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A Seasonal Study on Proximate Composition of Major Food Fishes of Cochin Back Water, (CBW) of Kerala, India

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Abstract

The biochemical constituents of fish vary widely from species to species and undergo changes with respect to seasonal changes and physiological factors such as feeding, maturation, etc. The proximate composition of fish includes lipid, protein, carbohydrate, moisture and ash. Estimation of all these constituents helps to assess its nutritive value. Sample collection and preparation must be done carefully to ensure accurate results. This study aimed to investigate effect of seasonal changes in the proximate composition of selected major food fishes of Cochin (CBW) Back water, Kerala.

***Key words**: Cochin back water, proximate composition, food fishes, lipid, protein, carbohydrate.*

1. Introduction

Fish is considered as a main resource around the world. Fish is an important food source, due to presence of therapeutically important polyunsaturated fatty acids, calcium, iodine, vitamins, and several other nutrients. Fish is a good source of high quality animal protein. According to estimation by FAO global fish consumption will increase from 19 Kg - 21 Kg per capita by 2020. The major constituents in the edible portion of fish are water, protein, lipid, and ash. Fish oil may protect from cognitive problems associated with Alzheimer's disease, those with rheumatoid arthritis, psoriasis or other auto- immune disorders. Fish oil prevents age related blindness. The basic constituents of fish are often referred to as proximate composition. India is presently the world's fourth highest fish producer and the second highest inland fish producer .The south-western state of India - Kerala is gifted with large number of water bodies and different species of fish. Kerala state has a total coastline of 590 Km. Fishing is a major occupation in the state and a main source of income.

Proximate composition of a species helps to assess its nutritional and edible value. Variation in the composition of fish may occur within same species depending upon the fishing ground, age, fishing season, sex of the individual and the reproductive status. Human populations include fish as a main part of their daily diet, especially in foreign countries. Fishes are quite different from the other animal food sources, because they provide calories with high quality proteins, which contain all essential amino acids in easily digestible form and are beneficial nutritional sources (Weatherly and Gill,1987).

Proper knowledge on the biochemical composition of fish finds application in several areas. Many products are made from fish sources which are quite nutritious for health and beneficial. For formulating such products, proper data on the biochemical composition is very essential. Fish is an easily perishable commodity and deterioration in quality is due to the changes taking place to the various constituents like proteins, lipids etc. Generally changes in chemical composition of body reflect storage or depletion of energy reserves. Food composition, environment and genetic trait are also known to influence chemical composition of fish (Oni et al., 1983). According to the World Health Organization (WHO), the fish provides the healthiest animal protein. The high quality protein, retinol, vitamin D and E, iodine and selenium often increasingly associates their consumption to greater brain development and learning in children, also improving eye health, and protection against cardiovascular disease and some cancers. The fats and fatty acids of fish are highly beneficial and difficult to obtain from other food sources (FAO,2013).The consumer acceptance of fishery products depends on the most important attributes are food security, nutrition, taste, texture,

color and appearance and suitability of raw materials for processing and preservation. The relative importance of any of these features depends on the particular material and its intended use on information about the chemical and nutritional composition of derived fishery products is important and useful for the formulation of diets (Haard, N.,1992).

2.Materials and Methods

Fishes were collected directly from the collections of fishermen present in the seven landing centres adjacent to the Cochin backwaters and immediately brought to the laboratory for further analysis. Fish samples were collected during pre monsoon, monsoon and postmonsoon for a period two consecutive years [postmonsoon2008 (POM08) to premonsoon2010 (PRE10)]. Out of the fishes collected, seven species were selected for analysis, using as criteria the capture volume and marketing potential. Fishes were identified by made use of Jhingran 1975. The following species were taken: *Oreochromis mossambicus, Mugil cephalus, Channa striatus, Etroplus suratensis, Etroplus maculatus , Arius arius and Anabas testudineus* and their morphometric measurements of total length and weight were measured. Flesh was pulled out a portion of an average of 150g of flesh from the lateromedial region (abdominal muscles), skinless and boneless representative of the edible part of each sample. Subsequently, samples were packed in plastic bags of polyethylene, properly identified and frozen at -17° C until the time of analysis. All biochemical analyses were carried out on fish samples previously oven dried at 60ºC until constant weight and finely powdered with a pestle (Pulverisette2, FRITSCH).

