors supplyof nutrients to gonads from all parts of body

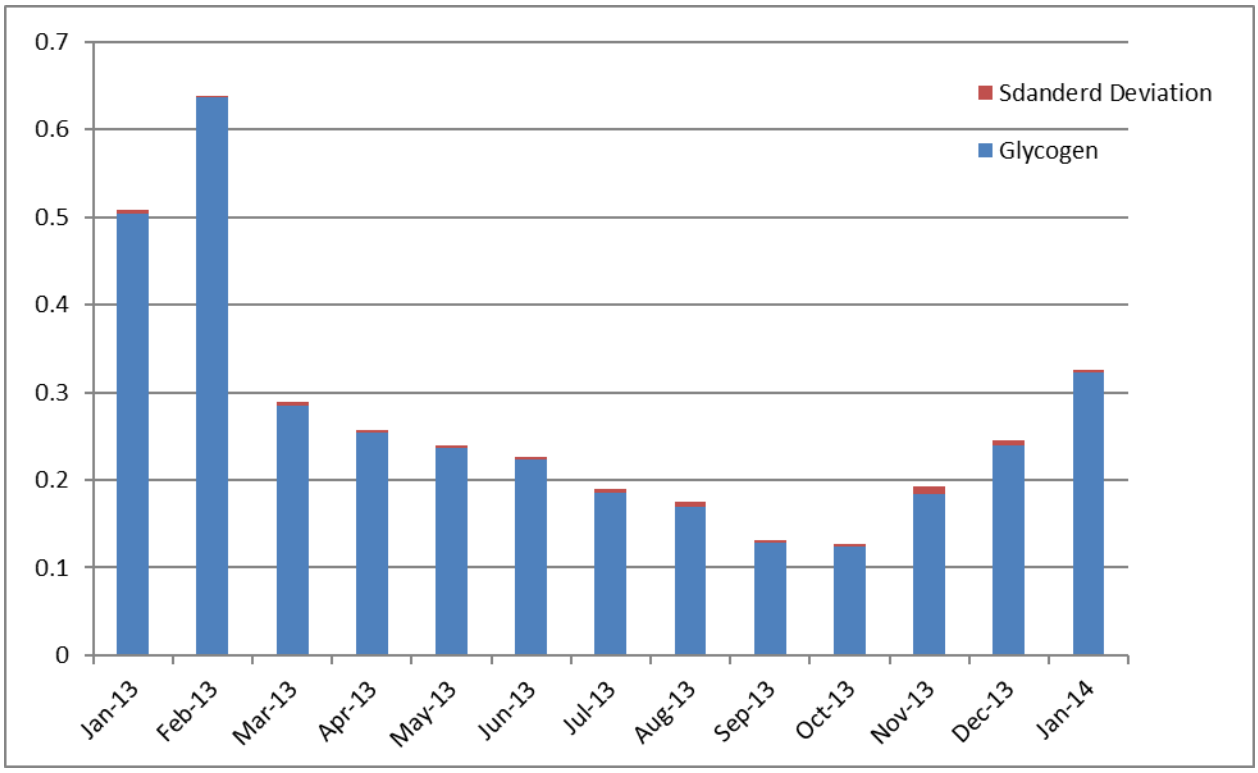
Table No. 1: Seasonal variation in the Biochemical Components of the Muscles of *Notopterus chitala* (Gunther, 1839)

