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# Nutritive Composition of Some Edible Fin Fishes

S. Ravichandran, K. Kumaravel and E. Pamela Florence
Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai, Tamil Nadu, India

*Corresponding Author: S. Ravichandran, Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai, Tamil Nadu, India 608-502 Tel: + 91-4144-243223, 243533 Fax: + 91-4144-243555*

## ABSTRACT

The aim of the present study was to validate out the nutritive value of six important commercial fishes from India. Nutritive parameters which include carbohydrate, protein, fatty acid and Moisture content were estimated biochemically. The moisture content in the case of the two brackish water fishes namely *Lates calcarifer* and *Mugil cephalus* varies from 77.6 to 81.2% and the highest is found in *L. calcarifer*. Analysis of protein were carried out in the total number of six fishes inhabiting three ecosystems namely brackish, fresh and marine water ecosystem However, in the case of marine fishes the protein content showed much fluctuation. It ranged from 17.04 to 28.01%. In the case of *Sardinella longiceps*, the protein content is the lowest 17.04%. *Catla catla* exhibited lipid content of 1.5% where as in *Oreochromis mossambicus* the lowest value of 0.45% was observed. The highest amount of carbohydrate was found in the *Lates calcarifer*, the value being 20.8% where as in *Mugil cephalus* the carbohydrate content was 18.3% only. The fatty acid composition of the fresh water reported here show marked differences in quantities of polyunsaturated fatty acids especially C22:6n3 (Docosahexaenoic Acid) compared to various other species analyzed. Overall these data on fresh water fish particularly are highly unsaturated with a high concentration of C22: 6n3. From this investigation it is concluded that each habitat group of fishes has its own biological value.

**Key words:** Carbohydrate, fresh water fish, fatty acid, lipid, moisture, protein

## INTRODUCTION

Fish is an important source of food for mankind all over the world from the times immemorial. Fish is a very important source of animal protein in the diets of man. The importance of fish as source of high quality, balanced and easily digestible protein, vitamins and polyunsaturated fatty acids is well understood now. Fish having energy depots in the form of lipids will rely on this. The amount of protein in fish muscle is usually somewhere between 15 and 20% but values lower than 15% or as high as 28% are occasionally met muscle is always low, usually below 1% and seasonal fluctuations in fat content are noticeable mainly in the liver where the bulk of the fat is stored. Lipids occur in the fish muscles, adipose and liver. The fishes offered as a dietary supplement to the farming pigs has considerably increased their weight and meat yield (Ojewola and Annah, 2006). The consumption of fish and fish products is recommended as a means of preventing cardiovascular and other diseases and has greatly increased over recent decades in many European countries (Cahu *et al*., 2004). Besides this fishes are good source which possess immense antimicrobial peptide in defending against dreadful human pathogens (Ravichandran *et al*., 2010).

However, the most important feature of this food is an advantageous fatty acid profile, resulting from the high content of essential polyunsaturated fatty acids such as eicosa pentaenoic acid

(C20:5 n-3) and docosahexaenoic (C22:6 n-3) (Kris-Etherton *et al*., 2003). In recent years, investigations aimed at identifying the benefits of fish consumption have also indicated that there are risks connected with toxic contaminants such as methyl mercury and persistent organic pollutants (Mahaffey, 2004; Domingo *et al*., 2007a, b; Stern, 2007; Wu *et al*., 2008; Szlinder-Richert *et al*., 2008a, b; Szlinder-Richert *et al*., 2009). In a recent investigation concerning canned fish and other fish products, we showed that these products are characterized by high nutritional quality and that considering the present scenario of the fish consumption in Poland, they do not pose a threat for Polish consumers due to the contaminant levels (Usydus *et al*., 2008, 2009).

In the present investigation six commercial fishes from three different habitats of fresh water habitat (*Catla catla* and *Oreochromis mossambicus*) brackish water habitat (*Lates calcarifer* and *Mugil cephalus*) Marine water habitat (*Rastrelliger kanakurta* and *Sardinella longiceps*) were selected and their complete nutritive parameters of carbohydrate, proteins, fatty acids and moisture content were biochemically profiled.

## MATERIALS AND METHODS

The current research has been carried out in the year 2009. The proximate composition of commercially important six fishes was investigated. The two brackish water fishes namely *L.calcarifer* and *M.cephalus*, two marine fishes namely *R. kanakurta* and *S. longiceps* and two fresh water fishes namely *C. catla* and *O. mossambicus* were procured from the landing centers and fish markets. They were brought to laboratory, washed thoroughly and analysed. The specimens were identified by referring standard literature of Fischer and Bianchi (1984). The tissue was in good condition in all the fishes used. The identified fishes were cleaned and skin was removed. For the proximate analysis, muscle tissues were taken just below the dorsal fin and above the lateral line was used. The muscle tissue was weighed and the moisture content was estimated by hot air oven method (Jain and Singh, 2000).

