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Comparative study of proximate composition and nutritional status of major fresh water food fishes during post monsoon season in the culture and capture fisheries of Alappuzha District, Kerala, India

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Abstract

The basic biochemical constituents of fish are often referred to as proximate composition. Five species of fish(*Channa striatus*, *Oreochromis mossambicus, Anabas testudineus, Etroplus suratensis* and *Heteropneustes* fossilis) were collected from a brackish water farm and from a lotic habitat in Alappuzha district for the comparison of proximate composition. The protein content was comparatively less in *Heterpneustes fossilis* in both capture and culture fishes. 17% Protein content average was noticed in capture fishes and 16.7% in culture fishes. And in both capture and culture type, minimum value was seen in *Etroplus.suratensis*. In both culture and capture fishes selected, minimal value of carbohydrate content was obtained in *Anabas testudineus* and maximum value is in C.*striatus*. In the present study lipid content in culture fishes have a higher value than that of capture fishes. Average ash content in capture fishes was 7.06% and in culture fishes 6.11 %. Minimum ash content was observed in O. *mossambicus.* Feeding habit were assessed and grouped under various categories. The present study is an attempt to compare the proximate composition of different species of culture and capture fishes during post monsoon season.

Keywords: Protein, lipids, carbohydrates, brackish water, proximate composition

Introduction

Fish can be considered as a natural food resource, not only in terms of bio diversity but also a source of high quality animal protein, therapeutically important polyunsaturated fatty acids, calcium, iodine, vitamins, and several other nutrients[11]. The major constituents of fish are water, protein, lipid, and ash. Carbohydrate is seen only in negligible amount. Proximate composition of fish generally varies according to season, age, maturity, sex and availability of food[7]. Fish oil may protect the brain from cognitive problems associated with Alzheimer's disease, those with rheumatoid arthritis, psoriasis or other auto- immune disorders and age related blindness[4,11] India is presently the world's fourth highest fish producer and the second highest inland fish producer[4] .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 Kms. Fishing is a major occupation and a main source of income.

In general, the biochemical composition of fish indicates the quality. So, proximate or biochemical composition of a species showed its nuitritional quality and helps to assess its nutritional and edible value[8]. Variation in the composition of fish may occur within same species depending upon

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the fishing ground, age, fishing season, sex of the individual and the reproductive status. From the ancient time onwards, human population include fish as a major part of their daily diet. Due to the presence of high quality proteins, which contain all essential amino acids, they are considered as beneficial nutritional sources[15]. Proper knowledge on the biochemical composition of fish finds application in several areas. Different food products are made from fishes which are quite nutritious for health and are beneficial. For formulating such products, proper data on the biochemical composition is very essential. Another vital area where accurate information on biochemical composition is processing and preservation of fish and fishery products. 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. Feeding habit, environment and genetic trait are also known to influence chemical composition of fish[13].

The significance of the investigation relies on many relevant reasons. Different species of fishes are available in our market and they are being cultured in many farms around us. But fishes available in our markets are not of first quality. They are available only after several days of preservation and lose its natural quality. It is being preserved in less amount of Formalin, Ammonia and many other preservatives. Such preservatives are harmful for human health as well as affect the quality of fishes. So culture fishes are more preferable for edible purposes. Culture fishes are devoid of such preservatives and chemicals. They can be fed with fish feeds and domestic wastes and it is economically more feasible as they attain large size within a short span. Culture fishes grow faster than capture fishes.

Materials and Methods

The major food fishes such as *Channa striatus*, *Oreochromis mossambicus,Anabas testudineus*, *Etroplus suratensis* and *Heteropneustes fossilis* were selected with almost equal size and weight(Table 1). The weight of selected capture and culture fishes varied from 15-18 cm in capture and 9-17cm in culture. They were procured from different places and farms in Alappuzha District, Kerala. Muscle between the gills and the dorsal fins were used for analyses in triplicates. In the present investigation, both culture and capture fishes of same species were taken and proximate composition was estimated in which moisture content, ash content, protein, carbohydrate, lipid were estimated and tabulated with graphical representation.

