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RESEARCH ARTICLE

BIOCHEMICAL COMPOSITION AND CALORIC VALUEOF THE GOBY, *PARACHAETURICHTHYS OCELLATUS* (DAY 1873) FROM THE CREEKS OF MUMBAI

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ABSTRACT

Biochemical composition study helps to assess the nutritive value of fish from a particular region in different seasons. The biochemical composition in the muscles of goby fish, *Parachaeturichthys ocellatus* from the creeks of Mumbai was estimated from July 2010 to September 2011. The range of values obtained for proximal composition of adult *P.ocellatus* were: 78.05-81.51% of moisture, 13.47-15.65% of protein, 0.8-2.55% of Lipids, 0.06-0.16% of carbohydrates and 2.37-3.87% of ash. *P.ocellatus* was found to be low fat and high protein fish.. Seasonal variation was observed in male and female *P.ocellatus* during different months but there was no significant difference in the biochemical composition in terms of content of moisture, protein, lipid, carbohydrate and ash. Total caloric value calculated was 979.07cal/g in male and 995.44cal/g in females. The caloric content of the *P.ocellatus* was maximum during pre-spawning months and minimum in post spawning months. The fish was found to be nutritious throughout the year.

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INTRODUCTION

Fishes are quite different from other animal foods, because they provide calories with high quality proteins, which contain all essential amino acids in easily digestible form and are beneficial nutrition (Weatherley and Gill, 1987).The protein in the fish muscles has relatively high digestibility and is considered to have biological and growth promoting value (Shekhar *et al.*, 2004). Fish constitute a very important component of the diet for many people and often provide the much needed nutrient that is not provided in cereal based diets (Clucas and Sutchitte, 1981). The study of proximate biochemical composition of a species helps to assess its nutritional and edible value. Food composition, environment and genetic trait are known to influence chemical composition of fish (Oni *et al.*, 1983). Seasonal cycles of variation in the biochemical constituents such as proteins, carbohydrates and lipids are generally attributed to the complex interaction between environmental parameters, food availability, growth and reproductive activity (Venkataramanujam and Ramanathan, 1994). Thus a sound knowledge of variations in biochemical composition in different stages of development of fish is essential in exploiting the fish when their nutritional value is high.

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Sidhu (2003) has reported that fish meat has preventive effects against cardiovascular diseases and some types of cancer including colon, breast and prostate. The proximate composition study is therefore essential not only to know the nutritional status of fish but also to explore its therapeutic potential. The present study was under taken to understand the biochemical composition especially in the muscles of *P. ocellatus* from the creeks of Mumbai.

MATERIALS AND METHODS

Samples of *P.ocellatus* were collected during the period from June 2010 to September 2011 from the creeks of Mumbai. Muscle tissue was collected from the fish and subjected to biochemical analysis. Proximate composition was estimated every month.

Estimation of moisture content: The moisture content was estimated by oven drying the pre weighed sample of tissue at 60-80º C. The difference in weight was calculated and expressed as percentage moisture content of the tissue. Percentage was calculated by the following formula suggested by Sebastian (2012):

$$\text{Percentage of moisture} = \frac{\text{Wet weight - Dry weight}}{\text{Wet weight}} \times 100$$

Estimation of Protein: Protein content was estimated by colorimetric method of Lowry *et al.* (1951).

The Folin-Ciocalteau phenol reagent contains phosphomolybdic acid and tungstate. The aromatic amino acid residues such as tyrosine and tryptophan, present in protein react with the components of the Folin-Ciocalteau phenol reagent and produce a stable blue colour. The extinction of the coloured solution was read at 625nm. Bovine serum albumin was used as standard. The values are expressed in mg %.

Estimation of carbohydrate: Carbohydrate content was estimated according to the method of Hedge and Hofreiter (1962). Carbohydrates are hydrolysed into simple sugars using dilute hydrochloric acid. In hot acidic medium glucose is dehydrated to hydroxymethyl furfural. This reacts with anthrone and gives a green colour. Glucose solution is used as standard. The extinction is read at 630nm and the values are expressed in mg %.

