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Research Article

ASCERTAINING THE SEASONAL VARIATIONS IN NUTRITIONAL VALUE OF *CHANNA STRIATUS* FROM HALALI RESERVOIR OF RAISEN DISTRICT (MADHYA PRADESH, INDIA)

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ABSTRACT

Determining the seasonal alterations in the essential nutritional constituents of *Channa striatus* fish will be important to estimate their nutritive value with different seasons so as to plan the most beneficial consumption time period, commercial processing and storage for future. In the present work, it was evaluated that the seasonal variations in nutritional value of *Channa striatus* including total carbohydrate, protein and lipid content with respect to three season's i.e winter, pre-monsoon and post monsoon from Halali Reservoir in the Raisen district, of Madhya Pradesh. Nutritional components like carbohydrate, protein and lipids are severely influenced 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 post monsoon (October to November) and pre-monsoon (Juneto July) sample. So, it is suggested that the consumption of *Channa striatus* fish of Halali reservoir in the winter season must be increased for obtaining maximum nutritional benefits.

Keywords: *Channa striatus*, Seasonal nutritional analysis, Proximate composition, Halali Reservoir, 3-PUFA.

INTRODUCTION

The evaluation of proximate composition of *Channa striatus* will help us to assess its nutritional and edible value in terms of energy units. A difference of the biochemical composition of fish may also take place within the same species depending upon the fishing ground, fishing season, age and sex of the fish and reproductive status. The spawning cycle and food supply are the main factors responsible for this variation (Love *et.al*., 1980). The variation in nutritional value of fishes is seen with different seasons around the year. The four major biological constituents of the muscle tissue are water, protein, lipid, and ash, further being referenced to as the proximate composition of the fish. The protein composition in fish is declared to be of high-quality because of the balanced amino acid profile, which consists of significant amounts of all nine essential amino acids for human metabolism. Additionally, protein found in fish is easily digestible due to small amounts of connective tissue (EFSA, 2014, Murray and Burt, 2001, Toppe *et al.*, 2007). In the present era 'Blue Economy' is the most vocal term in fisheries science. Fish processing and different value added product development from fish is most important and easy way to go forward to blue economy. In this case, it is important to know about the effects of seasonal variation on the nutritional constituents of fish for its maximum utilization through various preservative and processing technologies (Silva and Chamul, 2000). Additionally, information of nutritional value that changes in different seasons will also aid the consumer, processor and other related stakeholders to endorse fish as healthy food in human nutrition (Nargis, 1970).

The important health benefits of eating fish are linked to the long-chain polyunsaturated omega-3 fatty acids

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eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) which very rarely present in plants and land animals (Stansby, 1985). While considering fish as food and the nutritional value connected with these products, first of all the n-3 PUFA are in focus. Furthermore, it gets obvious that the proteins and peptides in fish have not only a high nutritional value but also impact on human health issues. In addition to this fish can be considered as a good source of several minerals, vitamins and micronutrients. The most susceptible nutrients of fish are the fatty acid, as they are considerably influenced by the feed and the processing of the fish, whereas protein and the minor nutrients are usually less affected, provided that the fish was not starved or wrongly fed or exposed to abusive storage or processing conditions Tilamia *et. al.,* (2017)

Fish nutraceuticals can be used to improve health in various ways: it can delay the ageing process, prevent acute and chronic diseases, increase life expectancy, and support the basic structure and functions of the body. Urbanization of the population and health awareness in them with either a sedentary or hassled lifestyle are the primary causes of better growth in the nutraceutical market worldwide. Recent reports recommended that nutraceuticals give positive tactics to control healthcare with outstanding positive effects on human health. These nutraceuticals unaided or in combination with other therapies, not only assist in maintaining health and promoting quality of life, but also battle with serious medical illnesses of the present era, such as diabetes, cancer, cardiovascular diseases, cholesterol, arthritis, obesity, osteoporosis, etc. Therefore, inexpensive nutraceuticals are always in demand, predominantly among economically more susceptible or less income groups. In this way fish or fish by-products can also resolve the global malnutrition crisis and associated disorders by providing vital micronutrients and macronutrients, high-density fats, and easily digestible proteins. These essential nutrients have many more beneficial physiological roles than other proteins (Siddiqui *et al.,* 2020).In general, it should be highlighted that, when considering human nutrition and related health aspects, it is impossible to focus one group of nutrients separated from all others. Most probably the discussed effects of fish on human health are due to the consumption of the fish as a whole and hence the combination of all present nutrients. Future work regarding effects of fish consumption on human health should therefore focus on both, a holistic and metabolomics approach. When it comes to nutrition studies, metabolomics are developing fast as a powerful tool, enabling a direct insight into metabolism of the diverse nutrients, possible regulation pathways as well as finding markers for disorders (Cornett *et al*., 2007; Wagner *et al*., 2014; Cheng *et al*., 2016; Schmedes *et al*., 2016).The purpose of this study is to comprehensively present and conclude the seasonal variation in nutritional constituent of *Channa striatus*.

