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A study on the nutritional value changes of Channa striatus fish with different seasons from Upper Lake Bhopal, MP

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ABSTRACT

This study was conducted to determine the nutritional value of *Channa striatus* and its changes over different seasons to provide up-to-date data on its essential nutritional constituents and to estimate their energy value to plan the most suitable industrial and commercial dispensation in different seasons. In this work, seasonal variations in essential nutritional constituents (total carbohydrate, protein and lipid content) of *Channa striatus* with respect to three seasons i.e., winter, pre-monsoon and post monsoon from Upper Lake Bhopal district, of Madhya Pradesh were evaluated. The impact on the nutritional constituents like carbohydrate, protein and lipids was clearly observed with the change in season and water quality parameters. Total carbohydrate, protein and lipid were estimated by phenol-sulphuric acid method, Follin's-Lowry method and Folch *et al*. method, respectively. The nutritional analysis showed that the nutritional value of *Channa striatus* in the winter sample (January to February) was maximum as compared to the post monsoon (October to November) to and pre monsoon (June to July) sample. Results suggest that the *Channa striatus* fish species of Upper Lake Bhopal in the winter possess best nutritive value compared the pre monsoon and post monsoon and that the consumption of fish in the winter must be increased to obtain maximum nutritional benefits.

Keywords: Channa striatus, Seasonal nutritional analysis, Proximate composition, Upper Lake, 3-PUFA

Introduction

From time immemorial, fish have been eaten as an important source of food with very high quality of proteins, vitamins, distinguishing lipids, owing to its content of omega-3 fatty acids and minerals has widely been accepted as dietary sea food due to substantial increase in beneficial effect of consumption. Approximately 14% of the animal protein consumed by human being comes from marine fisheries sector which was considered as one of the important food producing sector in the state contributing to the livelihood as well as food security of a large

section of the economically under-privileged population. But fish was susceptible to rapid spoilage and get deteriorated during the post-mortem period, at ambient temperature resulting in a variety of biochemical and microbial break down. Fish, which form a much cherished delicacy that cut across socio-economic, age, religions and educational barriers, was eaten fresh, dry, smoked and dried products received frequent complaints about the quality due to different marketing chains and time required to reach the landing centers and destinations from catching point, preservation techniques followed, dehydration techniques etc

Fishes have a high nutritional value regarding beneficial amounts of protein, lipids as well as essential micronutrients. Aquatic animal foods are a rich source of protein and have a lower caloric density, and have a high content of omega 3 long chain polyunsaturated fatty acids (n-3 LC PUFA) compared to land living animals (**Tacon and Metian,2013**). Fish protein hydrolysates are considered as superior from a nutritional point of view due to the excellent amino acid composition and easily digestible proteins. But, due to the undesirable fishy odor and flavor they have been earlier mostly used in animal nutrition (**Kristinsson and Rasco, 2000**). In addition to its valuable lipid and protein composition, fish is also a significant source of vitamin D (**Holick, 2008b**). Deficiency of vitamin D leads among others to rickets, osteomalacia, a low bone mineral density (BMD) and thereby to osteoporosis. Also an increased occurrence of cases of falling has been found in people with low vitamin D levels (**Cranney *et al*., 2007**). According to Chilma (2006) Protein and fat are the two most important nutrients found in fish, and their levels tell us how well the organism is able to meet its nutritional needs. Fish have varying chemical compositions depending on the age, sex, environment and season with protein levels ranging from 16-21%, lipids 0.1-25%, ash 0.4-1%, moisture 60-81% and even high moisture content of 96% (**Muraleedharan *et. al*., 1996**). Furthermore, a significant correlation between higher fish intake and a lower risk of hip fractures was found in Chinese elderly (**Fan *et al*., 2013**). Beside bone connected issues deficiency of vitamin D has been connected with diabetes (**Holick, 2008a**), increased aggressiveness of certain cancers and increased occurrence of autoimmune diseases as well as cardiovascular diseases (**Holick, 2008b; Norman, 2008**). A number of factors influence the composition of fish flesh, for example the way of production and processing influences the quality of the final product. Under intensive culture conditions feed composition and feeding regimen have a major influence (**Lie, 2001**). Especially the lipid content and the FA composition are easily influenced by feed composition also in addition to feeding regimen and rearing system (**Morris, 2001; Shearer, 2001**). In contrary, as long as fish are fed adequate diets containing all needed nutrients in sufficient amounts, the protein content and composition seem to be predetermined for each species of fish regardless of the content in the diet or the feeding regimen (**Morris, 2001; Shearer, 2001**). Besides the feed and rearing system also other factors as water salinity and temperature have shown to influence the FA composition in fish **(Farkas, 1984; Fonseca Madrigal *et al*., 2012**). Regarding salinity, Roche et al. (1983) found a lower lipid content in sea dace (Icentrarchus labrax pisces) at a salinity of 4 ppt compared to higher values (18, 36, and 40 ppt, respectively). Fish also showed a lower content of MUFA and higher proportion of PUFA at the lowest salinity in this study. In