2.1 Total Proteins

Proteins in water were hydrolysed with IN NaOH at 80°C for 30 minutes. Colour developed using Copper reagent and Folin-Ciocalteu reagent (Lowry et al, 1951). The absorbance was then measured at 750 nm using UV - Visisble spectrophotometer.

2.2 Total Carbohydrates

Carbohydrates were estimated by the phenol-sulphuric acid method (Dubois et al., 1956). The samples were hydrolysed with IN conc. H_2S0_4 in 1: 1 ratio at 100^{o}C for 1 hour and cooled at room temperature and filtered. To l ml of the aliquots, add I ml of 5% phenol and concentrated H_2S0_4, cooled the test tube and measured absorbance at 490 nm using UV Visible spectrophotometer (Genesys 10 UV).

2.3 Total Lipids

Lipids were extracted from the sediments and particulate matter according to the method of Bligh and Dyer, 1959. To 10 ml sample, 10 ml chloroform-methanol (2: 1 v/v) mixture and 20 ml of aqueous NaCI were added in separating flask and after thorough shaking. The preparation was allowed to stand for 30 minutes from the clean biphasic layer formed, the lower phase was removed and the same quantity of chloroform was added to make up the volume. This extract was dried in vacuum desiccators, over silica gel and added 0.5 ml concentrated H_2S0_4, boiled maintaining in a water bath at 60°C. After cooling to room temperature, 5ml vanillin reagent was added and allowed to stand for 30 minutes. The absorbance of pink color developed was measured at 520 nm using spectrophotometer.

The fishes collected were virtually of the same size and sex as variability in size stands to affect the proximate composition and the mineral elements concentration. All the samples were collected fresh and refrigerated below 40^{0}C prior use.

2.4 Moisture content

Estimation of moisture content was carried out by drying the pre-weighed wet samples at 60 °C until a constant weight was obtained. The difference in weight was calculated and expressed as percentage moisture content of the sample. Percentage was calculated by the following formula.

$$\text{Moisture \%} = \frac{(\text{Wet weight of tissue} - \text{Dry weight of tissue})}{\text{Wet weight of tissue}} \times 100$$

The dried samples were finely powdered using mortar and pestle and stored in desiccators for further analysis.

2.5 Ash%

$$\text{Ash \%} = \frac{\text{Weight of dry samples}}{\text{Original weight of the sample}} \times 100$$

2.6 Statistical Analysis

Seasonal and species wise variations of fishes were examined by Two way ANOVA without replication (Microsoft Excel, 2007).