MATERIALS AND METHODS

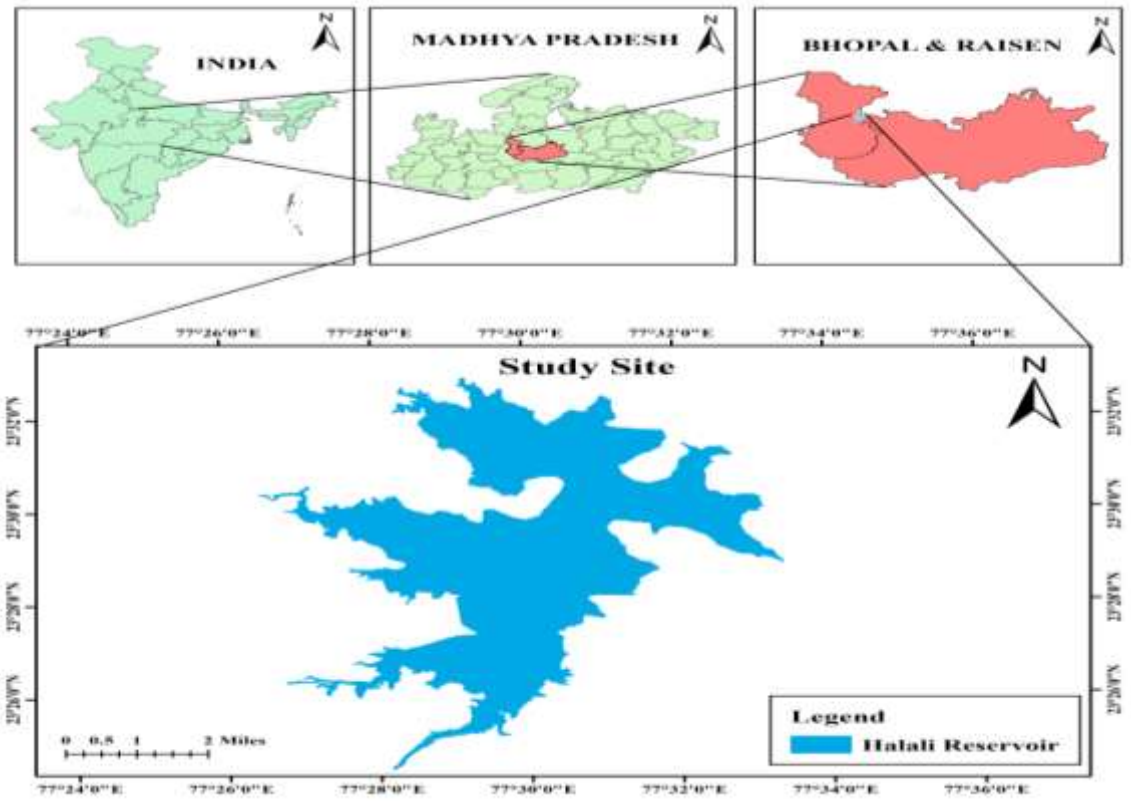

Figure 1.Satellite map view of the Halali Reservoir showing study area Source: Google Map

The *Channa striatus* fish samples used in the study were collected from Halali reservoir of Raisen district, in Madhya Pradesh using the seine netting and gill netting method or with the help of local fishermen. The sampling was carried out in three different seasons i.e. pre monsoon (June to July), post monsoon (October and November) and winter (January and February). The water quality parameters were analyzed and their effect on fish was also taken into consideration. The samples used in the study from different seasons were of same size.