the brackish Baltic Sea, herring (Clupeus harrengus) is less fatty compared to the saltier North Sea (**National Food Agency Sweden, 2017**). During processing, FA will be affected due to possible oxidation but especially due to the addition of oils or fat to the products. Last but not least the way of culinary preparation has a significant influence on the FA composition of the finally consumed product. The later aspects have recently been reviewed in separate articles (**Sampels, 2015a, 2015b**). Due to an increasing demand of fish and subsequently an increased aquaculture production, fish oil is getting scarce and since many years, research on good and sustainable substitutes which at the same time preserve the natural, nutritional valuable FA composition of fish (**Gatlin *et al*., 2007; Pickova and Morkore, 2007; Torstensen *et al*., 2008; Naylor *et al*., 2009; Thanuthong *et al*., 2011**) is ongoing.

The global consumption of fish and fish derived products has greatly increased the fish demand during recent decades due to the increasing world population, higher living standards and the good overall image of fish among the world consumers. Thus it is imperative to process and preserve some of the fish caught in the period of abundance, so as to ensure an all-round supply. The present study was taken considering the popularity and importance of *Channa striatius* and its products (Dried and Fresh) among the common consumers in developing country like India especially in Bhopal district of Madhya Pradesh and was envisaged to prepare good quality fresh fish and dry products using scientifically authorized methods and techniques to capture the urban market. Therefore the focus of the present study was to evaluate the nutritional value of fresh water fish *Channa striatus.*

Materials and Methods

The samples of the Channa *striatus* used in present study was collected from Upper Lake of Bhopal district, of Madhya Pradesh using the seine netting and gill netting method or with the help of local fishermen. The samples were collected in three different seasons i.e. pre monsoon and post monsoon and winter.

Figure 1: Map showing the study area of Upper Lake Bhopal

Sample Collection

The samples were collected in different seasons around the year.

The description of the water body and water quality parameters were also be taken into consideration.

The sample of same age and size was used in the study.

Figure 2: Showing area of study site and sample collection method

Determination of Protein Content

Folin - Ciocalteau Phenol method of Lowry et al. was used for the determination of the total protein in the tissue. In this method the dried tissue sample weighing 10mg is thoroughly homogenized with 1 ml of deproteinising agent (10% TCA) by keeping the tube in ice. Samples are centrifuged for 20 min at 3000 rpm. The precipitate obtained will be used for protein estimation. The precipitate is dissolved in 2 ml 1N NaOH and to 1 ml of this solution, freshly prepared 5 ml alkaline reagent is added. This is kept at room temperature for 10 min, after which 0.5 ml of 1N Folin - Ciocalteu reagent (Hi-media, India) is added and mixed rapidly. A standard solution is prepared by using Bovine serum albumin (Hi-media, India) crystal at a concentration of 0.2 mg/ml from the stock solution. A blank is prepared with 1 ml 1N NaOH and treated the same way as above. The test tubes are kept for 30 min at room temperature in dark and the optical density (OD) of the blue color developed is measured against the blank at 660 nm (Shimadzu UV-1800 UV spectrophotometer, Japan).

Determination of Carbohydrate Content

Total carbohydrate was estimated by Phenol-Sulphuric acid method, described by Dubois et al. About 5 mg of oven-dried tissue is taken in a test tube and 1 ml of phenol (5%) and 5 ml of concentrated sulphuric acid is added in quick succession. The tube is kept for 30 min at $30C^0$ and the optical density of the colour developed is measured at 490 nm against the blank (**Shimadzu UV-1800 UV spectrophotometer, Japan**).

