Print & Online, Open Access, Research Journal Available on http://jbsd.in
ISSN: 2229-3469 (Print); ISSN: 2231-024X (Online)
Research Article

Seasonal Biochemical Changes in the Muscles of Freshwater Fish *Mystus cavasius* (Ham)

Ganeshwade R. M. [1]*, Ghanbahadur Ashwini G[2].and S. R. Sonawane[3]

1*Department of Zoology, Padmabhushan Dr.VasantraodadaPatilMahavidyalaya, Tasgaon Dist. SangliMaharashtra, India.
2 Department of zoology RNC Arts, JDB Commerce, NSC Science College, Nashik, Maharashtra, India.
3 Departmentof Zoology, Dr. B.A.M.U. AurangabadMaharashtra, India.
*E-mail: rmganeshwade@gmail.com

Article Info

Received: 11-10-2015,
Revised: 07-12-2015,
Accepted: 17-12-2015

Keywords:
Mystus cavasius, Krishna River, Protein, Glycogen, Lipid and Ascorbic acid

Abstract

Fresh water fish *Mystus cavasius* were collected from Krishna River near Audumber during January 2013to Dec 2014. They were brought in to the laboratory and then scarified for further studies. The tissue was processed for Protein, Glycogen, Lipid and Ascorbic Acid estimations. There is no any drastic variation found in the protein content. Its highest value was observed in the month of November (19.4984 ±0.05954) and lowest value observed in the month of February (14.96984±0.0143). Glycogen level is ranges in between 0.08230 ± 3.4576^{-3} to 0.613595 ± 2.6137^{-3}. Ascorbic acid ranges between 0.08663 ± 4.5022^{-3} to 0.49774 ± 9.432^{-3}. The lipid levels in the muscles ranges between 0.11619 ±3.24155^{-3} to 0.5951 ± 3.5368^{-3}. It is maximum in the months of January and September and lowest in the months of May-June (Spawning period) and October-November (Spent season).

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 are 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).

In addition to the clear benefits of fish lipids in treatments, it is observed that due to lack of these essential fatty acids causes some symptoms to appear, such as slow growth, deformation of tail fin, faded and fatty liver, skin depigmentation and being shocked in case of stress (Ackman and Eaton, 1976).

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 and Kiran and Puttaiah, 2005). Number of workers studied on biochemical and histopathological changes under toxicity stress (Ganeshwade, 2012a, b and Ghanbahadur *et al*., 2015). Some workers have studies seasonal variation in the biochemical composition of freshwater fishes (Jan *et al*., 2012; Venkatesan *et al*., 2013 and Pawar and Sonawane, 2014).

Mystus cavasius 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 *Mystus cavasius*

MATERIALS AND METHODS

The fish *Mystus cavasius* were collected from Krishna River during January 2013to Dec 2014 and were obtained from fisherman. 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 DISCUSSION

Seasonal biochemical variations in the muscles of *Mystus cavasius* is given in the Table No. 1 and Graph Nos. 1-4. *Mystus cavasius* has prolonged breeding period starting from February to July, where development and maturation take place. August and September are the post spawning months and spent season was seen during October and November. There is no any drastic variation found in the protein content. Its highest value was observed in the month of November (19.4984 ±0.05954) and lowest value observed in the month of February (14.96984±0.0143).

Glycogen level is ranges in between 0.08230 ± 3.4576^{-3} to 0.613595 ± 2.6137^{-3}. It indicates that the glycogen level decreases in the month September, October and November. Increased level was observed in the months of February, March and April. Lowest level found in the month of October (0.08230 ± 3.4576^{-3}) and highest level was found in the month of February (0.613595 ± 2.6137^{-3}). It indicates that during preparatory phase glycogen level is increases and after spawning the level was decreased. It Suggests that the fish requires lot of energy after spawning period therefore it utilizes reserve food material (i.e. Glycogen) from the muscles. Similarly in the summer months food is available in more quantity therefore excess amount of food is stored in the muscles.