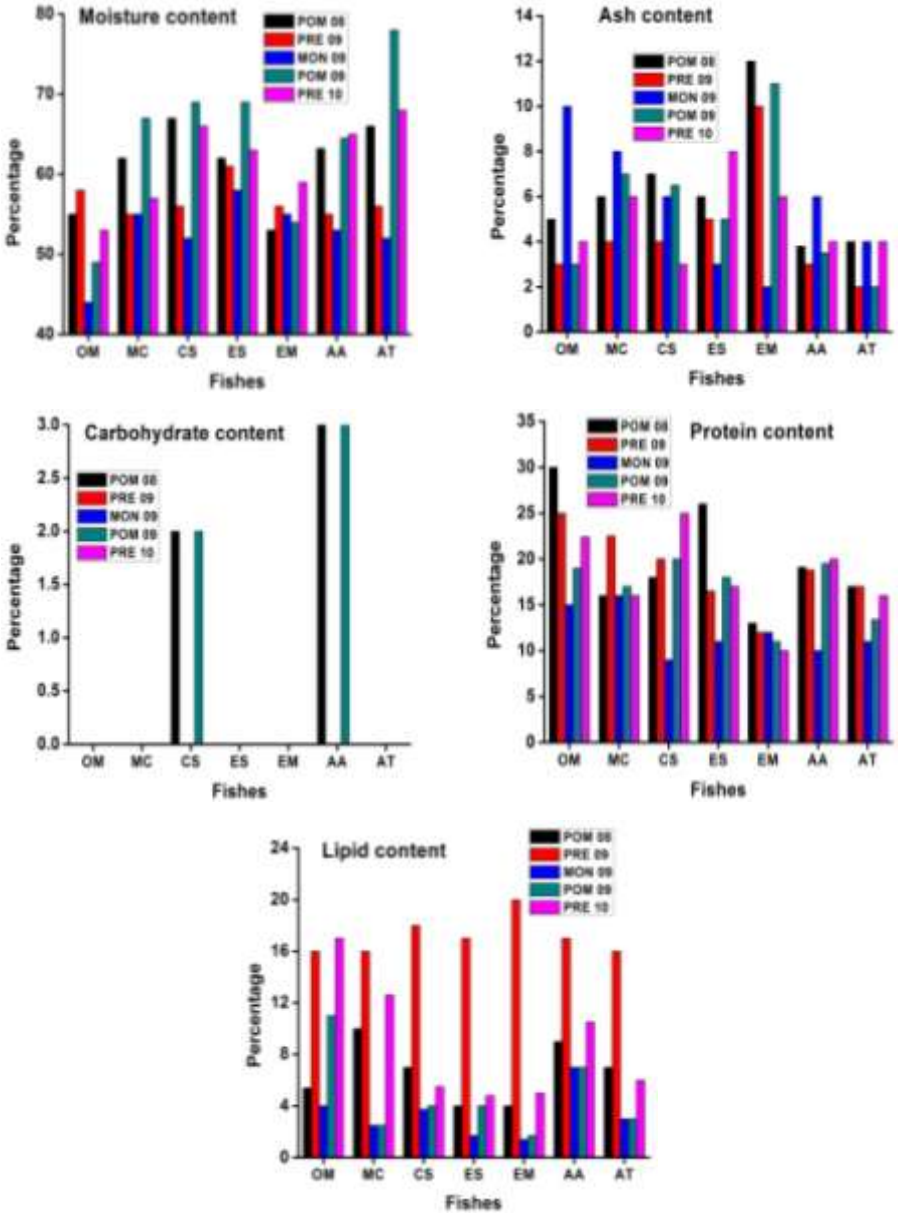
3. Results

Concentration of protein, carbohydrate and lipid which form the major biochemical constituents of

major fishes from Cochin Back waters were estimated. In the present study, the fish species were analysed individually, rich with protein (12 to 19.87%) and lipid (3.3 to 17.14%). Figure 1 represents the proximate composition of selected species of fishes in the study area.

3.1 Moisture Content

During POM 08, *Channa striatus* exhibited maximum moisture content (67%) (table 1). Minimum value was obtained from *Etroplus maculatus* (55%). It was found that during PRE 09 maximum moisture content was exhibited by *Etroplus suratensis* (61%), and minimum was shown by two fishes viz., *Mugil cephalus* and *Arius arius* (55%). The present study revealed that *Oreochromis mossambicus* showed the minimum value (44%) and *Etroplus suratensis* exhibited the maximum (58%) in the MON 09. In POM 09, minimum moisture content was recorded by *Oreochromis mossambicus* (49%) and the maximum was observed in *Anabas testudineus* (78%). During PRE 10, minimum moisture content observed was (53%) in the case of *Oreochromis mossambicus* and maximum (68%) in the case of *Anabas testudineus*. Moisture content during POM 08 varied from 53% to 67% (average: 61.17±5.29%), 55% to 61% (average: 56.71±2.14%) during PRE 09, from 44% to 58% (average: 52.71±4.39%) during MON 09, from 49% to 78% (average: 64.36±9.83%) during POM 09, and from 53% to 68% (average: 61.57±5.41%) during PRE 10.