Moisture content was estimated by the method in FAO (1989)[4]. Total lipid was estimated by the method of Folch *et.al*, (1957)[6]. Protein estimation was done by the method of Lowry *et.al*.[10]. Dubois *et.al*[3]. (1956) method was used for the estimation of carbohydrate (Phenol-Sulphuric method).

Estimation of nutritional value

The importance of a species depends on its nutritional value. The fishes were classified into five types based on the fat and protein contents in the muscle[14].

Note :Microsoft Excel 2007 was used for statistical analysis.

Results and Discussion

Species wise variation of the proximate

Category	Type	Oil content (%)	Protein content (%)
A	Low oil- high protein	Less than 5	15-20
B	Medium oil- high protein	5 -15	15-20
C	High oil – low protein	More than 15	Less than 15
D	Low oil- very high protein	Less than 5	More than 20
E	Low oil- low protein	Less than 5	Less than 5

Table 1. Length and weight of selected food fishes under study

Fishes	Channa		Etroplus		Anabas		Oreo-chromis		Hetero-pneustes	
	Capture	Culture	Capture	Culture	Capture	Culture	Capture	Culture	Capture	Culture
Length (cm)	18	18.5	15.7	16.5	18.2	17.2	16.7	16.4	24.1	26.2
Breadth (cm)	4	3.5	7.2	5.2	4.6	3.3	5.7	4.5	5.7	3.8
Weight (gm)	55.50	38.40	65.24	34.55	70.45	19.68	70.15	33.3	56.10	40.62

Table 2. Proximate composition of selected capture and culture fishes during post monsoon season

FISH SPECIES	Carbohydrate (%)		Moisture content(%)		Lipid(%)		Protein(%)		**Ash**(%)	
	Capture	Culture	Capture	Culture	Capture	Culture	Capture	Culture	Capture	Culture
Channa striatus	0.22± 0.01	0.26± 0.05	66.34± 0.02	63.77± 0.01	12.9± 0.01	13.6± 0.01	15± 0.01	19.5± 0.02	7.63± 0.02	6.30± 0.01
Etroplus suratensis	0.18± 0.02	0.20± 0.03	71.31± 0.07	64.36± 0.02	10.8± 0.01	12.5± 0.01	12.5± 0.02	17± 0.02	6.52± 0.01	7.32± 0.01
Anabas testudineus	0.18± 0.02	0.17± 0.03	62.5± 0.03	64.85± 0.02	11.4± 0.01	12.1± 0.02	18± 0.02	20± 0.03	8.30± 0.02	6.25± 0.04
Oreochromis mossambicus	0.21± 0.04	0.24± 0.02	64.50± 0.01	57.28± 0.03	11.1± 0.02	12.9± 0.02	21.5± 0.01	24.5± 0.02	5.38± 0.01	5.19± 0.02
Heteropneustes fossilis	0.16± 0.01	0.19± 0.03	59.22± 0.02	54.28± 0.02	18.9± 0.04	19.4± 0.02	18± 0.01	22.5± 0.01	7.48± 0.01	5.51± 0.01

composition of selected five fish species were reported and presented in Table 2 and Fig.1a-e. It has been observed that the species are protein rich during post monsoon season.

The principle constituents are water (66 – 84%), protein (15 – 24%), lipids (0.1 – 22%), minerals (0.8 – 2%) and sugar in very minute quantity (0.3%) at maximum value in fishes [6]. The proximate composition of Indian fishes ranged between 65 – 90% water; 10 – 22% protein, 01 – 20% lipid and 0.5–05% minerals[13]. However main changes in body occur in moisture and lipid content.