Ascorbic acid ranges between 0.08663 ± 4.5022^{-3} to 0.49774 ± 9.432^{-3}. During the pre-spawning months ascorbic acid level is maximum and in post –spawning months (July, August and September) level is minimum. During spent season (October and November) level of ascorbic acid increases drastically and it may be due to excessive feeding rate.

The lipid levels in the muscles ranges between 0.11619 ±3.24155^{-3} to 0.5951 ± 3.5368^{-3}. It is maximum in the months of January and September and lowest in the months of May-June (Spawning period) and October-November (Spent season). In the month of August and September lipid level increases, it might be due to availability of food. Therefore lipid values depend on the food availability, feeding factor as well as the maturity condition of fish.

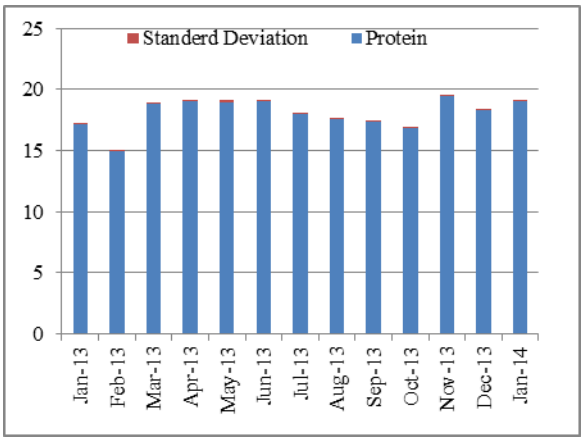
In the reproductive phases of *Mystus cavasius*, muscle lipid was increased in post-spawning and preparatory phase because of fishes accumulate energy from October to January. The deposited lipid was decreased by early spawning phase, because energy fall occur during January to July in testes and they utilize the energy for spermatogenesis.

Table No. 1: Seasonal variation in the Biochemical Components of the Muscles of *Mystus cavasius* (Ham) [Marathi Name -Katarna /Katirna]