OM= *Oreochromis mossambicus* , MC= *Mugil cephalus* , CS= *Channa striatus*, ES= *Etroplus suratensis*, EM= *Etroplus maculeatus* , AA= *Arius arius*, AT= *Anabas testudineus*

Figure. 1 Proximate composition of selected species of fishes in the study area

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FISH SPECIES	POM08	PRE09	MON09	POM09	PRE10
Oreochromis mossambicus	55	58	44	49	53
Mugil cephalus	62	55	55	67	57
Channa striatus	67	56	52	69	66
Etroplus suratensis	62	61	58	69	63
Etroplus maculatus	53	56	55	54	59
Arius arius	63.2	55	53	64.5	65
Anabas testudineus	66	56	52	78	68
Minimum	53	55	44	49	53
Maximum	67	61	58	78	68
Average	61.17±5.29	56.71±2.14	52.71±4.39	64.36±9.83	61.57±5.41
ANOVA					
Species wise	0.22				
Seasonal	0.0005				

Table 1 Moisture content in fish samples in the study area (%)

3.2 Ash Content

The content of ash ranged from 3.8 to 12 % (average: 6.26 ±2.78%) during POM 08 (table 2). The maximum value recorded during PRE 09 was 10 % and minimum was 2% (average: 4.43± 2.64%) in PRE09. Ash exhibited variation from 2 to 10% (average: 5.57 ±2.81%) during MON 09. The minimum value recorded during POM 09 was 2% and the maximum was found to be 11% (average: 5.43±3.06%). During PRE 10, ash percentage varied from 3 to 8% (average: 5±1.73%).

During POM 08, lowest value was showed by *Arius arius* (3.8%) and highest was that of *Etroplus maculatus* (12%). But in PRE09 minimum ash percentage was recorded by *Anabas testudineus* (2%) and recorded highest value was 10% in the case of *Etroplus maculatus.* In MON 09, minimum ash content was exhibited by *Etroplus maculatus* (2%) and maximum by *Oreochromis mossambicus* (10%). While in POM 09 minimum value (2%) was showed by *Anabas testudineus* and maximum value was 11% in the case of *E.maculatus.* Meanwhile during PRE 10, minimum content (3%) was recorded by *Channa striatus* and the maximum ash content was recorded by *Etroplus suratensis* (8%).

FISH SPECIES	POM08	PRE09	MON09	POM09	PRE10
Oreochromis mossambicus	5	3	10	3	4
Mugil cephalus	6	4	8	7	6
Channa striatus	7	4	6	6.5	3
Etroplus suratensis	6	5	3	5	8
Etroplus maculatus	12	10	2	11	6
Arius arius	3.8	3	6	3.5	4
Anabas testudineus	4	2	4	2	4
Minimum	3.8	2	2	2	3
Maximum	12	10	10	11	8
Average	6.26±2.78	4.43±2.64	5.57±2.82	5.43±3.06	5.00±1.73
ANOVA					
Species wise	0.22				
Seasonal	0.84				

Table 2 Ash content in fish samples in the study area (%)

3.3 Carbohydrate Content

Carbohydrate occurs in minute quantity in the fish tissues. During PRE 09, MON 09 and PRE 10 non detectable levels were found (table 3). During POM 08 and POM 09, *Channa striatus* and *Arius arius* showed a concentration of 2% and 3 % respectively (average: 0.62±1.18%).

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FISH SPECIES	POM 08	PRE 09	MON 09	POM 09	PRE10
Oreochromis mossambicus	ND	ND	ND	ND	ND
Mugil cephalus	ND	ND	ND	ND	ND
Channa striatus	2	ND	ND	ND	ND
Etroplus suratensis	ND	ND	ND	ND	ND
Etroplus maculatus	ND	ND	ND	ND	ND
Arius arius	3	ND	ND	3	ND
Anabas testudineus	ND	ND	ND	ND	ND
Minimum	ND	ND	ND	ND	ND
Maximum	3	ND	ND	3	ND
Average	0.62±1.18	ND	ND	0.62±1.18	ND
ANOVA					
Species wise	0.0397				
Seasonal	0.091				

Table 3 Carbohydrate content in fish samples in the study area (%)

3.4 Lipid Content

Mugil cephalus exhibited maximum lipid content (10%) and the minimum concentration was exhibited in two species *Etroplus maculatus* and *Etroplus suratensis* (4%) during POM 08 (table 4). *Anabas testudineus*, *Oreochromis mossambicus* and *Mugil Cephalus* recorded minimum content (16%) and *Etroplus maculatus* exhibited the maximum (20%) in the PRE 09. In MON 09, minimum lipid content was recorded by *E.maculatus* (1.4 %) and maximum was shown by *Arius arius* (7%). During POM 09, minimum content ranged from 1.7% (*Etroplus maculatus*) to 11% (*Oreochromis mossambicus*). But in PRE 10, minimum lipid content (4.8%) was observed in the case of *Etroplus suratensis* and maximum (17%) in the case of *Oreochromis mossambicus*.