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 color 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.

RESULT AND DISCUSSION

Results are clearly depicting that there are seen variations in the nutritional value of *Channa striatus* (Table 1-5 Figure 2, 6). The protein content is seen maximum in the winter season (27.74 µg/gm.) followed by post-monsoon and then pre-monsoon (25.94 µg/gm. and 23.89 µg/gm. respectively). Similar pattern of change with seasonis seen in carbohydrate content, as maximum carbohydrate content is seen in winter season (411.84 mg/l) followed by post-monsoon (405.04 mg/l) and then pre-monsoon (403.62 mg/l). That the lipid content of *Channa striatus* was found 17.13 mg, 14.44 mg and 12.38 mg in winter season, post-monsoon and pre-monsoon respectively. Winter season is the best season from the nutritional point of view for *Channa striatus* because the nutritional value of fish is maximum in this season followed by post-monsoon and pre-monsoon season. So, the consumption of fish must be more in the winter season for taking benefits of better nutritional value, also storage of the fish in this season must be done for future use.

Table 1. Standard table of Bovine Serum Albumin (BSA) showing absorbance at 660 nm.

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

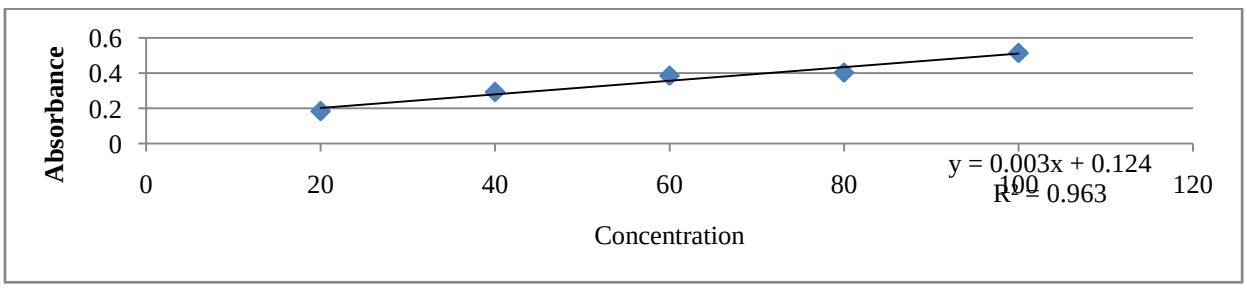

Figure 2. Standard absorbance graph of Bovine Serum Albumin at 660 nm against different concentration.

Table 2. Total protein content in *Channa striatus* fish sample from Halali reservoir during season 1 (winter season), season 2 (Pre-monsoon/ summer season) and season 3 (Post-monsoon) is as under.

S.No	Nutritional component	Season	No. of Readings	Absorbance at 660nm	Mean±SD	TPC in µg/gm equivalent of BSA
1	Protein	Season.1 (Winter season)	1	0.236	0.233±0.0025	27.74 µg/gm
			2	0.234		
			3	0.231		
		Season.2 (Pre-monsoon/Summer season)	1	0.218	0.218±0.0025	23.89 µg/gm
			2	0.221		
			3	0.216		
		Season.3 (Post-monsoon)	1	0.229	0.226±0.0025	25.94 µg/gm
			2	0.224		
			3	0.227		

The Total Protein content in Halali fish sample (*Channa striatus)* season 1(winter season), season 2 (pre-monsoon/ summer season) and season 3 (post-monsoon)using bovine serum albumin (BSA) was found 27.74µg/gm, 23.89 µg/gm and 25.94 µg/gm respectively.