Determination of Total Lipid Content

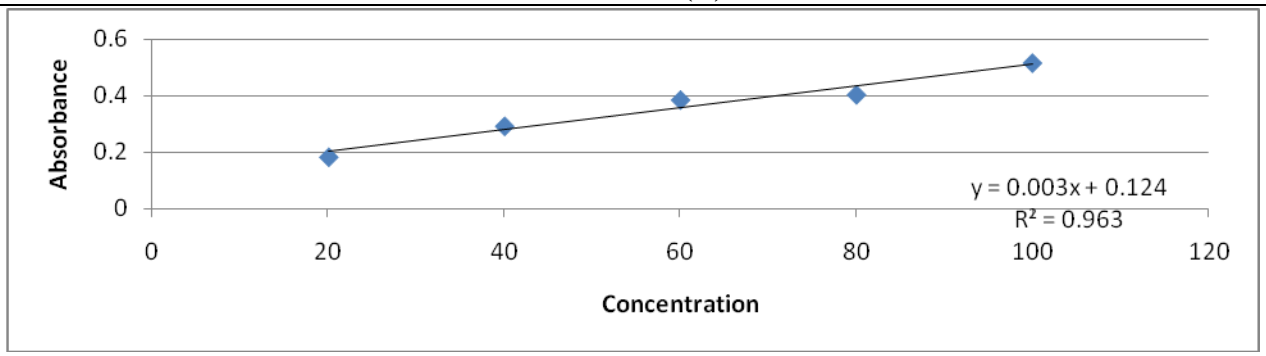
Lipid content was estimated by the procedure given by Folch et al. About 5 mg of powdered oven dried tissue is mixed with 5 mL of chloroform: methanol (2:1) mixture tightly covered with aluminum foil and kept at room temperature for 24 h. It is then filtered by using Whatman No. 1 filter paper (11 mm) and the filtered extract is taken in a pre-weighed beaker and oven dried. Beaker is weighed with lipids and the difference in weight is taken as total lipid content and percentage is calculated.

Results

Table 1: Determination of total protein in fish sample,

S.No	Concentration µg/ml	Absorbance at 660 nm (Mean±SD)
1.	20	0.184±0.003
2.	40	0.292±0.0005
3.	60	0.385±0
4.	80	0.403±0
5.	100	0.514±0.0005

Standard table of Bovine Serum Albumin (BSA)



Graph represent standard curve of BSA

Table 2: Total protein content in Upper Lake fish sample season 1

S. No	Absorbance at 660nm	Mean±SD	TPC in µg/gm equivalent of BSA
1	0.246	0.246±0.003	31.07 µg/gm
2	0.243		
3	0.249		

The Total Protein content in Upper Lake fish sample (*Channastriatus)* season 1(winter season) using bovine serum albumin (BSA) was found to be 31.07 µg/gm.

Table 3: Total protein content in Upper Lake fish sample season 2

S. No	Absorbance at 660nm	Mean±SD	TPC in µg/gm equivalent of BSA
1	0.213	0.215±0.0025	23.12 µg/gm
2	0.218		
3	0.215		

The Total Protein content in Upper Lake fish sample (*Channastriatus)* season 2using bovine serum albumin (BSA) was found 23.12 µg/gm.

Table 4: Total protein content in Upper Lake fish sample season 3

S. No	Absorbance at 660nm	Mean±SD	TPC in µg/gm equivalent of BSA
1	0.231	0.228±0.003	26.46 µg/gm
2	0.228		
3	0.225		

The Total Protein content in Upper Lake fish sample (*Channastriatus)* season 3using bovine serum albumin (BSA) was found 26.46 µg/gm