During POM 08, it ranged from 4 to 10 % with an average of 6.62±2.33%. Lipid content varied from 16 to 20 % and estimated average was found to be 17.14±1.46% (during PRE 09). The range of lipid ranged from 1.4 to 7% and recorded average was 3.33±1.8% (MON 09). But in POM 09 minimum content observed was 1.7 and the maximum was found to be 11 % (average: 4.74±3.23%). In the present study, minimum lipid content was found to be 4.8% (*Etroplus suratensis*) and maximum was 17% (*Oreochromis mossambicus*) (average: 8.77±4.72%) in PRE 10.

FISH SPECIES	POM08	PRE09	MON09	POM09	PRE10
Oreochromis mossambicus	5.4	16	4	11	17
Mugil cephalus	10	16	2.5	2.5	12.6
Channa striatus	7	18	3.73	4	5.5
Etroplus suratensis	4	17	1.7	4	4.8
Etroplus maculatus	4	20	1.4	1.7	5
Arius arius	9	17	7	7	10.5
Anabas testudineus	7	16	3	3	6
Minimum	4	16	1.4	1.7	4.8
Maximum	10	20	7	11	17
Average	6.63±2.33	17.14±1.46	3.33±1.88	4.74±3.23	8.77±4.72
ANOVA					
Species wise	0.22				
Seasonal	1.96903E-08				

Table 4 Lipid content in fish samples. in the study area (%)

3.5 Protein Content

During POM 08, it was observed that protein content varied from 13 (*Etroplus maculatus*) to 30% (*Oreochromis mossambicus*) with an average of 19.87±5.98% Ttable 5). It was found that PRE 09 recorded a minimum of 12% (*Etroplus maculatus*) and maximum of 25% (*Oreochromis mossambicus*) and exhibited an average concentration of 18.83±4.25%. The minimum protein content was 9% (*Channa striatus*) and maximum of 16% for *Mugil cephalus* (average: 12±2.58%) during the MON 09 period. However, during POM 09 exhibited a minimum value of 11% (*E.maculatus*) and maximum of 20% represented by *Channa striatus*. (average: 16.84±3.39). It was observed that during PRE 10, minimum protein content was 10% (*Etroplus maculatus*) and maximum content of 25% was estimated for *Channa striatus* (average: 18.06±4.92%).

FISH SPECIES	POM08	PRE09	MON09	POM09	PRE10
Oreochromis mossambicus	30	25	15	19	22.4
Mugil cephalus	16	22.5	16	17	16
Channa striatus	18	20	9	20	25
Etroplus suratensis	26	16.5	11	18	17
Etroplus maculatus	13	12	12	11	10
Arius arius	19.1	18.8	10	19.5	20
Anabas testudineus	17	17	11	13.4	16
Minimum	13	12	9	11	10
Maximum	30	25	16	20	25
Average	19.87±5.98	18.83±4.25	12.00±2.58	16.84±3.39	18.06±4.92
ANOVA					
Species wise	0.0373				
Seasonal	0.00896				

Table 5 Protein content in fish samples in the study area (%)

4. Discussion

Proximate composition, were determined in some widely consumed fish species obtained from the CBW. The results obtained in the present study indicated that biological differences existing in fish species can influence the values to be set for the standards and composition (Guner et al., 1999). The data on proximate composition help the nutritionist, dieticians and consumers to estimate the intake of the principal nutrient in the human diet, to calculate energy values, contents of the diet and was useful to determine the difference in the nutrient value seasonally. The variation was observed from species to species. Increase in the moisture content during seasons other than MON 09 was coincided with increase in salinity. Shekhar et al., (2004) reported that moisture content differ according to season when other constituents were low. The low values of carbohydrates recorded in the present study could be because glycogens in many marine animals do not contribute much to the reserves in the body (Jayasree et al., 1994). Ramaiyan et al., (1976) reported similar findings in 11 species of Clupeids. Phillips et al., (1967) reported that carbohydrates are utilized for energy in trout, thus sparing protein for building of the body.