Biochemical Compo / Months	Protein	Glycogen	Ascorbic Acid	Lipid
January 2013	17.18643 ±0.0143	0.504085864 3.561909039^{-3}	0.077442352 $\pm7.352121997^{-3}$	0.674307639 ±0.045354189
February 2013	16.96715202 ±0.02976901	0.636124649 $\pm2.15306874^{-3}$	0.090921242 $\pm5.6152275928^{-3}$	0.410932006 $\pm4.814934994^{-3}$
March 2013	19.21710868 ±0.014300506	0.284781706 $\pm3.920590013^{-3}$	0.402773754 ±0.01023372	0.349627025 $\pm1.732683708^{-3}$
April 2013	19.975039 ±0.028601188	0.253837705 $\pm3.154166665^{-3}$	0.429731535 $\pm6.454951317^{-3}$	0.287378908 $\pm4.147516248^{-3}$
May 2013	19.26954412 ±0.043688945	0.236015762 $\pm3.920590115^{-3}$	0.497125988 $\pm8.288138856^{-3}$	0.189526708 $\pm1.080518417^{-3}$
June 2013	19.45545155 ±0.073384834	0.222897438 $\pm3.857856555^{-3}$	0.572485239 $\pm7.428311777^{-3}$	0.073047243 $\pm3.241554642^{-3}$
July 2013	18.97399896 ±0.028601118	0.185253551 $\pm3.857856542^{-3}$	0.078667705 $\pm5.61527593^{-3}$	0.370612191 $\pm3.189686458^{-3}$
August 2013	16.70497486 ±0.043688971	0.169568598 $\pm5.156967803^{-3}$	0.101949426 $\pm8.288138836^{-3}$	0.496523192 $\pm4.263794754^{-3}$
September 2013	14.28341134 ±0.028601153	0.127932178 $\pm2.7501854^{-3}$	0.139322713 $\pm6.454951221^{-3}$	0.654265626 $\pm2.484184474^{-3}$
October 2013	13.67563703 ±0.027383513	0.123654463 $\pm3.457635329^{-3}$	0.347020162 $\pm5.615276382^{-3}$	0.069510417 $\pm2.122095502^{-3}$
November 2013	15.43699081 ±0.043688971	0.183257284 $\pm9.616139412^{-3}$	0.407675169 ±0.014038189	0.052062076 $\pm3.18968645^{-3}$
December 2013	17.00052002 ±0.05720229	0.239143841 $\pm5.995183058^{-3}$	0.496513311 $\pm7.352121996^{-3}$	0.488977964 $\pm2.829461026^{-3}$
Jan 2014	17.64881262 ±0.021844492	0.322140412 $\pm3.857856477^{-3}$	0.133808621 ±0.011816882	0.654501414 $\pm3.938442395^{-3}$

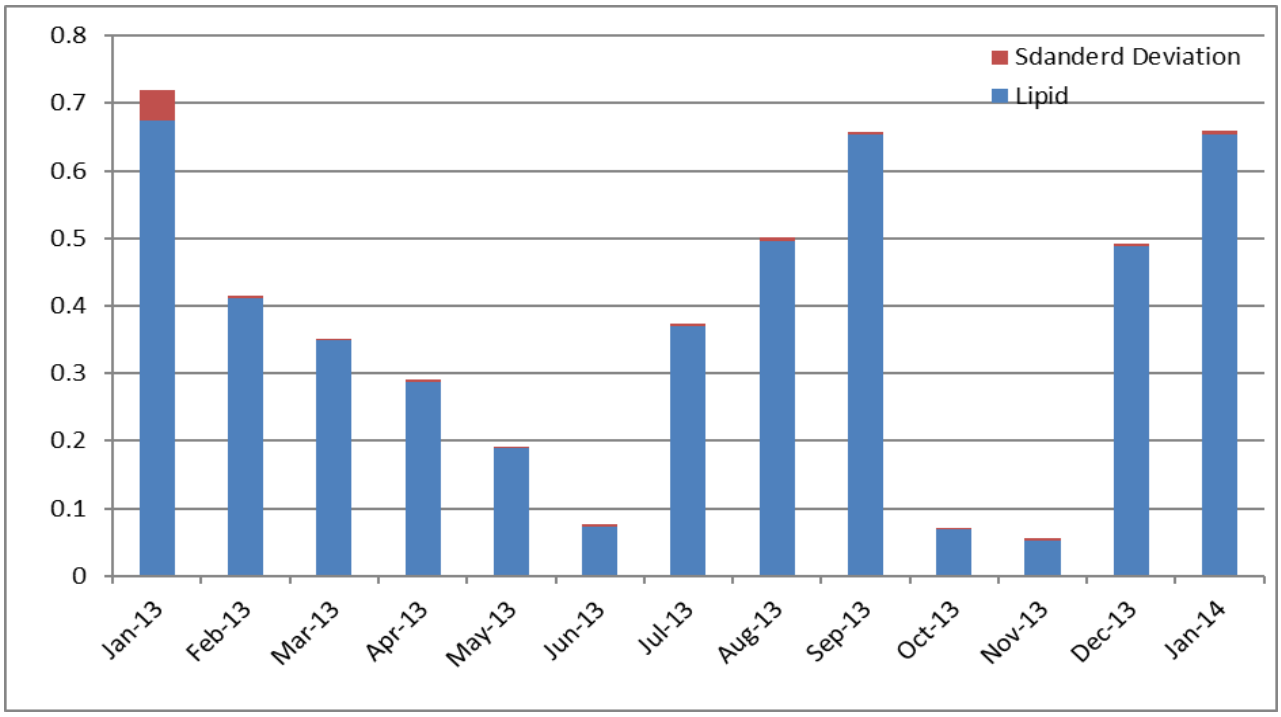
Graph No. 1: Seasonal variation of Protein in the Muscles of *Notopterus chitala* (Gunther, 1839