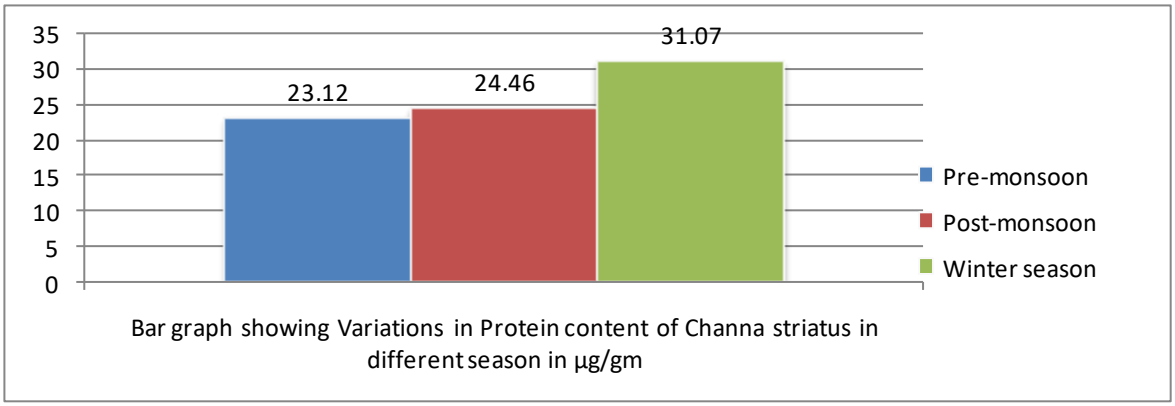
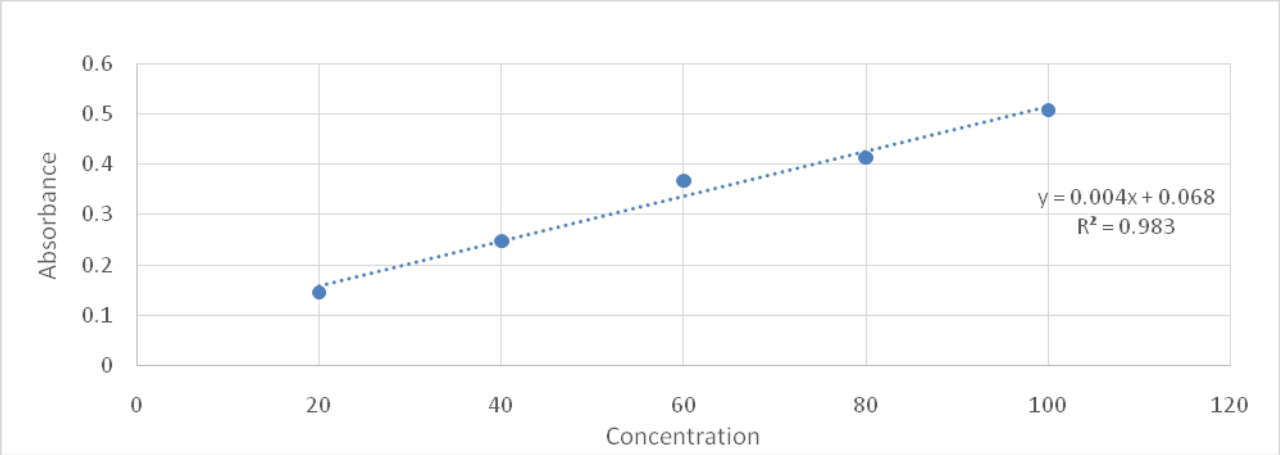


Table 5: Determination of Carbohydrate (Standard glucose table)

S.No	Concentration µg/ml	Absorbance at 490 nm (Mean±SD)
1.	20	0.145±0.0219
2.	40	0.246±0.0015
3.	60	0.368±0.002
4.	80	0.414±0.002
5.	100	0.507±0.0025



Graph represent standard curve of Glucose

Table 6: Carbohydrate content in Channa *striatus* fish of Upper Lake sample season 1

S.No	Absorbance	Mean±SD	Total Carbohydrate content in mg/L
1	2.215	2.216±0.0015	477.17 mg/l
2	2.216		
3	2.218		

The Total Carbohydrate content in Upper Lake fish sample (*Channa striatus)* of season 1 was found 477.17 mg/L.

Table 7: Carbohydrate content in *Channa striatus* fish of Upper Lake sample season 2

S.No	Absorbance	Mean±SD	Total Carbohydrate content in mg/L
1	2.198	2.195±0.003	472.51 mg/l
2	2.192		
3	2.195		

The Total Carbohydrate content in Upper Lake fish sample (*Channa striatus)* of season 2 was found 472.51 mg/L.