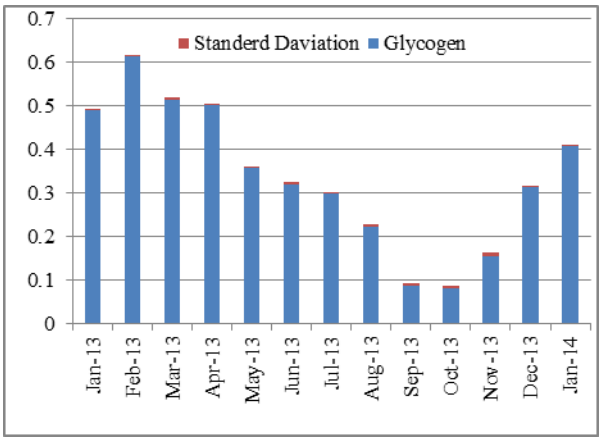
Biochemical Compo / Months	Protein	Glycogen	Ascorbic Acid	Lipid
January 2013	17.14353 ±0.0286	0.488971274 $\pm 2.153069402^{-3}$	0.086632504 $\pm 4.502236854^{-3}$	0.591310125 $\pm 2.16103621^{-3}$
February 2013	14.96983879 ±0.014300594	0.613595353 $\pm 2.613726937^{-3}$	0.133195944 $\pm 6.454951219^{-3}$	0.417062505 $\pm 5.214070133^{-3}$
March 2013	18.84529381 ±0.014300611	0.514067198 $\pm 5.610170113^{-3}$	0.382555418 $\pm 8.422914116^{-3}$	0.34891966 $\pm 1.414730133^{-3}$
April 2013	19.00736696 ±0.057795086	0.500378512 $\pm 4.763461331^{-3}$	0.408900523 ±0.016058679	0.313197719 $\pm 3.501278824^{-3}$
May 2013	18.97876582 ±0.119931707	0.356932489 $\pm 3.004567773^{-3}$	0.438921688 $\pm 7.652331227^{-3}$	0.181745691 $\pm 1.472498234^{-3}$
June 2013	19.02166753 ±0.108282186	0.320429326 $\pm 5.156967757^{-3}$	0.497738665 $\pm 9.432039928^{-3}$	0.151328988 $\pm 3.189686458^{-3}$
July 2013	18.00156006 ±0.057202293	0.299325935 $\pm 3.084703624^{-3}$	0.109914225 $\pm 3.826165683^{-3}$	0.249416959 $\pm 3.895863229^{-3}$
August 2013	17.5725429 ±0.028601142	0.221471533 $\pm 5.342863745^{-3}$	0.107463517 $\pm 6.454951217^{-3}$	0.442527651 $\pm 1.7801163391^{-3}$
September 2013	17.40093604 ±0.028601142	0.08686612 $\pm 5.500371003^{-3}$	0.152801603 $\pm 6.627113493^{-3}$	0.59508274 $\pm 3.536825766^{-3}$
October 2013	16.83844687 ±0.035988982	0.082303224 $\pm 3.457635414^{-3}$	0.327414503 $\pm 6.627112946^{-3}$	0.129636456 $\pm 2.550441331^{-3}$
November 2013	19.49835327 ±0.0595388034	0.154739188 $\pm 8.682811609^{-3}$	0.387456834 $\pm 8.288138826^{-3}$	0.116196518 $\pm 3.241554208^{-3}$
December 2013	18.25897036 ±0.028601171	0.311873898 $\pm 5.227453104^{-3}$	0.457301993 $\pm 7.652331204^{-3}$	0.579992283 $\pm 1.780163195^{-3}$
Jan 2014	19.07886982 ±0.021844507	0.406553976 $\pm 4.390305155^{-3}$	0.13013256 $\pm 8.288138322^{-3}$	0.582350166 $\pm 3.241554411^{-3}$
The values are expressed in mg/100mg dry weight (Mean ± S.D.)				

In the fish *Mystus cavasius* protein level increases during preparatory phase i.e. from the month of October to April and it was decreased in the spawning period. Similar result was observed by Bruce (1924) in the muscles of herrings.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. Decline of protein has also been reported by Srikar *et al.*, (1979). 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.

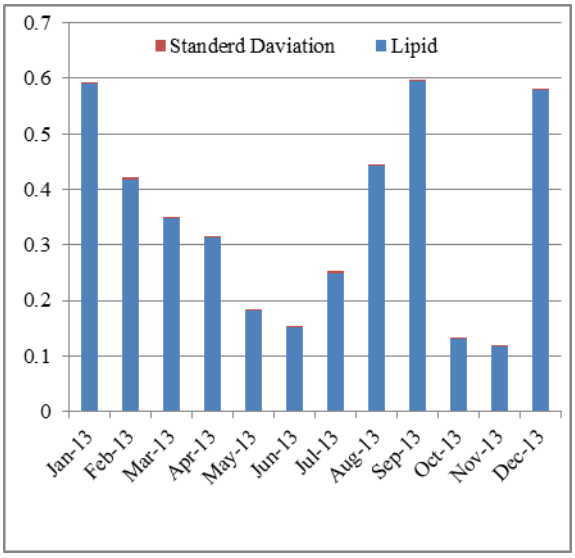
These observations confirm the earlier findings of Bruce (1924). Ashashree *et al.*, (2013) studied seasonal changes in protein muscles in *Mystus cavasius* and observedprotein levels of muscle ranged from 0.42±0.01 to 5.27±0.04, being maximum in December and minimum in July.