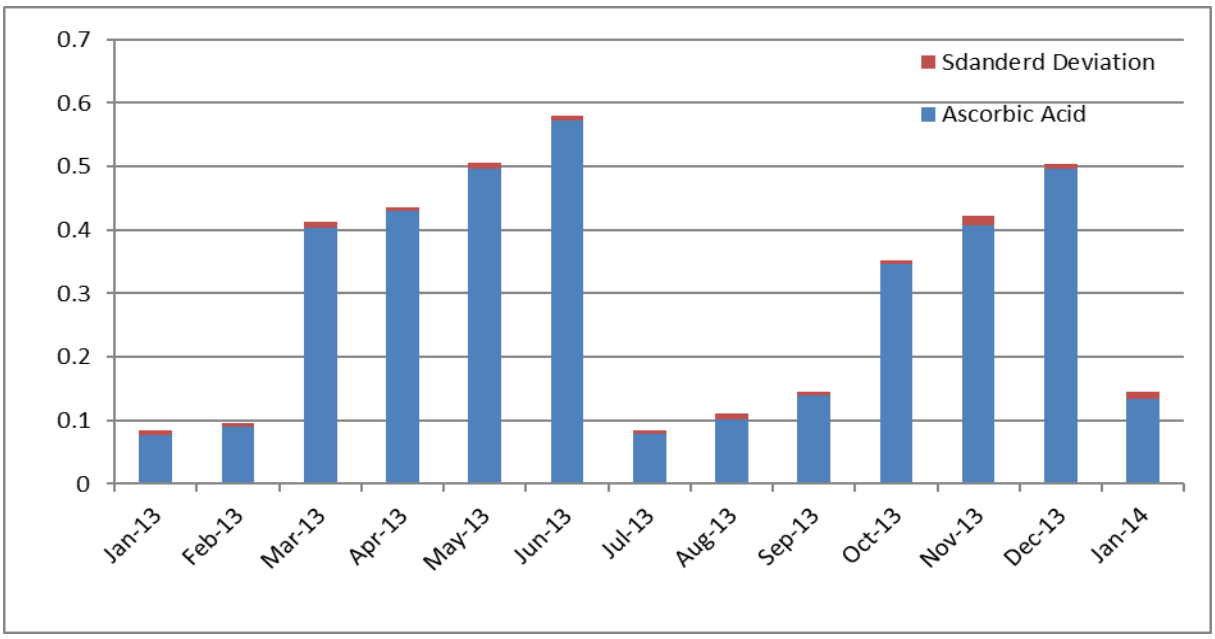
Graph No. 2:Seasonal variation of Glycogen in the Muscles of *Notopterus chitala* (Gunther, 1839)



Graph No. 3:Seasonal variation of Lipid in the Muscles of *Notopterus chitala* (Gunther, 1839)



Graph No. 4: Seasonal variation of Ascorbic Acid in the Muscles of *Notopterus chitala* (Gunther, 1839)



including liver and muscles. Proteins get accumulated in gonads when fish matures and at the time of spawning the gonadal elements get released either as eggs or milt carrying the protein along with them and protein declines. During the month of August, September and October the protein content declines as protein for germ building is mobilized from muscle as reported by Sivakami *et al*., (1986). In this period gonadal development starts so the food that fish eats utilizes for making gonads. The same pattern of variation was observed in the muscles of the *Puntius kolus* (Ganeshwade, 2015). Ashashree *et al*., (2013) studied seasonal changes in protein muscles in *Mystus cavasius* and observed protein levels of muscle ranged from 0.42±0.01 to 5.27±0.04, being maximum in December and minimum in July.