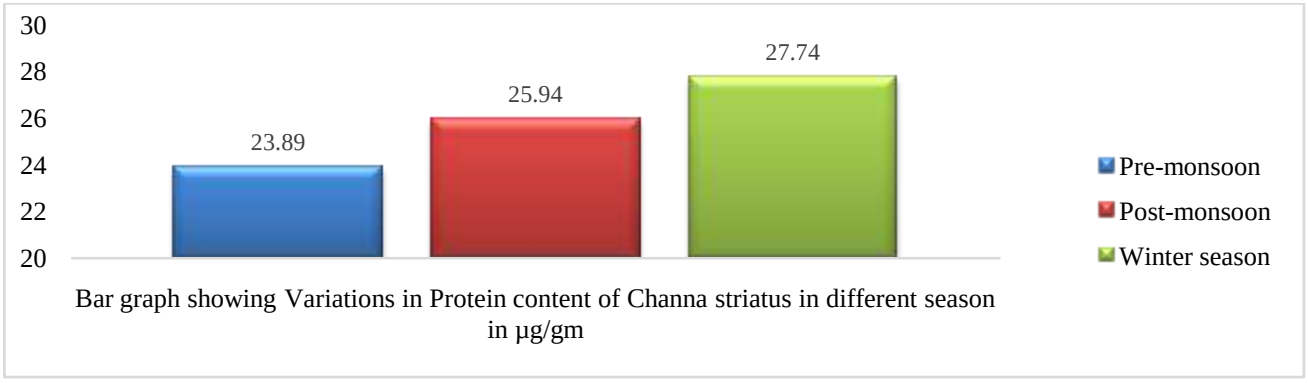

Figure 3. Bar graph showing variations in protein content of *Channa striatus* in different season in µg/gm.

Table 3. 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

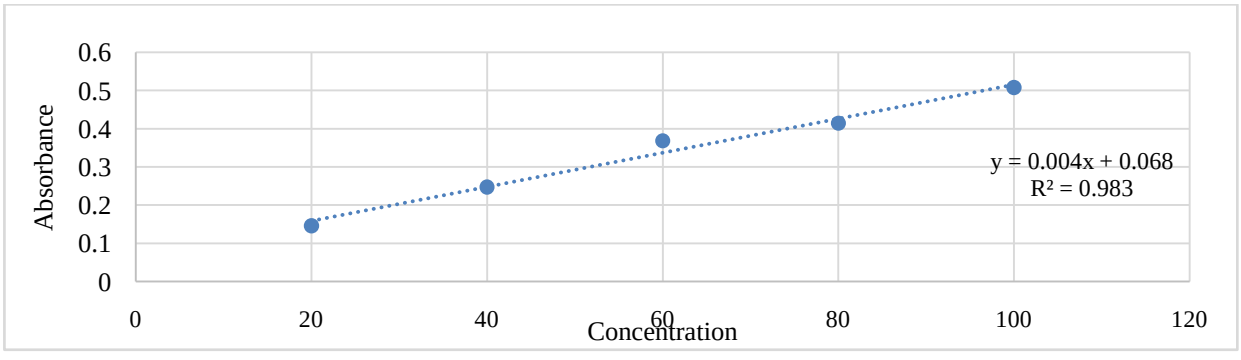

Figure 4. Graph represent standard curve of Glucose.

Table 4. Total Carbohydrate content in *Channa striatus* fish sample from Halali reservoir during season 1 (winter season), season 2 (Pre-monsoon/ summer season) and season 3 (Post-monsoon) is shown as under.

S.No	Nutritional component	Season	No. of Readings	Absorbance at 490nm	Mean±SD	Total Carbohydrate content in mg/L
1	Carbohydrate	Season.1 (Winter season)	1 2 3	1.924 1.926 1.918	1.922±0.004	411.84 mg/l
		Season.2 (Pre-monsoon/Summer season)	1 2 3	1.889 1.884 1.882	1.885±0.003	403.62 mg/l
		Season.3 (Post-monsoon)	1 2 3	1.892 1.898 1.890	1.893±0.004	405.04 mg/l

The total cabphydrate content in Halali fish sample (*Channa striatus)* season 1(winter season), season 2 (pre-monsoon/ summer season) and season 3 (post-monsoon) was found 411.84 mg/l, 403.62 mg/l and 405.04 mg/l respectively.