Estimation of Lipid: Lipid content was estimated gravimetrically according to the method of Folch (1957). The total lipid from the muscle tissue was estimated after extraction in chloroform: methanol (1:1v/v). The lipid content was estimated by the following formula:

$$\text{Lipid \%} = \frac{\text{Weight of lipid (mg)}}{\text{Weight of the sample (mg)}} \times 100$$

The result is expressed as mg % of lipid content in the muscle tissue

Estimation of Ash: Ash was estimated by incineration of known weight of fish muscle kept in a porcelain crucible in a furnace at 150^0 C, the white charred remains were weighed and expressed as percentage.

Proximal composition in terms of calories per/g wet weight: Caloric content was calculated by multiplying the concentration of various components with conversion factors 4.15, 9.4 and 5.65 for carbohydrate, lipid and protein respectively as per the method adopted by Shamsan (2008). The caloric values were expressed as calories per gram wet weight of the fish.

RESULTS AND DISCUSSION

The study of proximal composition of fish is essential since the nutritive value is reflected in its biochemical contents. In the present study, the range of values obtained for proximal composition of adult *P.ocellatus* were: 78.05-81.51% of moisture, 13.47-15.65% of protein, 0.8-2.55% of Lipids, 0.06-0.16% of carbohydrates and 2.37-3.87% of ash. Table no.1 gives the average proximal composition of male and female *P.ocellatus*.

Table 1. The average proximal composition of male and female *P.ocellatus*

Fish	Male	Female
Moisture (%)	79.98	80.05
Protein (%)	14.86	14.09
Lipid (%)	1.45	2.08
Carbohydrate (%)	0.09	0.10
Ash (%)	3.15	3.19

The range of proximal composition observed in the present study is in accordance with in the ranges recorded in many fishes studied by Islam and Joadder (2005) Abdulrahman and D'Souza (2008) Shamsan (2008) and Sebastian (2012).

The present study on biochemical composition of *P.ocellatus* deals with the understanding of nutritive value of fish in terms of percentage composition and caloric content. Table no. 2 and 3 shows the biochemical composition of male and female *P.ocellatus* in different months. The major component of *P.ocellatus* muscle was moisture followed by protein, fat and carbohydrate. Love (1974) indicated that the availability of food at different times of the year has considerable effect on proximate composition of the muscle. The moisture content in the male was maximum in April 2011 while in female it maximum in March 2011. There exists a negative correlation between moisture and protein content in male and female. The correlation values were highly significant at $p<0.01$. The maximum moisture content in male *P.ocellatus* coincided with minimum protein content while in the female minimum moisture content coincided with maximum protein content. Similar observations were recorded in the moisture and protein content in *Glossogobiusgiuris* (Islam and Joadder, 2005) and *Anbustestudineus* (Nargis, 2006). Protein content of the fish showed variation in different months.

The protein was maximum in male *P.ocellatus* in June 2011 and minimum in April 2011 while in female it was maximum in December 2010 and minimum in August 2011. The spawning season of *P.ocellatus* is at peak from February to April. Hence in males the protein content increased after spawning and decreased to the lowest during spawning months while in females it was maximum during pre-spawning period and decreased to minimum in post spawning month. In females the variation in protein content may probably be due to the development of gametes, proteins might have contributed in the process of growth and development of gametes. The male fishes might have recovered the lost protein by active feeding immediately after spawning. Sivakami*et al.* (1986) had found in *Cyprinus carpio* that protein for germ building was mobilized from the muscle in stages I to IV of maturity. Protein content showed sudden increase from April 2011 to June 2011 in male and female *P.ocelltus*. This may be due to intense feeding and feeding on larger organisms like crustaceans and fish in post spawning period.