Table 8: Carbohydrate content in Upper Lake Channa striatus fish sample season 3

S.No	Absorbance	Mean±SD	Total Carbohydrate content in mg/L
1	2.209	2.212±0.003	476.28 mg/l
2	2.212		
3	2.215		

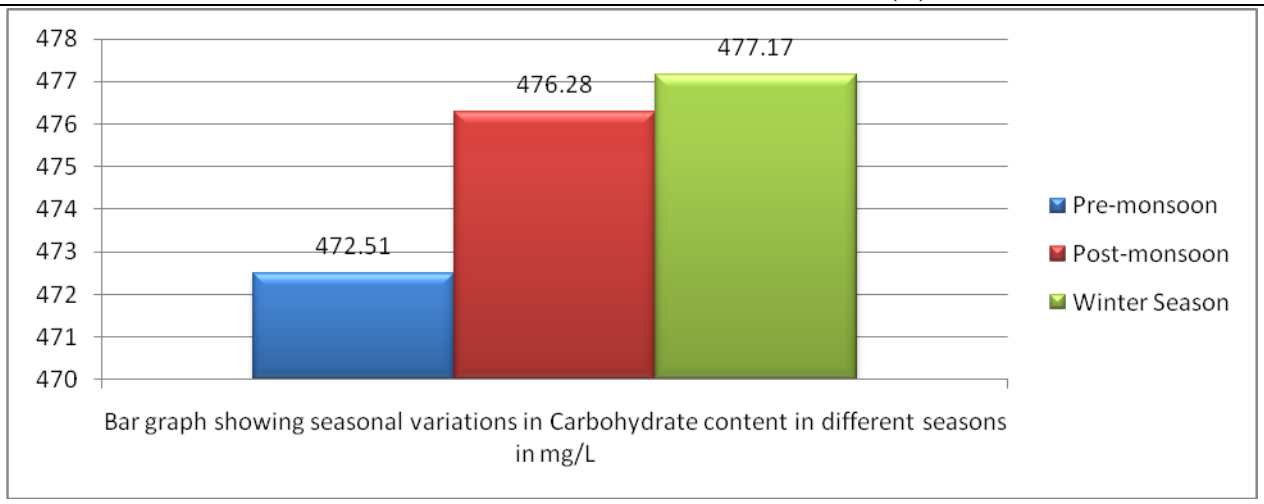
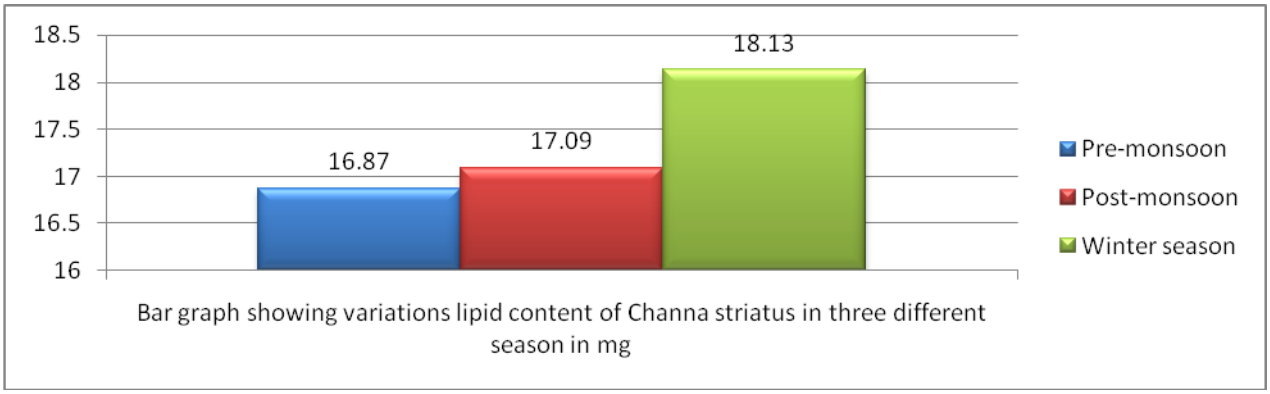


Table 9: Showing seasonal changes in Lipid content of *Channa Striatus*from Upper Lake Bhopal.

S.no	Nutritional components	Pre-monsoon sample	Post-monsoon sample	Winter sample
1.	Lipid	16.87 mg	17.09 mg	18.13 mg



Conclusion

This study was conducted to determine the nutritional value of Channa striatus fish and variations in its nutritional value with the change in season from pre monsoon to post monsoon and winter taken from Upper Lake located in the Bhopal district of Madhya Pradesh. From the results, it can be concluded that the *Channa striatus* fish has excellent nutritional value and there are variations in its nutritional value with the change of season. During the winter *Channa striatus* possesses the maximum nutritional components followed by post monsoon and then pre monsoon. One of the main reasons behind the change in nutritional value is the change in the parameters of water. It is highly recommended that the consumption of the *Channa striatus* from Upper Lake Bhopal must be increased during the winter. Further the, processing and preservation for the future time must also be increased during this season.

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