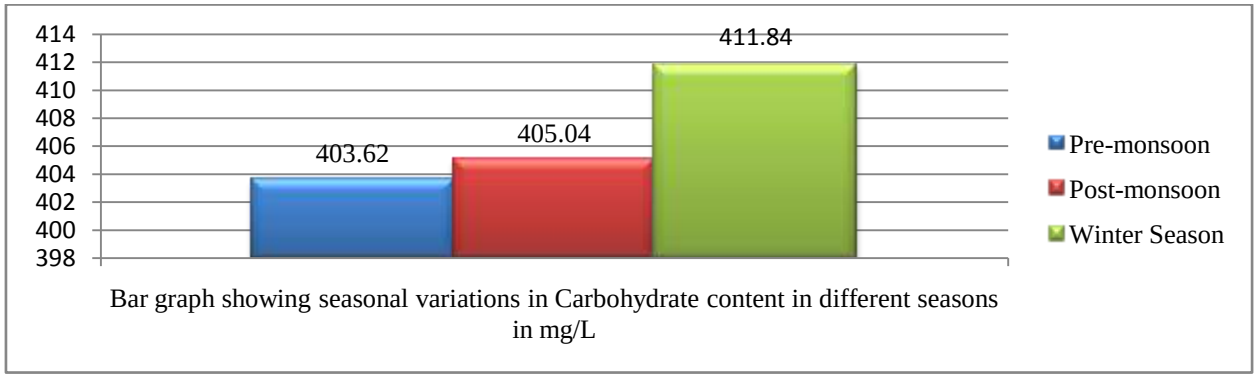

Figure 5. Bar graph showing seasonal variation in carbohydrate content in different seasons in mg/l.

Table 5. Showing seasonal changes in Lipid content of *Channa striatus* in three different seasons.

S.No	Nutritional components	Pre-monsoon sample	Post-monsoon sample	Winter sample
1.	Lipid	12.38 mg	14.44 mg	17.13 mg

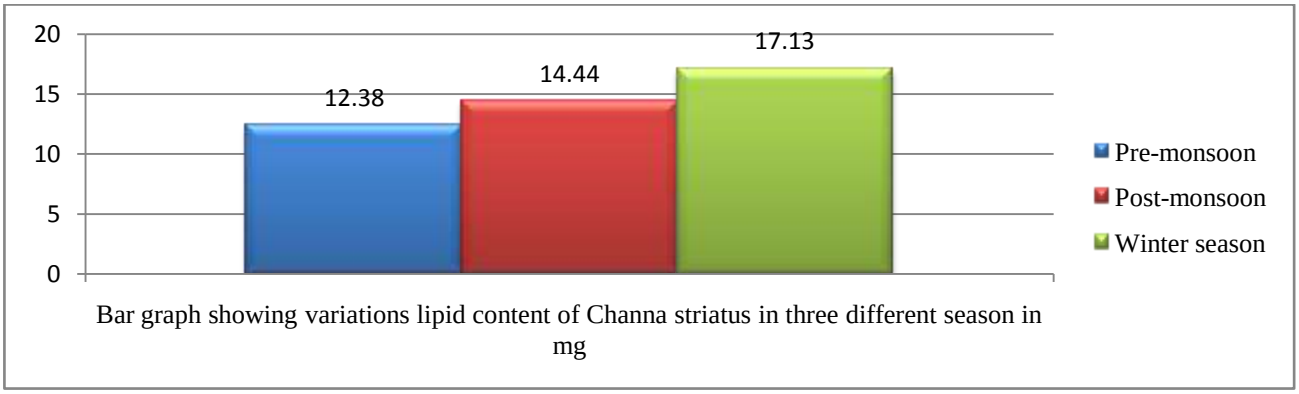

Figure 6. Bar graph showing variations in lipid content of *Channa striatus* in different seasons.

CONCLUSION

The present was carried to evaluate the nutritional value and its variations with the change in season from pre monsoon to post monsoon and winter of *Channa striatus* of Halali reservoir located in the Raisen district of Madhya Pradesh. From the results we concluded that the *Channa striatus* fish possess very good nutritional value and also there are variations in its nutritional value with the change of season. During the winter season fish possess 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 physical, chemical and biological parameters of water. So it is highly recommended that the consumption of the *Channa striatus* from Halali reservoir must be increased during the winter season. Further the, processing and preservation for the future time must also be increased during this season.

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