In the present study, moisture content was high in capture fishes. Maximum value was found in E.*suratensis* (71.31%) and minimum value in H. *fossilis* (59.22%), (Table 2). While in culture fishes, it was 64.85% in *A.testudineus* and minimum value 54.28% in H. *fossilis*. Estimations indicate that composition was not similar in selected fishes.

Maximum value was 21.5 % in *O.mossambicus* and minimum value was 12.5% in *E.suratensis*. But in culture type,

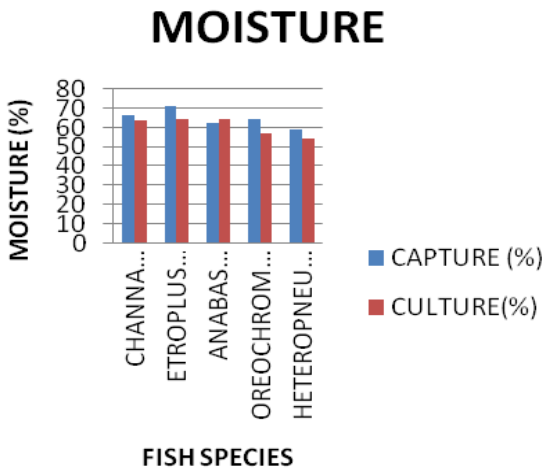

Fig. 1a. Moisture content of selected fishes from culture and capture fisheries during postmonsoon season

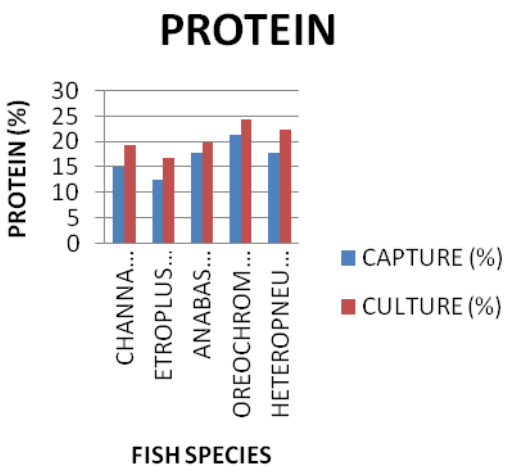

Fig. 1b. Protein content of selected fishes from culture and capture fisheries during postmonsoon season

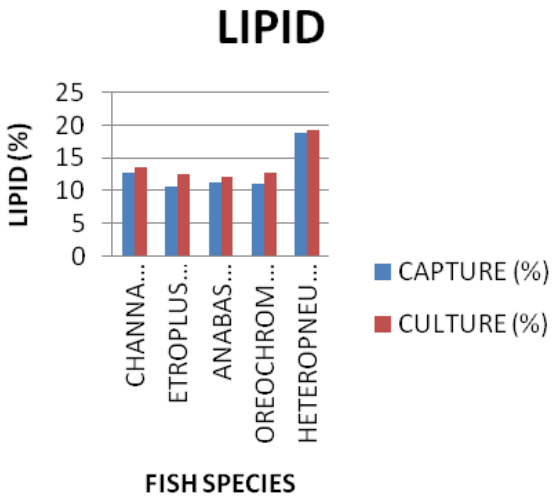

Fig. 1c. Lipid content of selected fishes from culture and capture fisheries during postmonsoon season

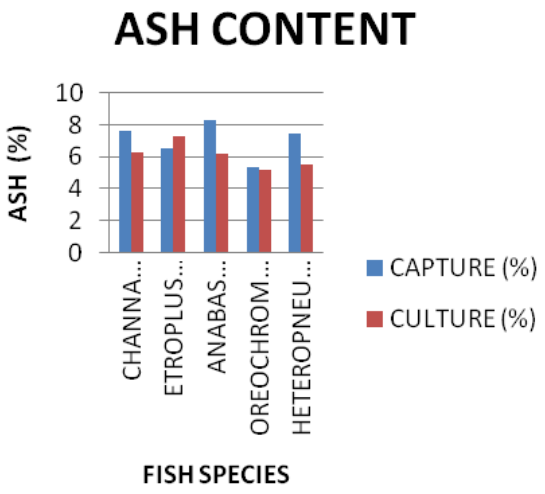

Fig.1d. Ash content of selected fishes from culture and capture fisheries during postmonsoon season