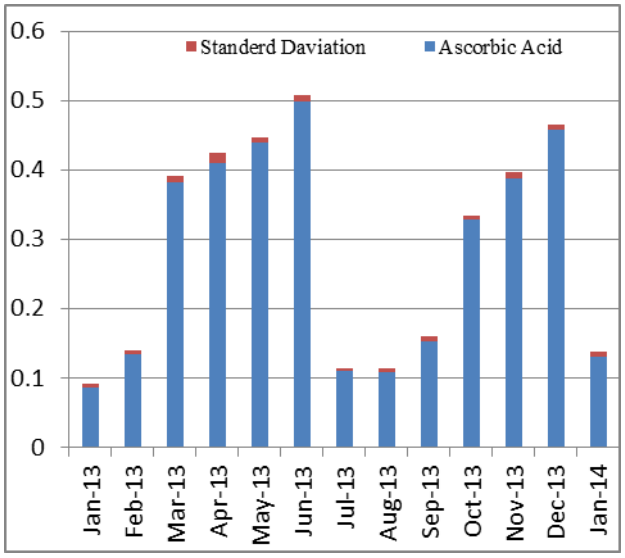
Graph No. 1: Seasonal variation of Protein in the Muscles of *Mystus cavasius* (Ham]



Graph No.2: Seasonal variation of Glycogen in the Muscles of *Mystus cavasius* (Ham)



Graph No. 3:Seasonal variation of Lipid in the Muscles *Mystus cavasius*(Ham)



No. 4: Seasonal variation of Ascorbic Acid in theMuscles of *Mystus cavasius* (Ham)

Glycogen content in the muscles of *Mystus cavasius* shows steady decrease from the month Jan to October. Highest level was observed in the month of Jan and Feb and lowest level was observed in the month of October. 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 drastically decreased from the month of Jan to October. During post-spawning its level decreases due to its utilization for to meet energy demand. Vijaykumaran (1979) stated that carbohydrate plays a minor role in energy reserves of *Ambasis gymnocephalus* and its depletion during the spawning season is significant. During the present work it is observed that in the summer its level is more and it goes on decreasing in advancement of maturity. 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.

Pawar and Sonawane (2014) observed low level of muscle glycogen in the month of November and December in *Garra mullya.* In *Mystus cavasius* 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.

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. There was also decline in the lipid content during spawning period and this 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). Agren *et al*., (1987) also reported that in addition to liver lipids, the stored lipids in muscles tissues were used during spawning period. Ashashreeet. al., (2014) reported muscle lipid reaches maximum in December (0.83 ± 0.09), January (1.05 ± 0.09) and minimum during July (0.35 ± 0.23). Similar results have been reported by Jorgensen, *et al*. (1997) and Sindhe & Kulkarni, (2005) in different fishes.

Ascorbic acid content in all fishes shows two peak values in the months of March-June and October-December. 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; Bai and Kalyani, 1960). It plays a role directly related to homeostatic mechanism and is essential for wound healing and regeneration (Gould, 1963). Ascorbic acidact as an essential factor for normal growth in rainbow trout *Salmo gairdneri* (Tucker, 1983). In terrestrial animals the dietary ascorbic acid has role in the host defense system. Though the complete prevention of viral infection is not possible, high doses of ascorbic acid reduces potency of the viral diseases (Murata, 1975).

During present investigation ascorbic acid shows decreased level of content 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)

REFRENCES

Ackman RG and Eaton CA 1976. Fatty acid composition of the decapod shrimp, pandulus borealis, in relation to that of the euphasiid, *Meganyctiphanes noruegica*. J. Fish. Res. Bd. Can., 33: 1634-1638.

Agren J, Mute P, Hannınen O, Harranen J and Pentila I 1987. Seasonal variations of lipid fatty acids of Boreal freshwater fish species. Comp. Biochem. Physiol., 88B: 905-909.

Ashashree HM, B Venkateshwarlu B and HASayeswara 2014. Impact of Seasonal Changes on Composition of Total Lipid Content in Muscle, Liver and Testes of Freshwater Male Fish *Mystus Cavasius* (Ham) From Bhadra Reservoir, Shivamogga, Karnataka, India. International J. Of Sci. Research .3(2):540-541.