The average lipid content in the fishes taken for study was maximum during PRE 09 (average: 17.14±1.46%) ie. during spawning season. Depending upon the level of lipids in the fish muscles, they are classified into three categories. Fat fishes with more than 8 % average fat content, average fat fishes with fat content range between 1 % and 8 % and lean fishe with fat content less than 1 % (Srivastava, 1999). In the present study, all fishes taken were fat fishes during PRE 09. In all other seasons they were included in the category entitled average fat fish. Lowest protein content was recorded during MON 09 and highest value was recorded in an almost steady

state during other seasons in the following order, POM 08> PRE 09 > PRE 1O> POM 09 which couples with high feeding intensity observed by the gorged conditions of stomach.

The percentage ash content in the fishes analyzed is an indication of ample mineral content in fish. The proximate composition of a species helps to assess its nutritional and edible value compared to other species. The chemical compositions of marine organisms are quite close to that of land animals. The principal constituents are water (66 to 84 %), protein (15 to 24 %), lipids (0.1 to 22 %), minerals (0.8 to 2 %) and sugar is in very low quantity (0.3%) at maximum value in fishes (FAO, 1998). The importance of the seasonal variation of proximate composition is complex and it is quite difficult to distinguish the effects of factors in the biochemical composition of fish (Medford and Mackay, 1978). According to Stansby, (1962), the biochemical constituents are influenced by metabolism, mobility of the fish and geographical area. In the present investigation variations were obtained in the biochemical composition of the fish muscles of different fishes under study, which may be the result of the above processes. The present findings describe the major nutritional composition of different fishes.

The range of values for these constituents in the edible portion of common fish species from Indian coastal waters are: moisture (65-90%), protein (10-22%), fat (1-20%), mineral (0.5- 5%) (source: CIFT library)

Minor quantities of carbohydrates, vitamins, nucleotides, other non-protein nitrogenous compounds etc. are also present and these play vital roles in maintaining the system and thus are essential for growth and development of the organisms.

5. Conclusion

Fishes are very good sources of protein, providing an important complement to the predominantly carbohydrate-based staple diet of many people in Kerala. The study of the proximate composition of *Oreochromis mossambicus, Mugil cephalus, Channa maruleus, Etroplus suratensis, Etroplus maculatus, Arius arius, Anabas testudineus* showed that they are rich in protein and have average to high lipid contents. The present investigation revealed that these fish species are good sources of minerals. It could also be inferred that the mineral elemental levels of each species is a function of the availability and preferential accumulation. Differences in biochemical composition of fish may also occur within the same species depending upon the fishing ground, fishing season, age and sex of the individual and reproductive status. Spawning cycle and food supplies are the main factors responsible for this variation (Love, 1980).

The present findings describe the major nutritional composition of different fishes under study. The proximate composition of the commercially important fish species from CBW were studied to assess their nutritional values in order to achieve the knowledge of the risk and benefits associated with the indiscriminate consumption of these species. The fish contains comparatively large amount of protein. These studies warrant that necessary steps should be taken to increase the production and proper management of natural habitat of the species for continued benefits. Data available in literature for proximate composition of individual species will only indicate the range or average and these are not usually taken as absolute values. Researches on the biochemical (proximate) composition of fish are useful in several ways. Now a day there is an ever-increasing awareness about healthy food and fish is finding more acceptances because of its special nutritional qualities. Proper understanding about the biochemical constituents of fish has become a prime need for the nutritionists and dieticians. The measurement of some proximate profiles such as protein contents, carbohydrates, lipids, moisture contents and ash percentage is often necessary to ensure that they meet the requirements of food.

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