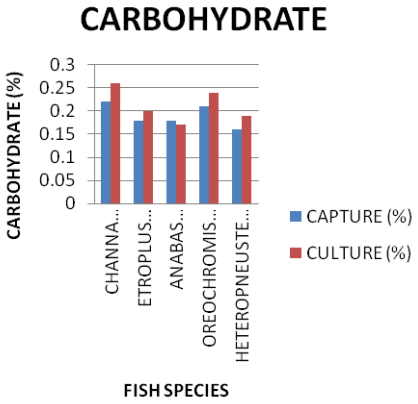

Fig. 1e. Carbohydrate content of selected fishes from culture and capture fisheries during postmonsoon season

maximum protein content is 24.5% and was found in *H. fossilis* and minimum is 17% and was found in *E.suratensis* respectively. Average of protein content is 17% in capture fishes and 16.7% in culture fishes. And it was found that in both capture and culture type, minimum value is seen in *E.suratensis* . According to the studies done before, it is found that, carbohydrates is absent or if present only in very minor quantities in fishes and hence plays a major role in activities[9]. The low values of carbohydrates recorded in present study supports the view that carbohydrate plays an insignificant role as energy

Table 3.Gut contents in the selected fish species studied

Contents	CHANNA		ETROPLUS		ANABAS		OREO-CHROMIS		HETERO-PNEUSTES	
	Capture	Culture	Capture	Culture	Capture	Culture	Capture	Culture	Capture	Culture
Crustaceans	P	A	A	A	A	A	A	A	P	A
Insect Remains	P	P	A	A	P	A	A	P	A	P
Fish Remains	A	A	A	P	A	P	P	A	P	A
Mud & Sand	A	A	P	A	A	A	A	A	P	A
Detritus	A	A	P	A	P	A	P	A	P	A
Algal Remains	A	A	P	P	A	A	P	P	A	P
Shell Remains	P	A	A	A	A	A	A	A	P	A
Spines & fins	A	A	A	P	P	P	A	A	P	P
Exoskeletons of Arthropods	P	A	A	A	P	A	A	A	P	A
Farm food	A	P	A	P	A	P	A	P	A	P
Plant materials	P	A	A	A	P	A	A	A	A	A
Worms & micro organisms	P	P	A	P	A	A	A	A	P	A
Others	P	P	P	P	P	P	P	P	P	P

reserve in aquatic animals[9]. In the present study, carbohydrate content ranged from 0.10-0.30 % and values were very low compared to other fishes. Minimum carbohydrate content was observed in *A.testudineus* (0.13 %) and maximum in *C. striatus* (0.22%) among capture fishes and *A.testudineus* has a low content (0.17%) and highest in *C.striatus* (0.26%) among culture fishes respectively. Average carbohydrate in capture fishes is assessed as 0.216% and 0.212 % in culture fishes. Hence it is found that, both in culture and capture fishes selected, minimal value of carbohydrate content obtained is in *A.testudineus* and maximum value is in *C.striatus*.

Lipids are the primary energy storage material in fish[9]. Lipid content is a good index of future survival in some species. Depending on the level of fat contents, fish can be grouped into four categories: lean fish (<2%), low fat (2-4%), medium fat (4-8%) and high fat (>8%) fish (Ackman, 1989). After estimation of lipid, maximum content is found in H. *fossilis* in capture (18.9%) and in culture also, it has the highest value (19.4%)(Figure 1). At the same time, minimum content is observed in E.*suratensis* in capture fishes and in *Anabas*, it is 12.1% among culture fishes. Lipid values ranges from 10%- 20% and average is 13.02% in capture and 14.1% in culture fishes (Figure 1) In fact, total lipid and its composition in fish vary more than any other nutrient component. Average value of result obtained is 13.02% in capture fishes and in culture fishes it is 14.1%. From the above result, the culture fishes have a higher value than that of capture fishes. The concentration of lipid varies considerably in different parts of the body of the fish[9].