Glycogen is a vital source of muscle energy of live animal and it is utilized during muscular action and stored up during rest (Pawar and Sonawane, 2014). Glycogen level in *Notopterus chitala* was also increases from the month of October (0.1237 ± 3.4576^{-3}) to reach maximum in the month February (0.6361 ± 2.1531^{-3}). Lowest level was observed in the month of October and highest level in the month of February.

Glycogen content in the muscles of *Notopterus chitala shows* steady decrease from the month Feb to October. Highest level was observed in the month of Jan and Feb and lowest level was observed in the month of October. During post-spawning glycogen level decreases due to its utilization for to meet energy demand. During the present work it is observed that in the summer its level is more and it goes on decreasing in advancement of maturity. In post-spawning season its level is very low because it is utilized as a source of energy. Vijaykumaran (1979) stated that carbohydrate plays a minor role in energy reserves of *Ambasis gymnocephalus* and its depletion during the spawning season is significant. Venkatesan *et al.*, (2013) reported muscle carbohydrate content in the female showed a general decline from the stage I-VI with the advancement of maturation. However, it decreased only slightly in male indicating utilization of carbohydrate to a lesser extent with the advancement of maturation.

The fish generally store lipids in their own liver and muscle tissues, but during the process of storage which tissues are important varies according to the fish species. It was reported that active fish stored their lipids in muscle tissues; but the fish inactive living at the bottom of water store their lipids in liver (Castell *et al.*, 1972). Storage lipids vary during reproduction and nutrition periods. It was observed that, especially in the reproduction period, the lipids mobilized from the livers and muscles to the gonads for development of gonads (Castell *et al.*, 1972). Much more energy is needed during the development of gonads; so, plenty of food must be available in that period (Wang *et al.*, 1990).

The decrease in the amount of total lipid and fatty acid in liver and muscle of fish during the periods of gonad development and reproduction shows that fish supply the required energy from the stored lipids during this period (Gill and Weatherley, 1984; Aggelousis and Lazos, 1991; Stansby *et al.*,1990; Akpınar, 1987).

In *Notopterus chitala* lipid level shows two peak values in the months of Dec-January and August-September. This indicates that the lipid level increases in pre-spawning months. Somvanshi (1987) reported percentage of fat in muscles of *Garra mullya*. She observed maximum fat percentage in July in females and November in males. This indicates high values were observed during pre-spawning and spawning months and low during the post-spawning months. Langer *et al*., (2013) studied on seasonal fluctuations in the proximate body composition of *Paratelphusa masoniana*. They observed two peaks in the muscle lipid content in the months of March (5.49 ± 0.381) and September (5.85 ± 0.46) and stated high lipid content was observed in spring and post-monsoon and this could be due to active feeding and optimum availability of food as a algal blooms and planktons.

The decline in the lipid content during spawning period is possibly due to mobilization of lipid as an energy source to meet the high energy demands during the act of ovulation and spawning on one hand and due to low feeding intensity and low availability of food items on the other. Reduction in the amount of lipid content in the muscles for the development and maturation of gonads has been well discussed by Raina (1999) and Samyal *et al*., (2011). A great amount of lipids is transferred to the different parts of the body to be used for various physiological actions (Yılmaz, 1995). The amount of total lipid from muscles of *O. mykiss* during generation period (December-May) had a tendency to decrease. It reached the minimum level in May and increased from June to September (Sevket and Polat, 2007).

The ascorbic acid plays an important role in detoxification of the foreign bodies or toxicants in metabolic process. The main site to synthesize the ascorbic acid is the liver. Ascorbic acid content in the muscles is less as compared to other tissues (Giroud *et al*., 1938). It plays a role directly related to homeostatic mechanism and is essential for wound healing and regeneration (Shah *et al*., 1971 and Padhi & Patnaik, 1978). Ascorbic acid content in Notopterus chitala also shows two peak values in the months of March-June and October-December i.e. in pre-spawning and post-spawning period. During breeding season ascorbic acid content is reduces due to its utilization for the process of maturation of gonads. Some authors have observed that AA concentrated in female gonads is transferred to the oocyte during maturation and then quickly consumed during the first days of embryonic growth (Blom and Dabrowski 1995).

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