The lipid content was maximum in September 2010 and December 2010 in male and female respectively while it was minimum in May 2011 in both male and female. The low values of lipid content in May 2011 in both male and female may probably be due to post spawning phase of *P.ocellatus*. Depletion of fat during and after spawning in the tissues has been reported in many species of fishes by Das, (1978); Bumb (1992). Ahmed *et al.,* (1984) observed differences in seasons and availability of food at different time of the year has a considerable effect on the tissue component of fish particularly fat. A positive and significant correlation at $p<0.05$ exists between protein and fat in female *P.ocellatus* while a negative and non-significant correlation exists in male *P.ocellatus*. Ackman (1989) grouped fish into four categories depending on the level of fat: lean fish (<2%), low fat fish (2-4%), medium fat fish (4-8%) and high fat fish (>8%). *P.ocellatus* has an average fat content in the range of 0.8-2.55% and can be grouped as low fat fish. *P.ocellatus* is a carnivorous fish feeding predominantly on crustaceans and biochemical composition revealed it to be a low fat fish. Carbohydrate content formed a very minor percentage of 0.09% in male and 0.1% in females. It showed variation in different months.

Table no. 2. Biochemical composition of muscles in male *P ocellatus* during different months

Months	Moisture	Protein (mg %)	Protein (cal/g)	Lipid (mg%)	Lipid (cal/g)	Carbohydrate (mg%)	Carbohydrate (cal/g)	Ash (mg%)	Total cal/g
Jun-10	79.86	15.49	875.18	0.89	83.66	0.07	2.90	3.45	961.75
Jul-10	81.06	14.49	818.68	1.23	115.62	0.08	3.32	2.78	937.62
Aug-10	80.45	14.9	841.85	1.4	131.60	0.18	7.38	2.59	980.83
Sept-10	78.29	14.84	838.46	2.13	200.22	0.13	5.51	3.69	1044.20
Oct-10	77.86	15.92	899.48	2.02	189.88	0.09	3.73	3.52	1093.09
Nov-10	78.45	14.85	839.02	1.98	186.12	0.07	2.90	3.87	1028.05
Dec-10	80.05	15.21	859.36	1.25	117.50	0.07	2.90	2.75	979.77
Jan-11	79.24	14.67	828.85	1.75	164.50	0.07	2.90	3.93	996.26
Feb-11	80.27	14.34	810.21	1.2	112.80	0.08	3.32	3.69	926.33
Mar-11	81.28	13.74	776.31	1.4	131.60	0.10	4.15	3.22	912.06
Aprl-11	82.29	12.63	713.59	1.88	176.72	0.04	1.66	2.88	891.97
May-11	80.29	15.76	890.44	0.78	73.32	0.09	3.73	3.04	967.49
Jun-11	80.19	16.18	914.17	0.79	74.26	0.06	2.49	2.24	990.92
Jul-11	79.45	15.26	862.19	1.15	108.10	0.05	2.07	3.90	972.36
Aug-11	79.45	15.21	859.36	1.44	135.36	0.12	4.98	2.89	999.70
Sept-11	78.98	14.23	803.99	1.84	172.96	0.14	5.81	2.01	982.76
Average	79.98	14.86	839.44	1.45	135.88	0.09	3.73	3.15	979.07

Table no.3 Biochemical composition of muscles in female *P ocellatus* during different months

Months	Moisture (mg %)	Protein (mg %)	Protein (cal/g)	Lipid (mg %)	Lipid (cal/g)	Carbohydrate (mg%)	Carbohydrate (cal/g)	Ash (mg %)	Total cal/g
Jun-10	81.45	13.45	759.92	1.78	167.32	0.06	2.49	3.25	929.73
Jul-10	79.85	14.85	839.02	2.01	188.94	0.09	3.73	**2.55**	1031.70
Aug-10	80.99	13.42	758.23	1.87	175.78	0.15	6.22	3.42	940.23
Sep-10	80.13	13.3	751.45	1.8	169.20	0.18	7.47	3.88	928.12
Oct-10	78.95	14.27	806.25	2.25	211.50	0.05	2.07	3.92	1019.83
Nov-10	77.65	15.15	855.97	2.98	280.12	0.08	3.32	3.88	1139.41
Dec-10	76.15	15.95	901.17	3.85	361.90	0.10	3.98	3.52	1267.05
Jan-11	79.54	15.04	849.76	2.39	224.66	0.07	2.90	2.93	1077.32
Feb-11	81.24	13.73	775.74	1.97	185.18	0.05	2.07	2.12	963
Mar-11	81.75	13.64	770.66	1.1	103.40	0.09	3.77	2.74	877.83
Apr-11	80.09	14.31	808.51	1.79	168.26	0.08	3.44	3.42	980.21
May-11	81.24	14.11	797.21	0.83	78.02	0.09	3.73	3.51	878.97
Jun-11	79.73	15.03	849.19	1.97	185.18	0.14	5.81	2.5	1040.18
Jul-11	79.52	13.39	756.53	2.89	271.66	0.18	7.47	2.85	1035.66
Aug-11	81.42	12.75	720.37	1.98	186.12	0.09	3.73	3.12	910.23
Sep-11	80.85	13.05	737.32	1.78	167.32	0.07	2.90	3.35	907.55
Average	80.05	14.09	796.08	2.08	195.28	0.10	4.07	3.19	995.44