Ash content of selected fishes were assessed and tabulated. Highest content was observed in *A.testudineus* as (8.30%) and lesser content in *O.mossambicus* (5.38%) among capture fishes while

E. *suratensis*(7.32%) has higher content and *O.mossambicus* (5.19%) has lesser content among culture fishes. It is found that, both in culture and capture fishes, minimum content was observed in *O.mossambicus*. Average ash content in capture fishes is 7.06% and in culture fishes it is 6.11 %.

Feeding habit was identified using gut content analysis (Table3).. Presence and absence of different types of food materials like crustaceans ,shell and insect remains ,detritus ,fins and fish remains, plant materials, mud and algal remains etc .were observed during the analysis and hence the feeding habit of fishes were identified. *C.striatus* and *A.testudineus* are included under carnivorous type whereas *E.suratensis*, *O.mossambicus* and *H. fossilis* are omnivorous type.

The importance of a species depends on its nutritional value. Fishes are classified the fishes into five types based on the fat and protein contents in the muscle[14]. According to the present results, *C.striatus* can be included under the category B (Medium oil-high protein), the oil content recorded was in between 5-15 % and protein content recorded was between 15-20%. In this study *E.suratensis* can be included under the category B with respect to oil and protein content. In *A. testudineus*, it can be included under the category B in which protein is high and less oil content based on the feeding habit. *Oreochromis mossambicus* is included under the category B in which oil content is medium and in category D where protein is very high. *H. fossilis* was also examined and is included under the category C, where oil content as well as protein content is very high. Carbohydrate content ranged from 0.10-0.30 % and values were very low compared to others .The low values of carbohydrates recorded in the present study supports the view that carbohydrate plays an insignificant role as energy reserve in aquatic animals (Love, 1980). Lipid content is a good index of future survival in some species. The percentage ash content in the fishes analysed is an indication of mineral content in fish. The proximate composition of a species helps to assess its nutritional and edible value compared to other species. The principal constituents are water (66 to 84 %), protein (15 to 24 %), lipids (0.1 to 22 %), minerals (0.8 to 2 %) and carbohydrate in very low quantity (0.3%) at maximum value in fishes[4]. The biochemical constituents are influenced by metabolism, mobility of the fish and geographical area[14]. 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 main constituent in edible parts is moisture content & protein content is comparatively less in *H. fossilis* from capture and culture. Minimal value of carbohydrate content obtained is in A. *testudineus* and maximum value is in *C. striatus* and culture fishes have higher lipid content than that of capture fishes. Both in culture and capture fishes, minimum ash content was observed in *O. mossambicus*. Present study reveals that culture fishes have comparatively higher nutritional value and quality than capture fishes. Lowest protein content was recorded in *Etroplus suratensis* (12.5±0.02)and highest value (24.5±0.02)was observed in *Oreochromis mossambicus*(both in culture and capture fisheries) which couples with high feeding intensity observed by the gorged conditions of stomach. In the present study, all fishes were fat fishes with moderate fat content.

Conclusion

The knowledge of chemical composition of any edible organism is extremely important as the nutritive value is reflected in its biochemical composition. The principal constituents of fish and mammals are the same. During long starvation period it may utilize protein in its body to survive. In general, the biochemical composition of the whole body indicates the fish quality.

The present study revealed the changes in the body composition of culture and capture fishes. In the present study *Oreochromis* is protein rich so it is an important source of animal protein for the local people. Since the feeding habit showed this species is an omnivorous feeder and can be easily cultivable.

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