Ashashree HM, M Venkateshwarlu and HA Sayeswara 2013. Seasonal changes of protein in the tissues of male catfish *Mystus cavasius* (Ham) in Bhadra Reservoir, Karnataka, India. International J of Applied Biology and Pharmaceutical Technolgy,4(4):264-267.

Bai PA and Kalyani M 1960. Studies on the ascorbic acid content of fish tissues. Ind. J. Zool., 7:216-219.

Barnes H and BlackstockJ 1973. Estimation of Lipid, Detailed investigation of the Sulpho - phospho vanillin method for total lipids. J. Expt. Mar. Biol.Assoc.12:103-118.

Blom JH, Dabrowski K 1995. Reproductive success of female rainbow trout (Oncorhynchusmykiss) in response to graded dietary ascorbyl monophosphate levels. BiolReprod 52:1073–1080.

Bruce JR 1924. Changes in the chemical composition of tissues of the herring in relation of age and maturity. Biochemical J. 18:469-485.

Conquer J and Holub BJ 2002. Human health effects of docosahexanoic acid. In J. Shi, G. Mazza and M. L. Maguer (eds) Functional foods: biochemical and proccessing aspects. Vol. 2 CRC Press Boca Raton. P. 311- 329.

De Zwaan A and Zandee DI 1972. Glycogen estimation with Anthrone reagent comp. Biochem. physiol. 43B: 53-55.

El-Sayed MM, Ezzat K, Kandeel M and Shaban FA 1984. Biochemicalstudies on the lipid content of *Tilapia nilotica* and *Sparatus auratus*. Comp. Biochem. Physiol., 4: 589-594.

Ganeshwade RM 2012a : Effect of Dimethoate on the level of cholesterol in freshwater *Puntius ticto* (Ham) Science Research Reporter 2(1):26-29.

Ganeshwade RM, 2012b. Histopathological Changes in the Gills of *Puntius ticto* (HAM) Under Dimethoate Toxicity. *The Bioscan* **7**(3):423-426.

Ghanbahadur Ashwini G, Ghanbahadur Girish R, Ganeshwade RM and SB Wagh 2015. Histopathological effect of organochloride endosulfan on gills of larvivorous fish *Rarbora daniconius* Bioscience Discovery, 6(2):121-124.

Giroud A, Leblond, CP, Ratsimamanya R and Gerge 1938. The normal level of ascorbic acid. Bull. Soc. Chem. Biol., 20: 1079-1087.

Gould BS 1963: International review of Cytology, Academic Press, New York,5:91-96.

Jan Ulfat, Mustafa Shah, Tahila Manzoor and Showkat Ahmad Ganie 2012. Seasonal and monthly variations of protein content in the muscle of fish *Schizothorax esocinus*.Recent Research in Science and Technology, 4(7): 05-07

Jan Ulfat, Mustafa Shah, TahilaManzoor and Showkat Ahmad Ganie 2012. Seasonal and monthly variations of protein content in the muscle of fish *Schizothoraxesocinus*.Recent Research in Science and Technology, 4(7): 05-07.

Jorgensen, EH, Johansen, SJS, Jobling M 1997. Seasonal patterns of growth, lipid deposition and lipid depletion in andromous. Arctic charr. J. of fish Biology, 51: 312-326.

Kiran BR and ET Puttaiah 2005. Biochemical composition of *Chela untrahi* from Bhadra reservoir, India, Geobios, 32: 93-95.

Konar V, Canpolat A and Yılmaz O 1999. *Capoeta trutta* ve *Barbus rajanorum mystaseus*'un Kas Dokularındaki Total Lipid ve Yağ Asidi Miktar ve Bileşimlerinin Üreme Peryodu Süresince Değişimi, Tr. J. of Biology, 23(3): 319-331.