Table no.4 Correlation between moisture, protein, carbohydrate and ash in male and female *P.ocellatus*

Variable	Male 'r'	Significance	Female 'r'	Significance
Moisture/Protein	-0.6334	Significant at p<0.01	-0.7822	Significant at p<0.05
Moisture/lipid	-0.3175	Not significant	-0.8681	Significant at p<0.05
Moisture/carbohydrate	-0.0701	Not significant	-0.0603	Not significant
Moisture/ash	-0.5921	Significant at p<0.05	-0.3773	Not significant
Protein/lipid	-0.4173	Not significant	0.5413	Significant at p<0.05
Protein/carbohydrate	0.0410	Not significant	-0.1773	Not significant
Protein/ash	0.0331	Not significant	0.0231	Not significant
Lipid/carbohydrate	0.2363	Not significant	0.0867	Not significant
Lipid/ash	0.2434	Not significant	0.1549	Not significant
Carbohydrate/ash	-0.333	Not significant	0.0546	Not significant

The low values of carbohydrates in fishes could be because glycogen does not contribute to the reserves in the body (Jayashree *et al*., 1994). In male *P.ocellatus* carbohydrate content was maximum in August 2010 and minimum in April 2011 while in females it was maximum in July 2011 and minimum in February 2011. The lower values of carbohydrate content were observed in the spawning months in both male and female. Vijayakumaran (1979) has stated that carbohydrates play a minor role as energy reserves in *Ambassisgymnocephalus* and depletion due to spawning is negligible. Selvaraj (1984) reported minimum content of carbohydrate in the muscle of *Ilishamelastoma* and concluded that its role in the mobilization of energy during maturation and spawning may be negligible. In *P.ocellatus* carbohydrates were found to be slightly higher in females compared to males. The ash in incinerated remains of *P.ocellatus* was maximum in January 2011 and minimum in September 2011 while in females it was maximum in October 2010 and minimum in February 2011. The variation in the ash in tissues of fishes may be because of the variation in mineral constituents, higher ash values observed in the tissues during certain seasons of the year may be attributed to the higher mineral demand of the body (Jafri and Khawaja, 1967). Table no.4 shows the correlation between moisture, protein, carbohydrate and ash in male and female *P.ocellatus.*

The Analysis of Variance (ANOVA) between male and female *P.ocellatus* showed no significant difference in the biochemical composition in terms of content of moisture, protein, lipid, carbohydrate and ash. The variations in the biochemical composition observed may be due to the feeding and reproductive stages of the fish. Total caloric value of the proximal composition of *P.ocellatus* was calculated as 979.07cal/g in males and 995.44cal/g in females. It was higher in females due to high fat content compared to males. The seasonal variation in caloric content in *P.ocellatus* revealed maximum cal/g in males in October 2010 and minimum in July 2010 while in females maximum was in December 2010 and minimum in May 2011. The caloric content of the *P.ocellatus* was maximum during pre-spawning months and minimum in post spawning months. This may probably be due to the high demand of energy during spawning in *P.ocellatus*. Thus the biochemical composition revealed that *P.ocellatus* is a nutritious fish throughout the year.

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