Langer Seema, PriyaManhas, YahyaBakhtiyar, Sheikh Rayees andGurdarshanSingh 2013. Studies on the Seasonal Fluctuations in the Proximate Body Composition of *Paratelphusamasoniana*(Henderson) (Female), a Local Freshwater Crab of Jammu Region. Advance Journal of Food Science and Technology 5(8): 986-990.

Love RM 1980. The Chemical Biology of Fishes, Vol. 2. New York: Academic Press.

Lovell T 1989. Nutrition and feeding of fish Van Nostrand Reinhold Publishers. New york, USA.

Lowery OM, Rosenbrough NJ, Farr AC, Randall RF 1951. Protein estimation with Folin Phenol Reagent. J. Biol. Chem. 193:265-275.

Mahdi AA, MS Faddagh , AJ Tuman and TA Abdullah 2006. Biochemical composition and calorific value of six fresh waterfish species from southern Iraqi Marshes Marsh Bulletin 1(1)47-53.

Murata A 1975. Virucidal activity of vitamin C: vitamin C for prevention and treatment of viral diseases. Proc .First Intersec. Congr. IAMS, Sci. Cn. Of Japan.

Pandey BN, PK Pandey, BJ Choubey and JS Datta Munshi 1976. Studies on blood components of an air-breathing siluroid fish, *Heteropneustes fossilis* in relation to body size. Folia Haematol., 103 : 101- 116.

Pawar SM and Sonawane SR 2014. Seasonal variation in muscle glycogen and moisture content of *Garra mullya* and *Rasbora daniconius* International j of Fauna and boil. Studies. 1(5):91-94.

Raina S 1999. Seasonal variations in biochemical composition of ovary, liver and muscles and histology and histochemistry of ovary in *Channagachua*(Ham.) and *Puntiusconchonius*(Ham.). Ph. D. Thesis, Jammu University.

Roe JH 1967. Methods of Biochemical analysis Vol.5, (Ed. By Glick Inter. Science, New York) p-44.

Samyal AY Bakhtiyar A Verma and S Langer 2011. Studies on the seasonal variation in lipid composition of muscles, hepatopancreas and ovary of freshwater prawn, *Macrobrachiu mdayanum* (Henderson) during reproductive cycle. Adv. J. Food Sci. Technol., 3(3): 160-164.

Sindhe VR and Kulkarni RS 2005. Variation in the hepato-gonadal contents of Protein, lipid and cholesterol in the freshwater fish, *Notopterus notopterus* (Pallas) exposed to heavy metals. Gnyan Ganga Journal of Science and Technology, 4: 100-103.

Srikar LN Keshavanath P and Peter M 1979. Changes in biochemical composition of *Clarias batarachus* in before and after spawning. Mysore J. Agr.

Thilsted SH and Roos N 1999. Policy issues on fisheries in relation to food and nutrition security. Pp 61-69. In Ahmed, M., Delgado, C., Sverdrup-Jensen,S. and Santos, R.A.V. (eds). Fisheries policy research in developing countries: Issues, Prioritis and needs. ICLARM conf. Proc.60, 112p.

Tucker, B. W. 1983: Studies on vitamin C metabolism in rainbow trout. Ph. D. dissertation.Univ. of Washington, Seattle, USA.

Venkatesan VV Gandhi and PU Zacharia 2013. Observations on the utilization of the biochemical constituents during maturation of the butterfish *Scatophagus argus* (L.1766) from Palk Bay, South east coast of India.Ind. J. Geo-Marine Sciences, 42 (1):75-81.

Vijayakumaran M. 1979. Chemical composition and caloric content of *Ambassisgymnocephalus*. J. Mar. Biol. Assoc. India, 21(1&2): 182-184.

How to Cite this Article:

Ganeshwade RM, Ghanbahadur Ashwini G and S. R. Sonawane, 2016. Seasonal Biochemical Changes in the Muscles of Freshwater Fish *Mystus cavasius* (Ham). *Bioscience Discovery*, **7**(1):34-40.