**Estimation of moisture:** Drying is the method employed for the estimation of the moisture content of the given sample. A known quantity of the sample is taken in a weighed dish and the moisture is removed by heating in a hot air oven. Finally it is cooled in a desiccator and weighted. The difference between the weight of the sample before and after drying gives the moisture content and it is usually expressed as percentage (%) of the weight of the sample.

**Estimation of carbohydrate:** The total carbohydrate content of the fish was estimated by using Anthrone reagent (Travelyan and Harrison, 1952).

**Estimation of protein:** The total protein content of the fish was estimated by following the method of Lowry *et al*. (1951).

**Estimation of lipid:** The total lipid content of the fish was estimated by following the method of Bligh and Dyer (1959).

**Fatty acid analysis:** Fatty acid profiles of the fish sample were determined by following the standard procedures. Extraction was then performed with a (2:1) chloroform/methanol mixture in a soxhlet device. After extraction, fats were completely dried with a rotary evaporator, reconstituted with 15 mL of solvent and washed with 3 mL of 0.1 M KCl. The aqueous layer was re-extracted

with solvent. Emulsions were then broken down by centrifugation and the extracts were dried with Sodium sulphate. After rotary evaporation, 4 mL of 0.5 M sodium hydroxide in methanol were added per 100 mg of lipid. To hydrolyze the lipid, the mixture was then refluxed until the oil disappeared. Methylation of fatty acids was conducted using a boron trifluoride/methanol reagent (14% $BF_3$ in methanol; 5 mL per 100 mg of lipid) which was added to the sample and refluxed for another 2 min. Heptane (5 mL) was added to extract the fatty acid methyl esters and heptane layer was then concentrated with nitrogen gas.

All the results were fed into the statistical analysis for comparing the mean differences and overall ratio changes in each species. Differences were graphically illustrated.

## RESULTS

**Moisture content:** The moisture content in the case of the two brackish water fishes namely *Lates calcarifer* and *Mugil cephalus* varies from 77.6 to 81.3% and the highest is found in *L. calcarifer*. In the case of two fishes collected from marine habitat namely *Rastreillger kankurta* and *Sardinella longiceps* the water content is 70.02 to 80.13% when compared to the brackish water fishes, the range of variation is slightly higher (Fig. 1). The water content in *Catla catla* and *Oreochromis mossambicus* which inhabit the fresh water ecosystem varies from 77.93 to 82.7%. The range of variation is similar to that of fishes collected from the brackish water. In general the pattern of variation agrees with the pattern commonly observed in fishes in Fig.1. It may be commented that the lowest Percentage of water was found in *Sardinella longiceps*, the value being 70.01% which may be due to high lipid content of the fish.

**Carbohydrate:** The highest amount of carbohydrate was found in *L. calcarifer*, the value being 20.8% where as in *M. cephalus* the carbohydrate content was 18.3% only. A similar picture was obtained in the case of marine fishes namely *R.kanakurta* and *S. longiceps*. The value ranged from 18.1 to 18.36% shown in Fig. 2. It may be pointed out in the case of carbohydrates; it did not show

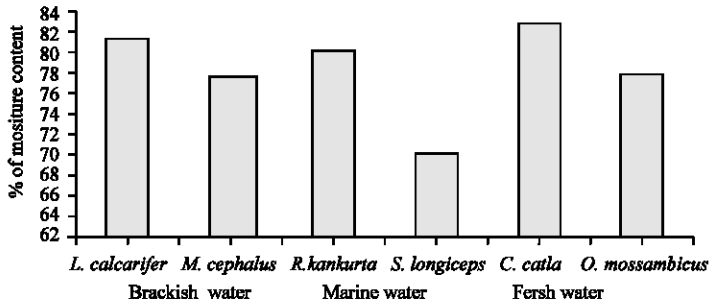


Fig. 1: Variation in moisture content of fishes

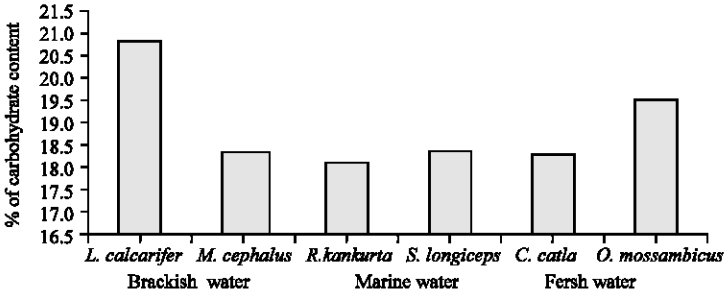


Fig. 2: Variation in carbohydrate content of fishes

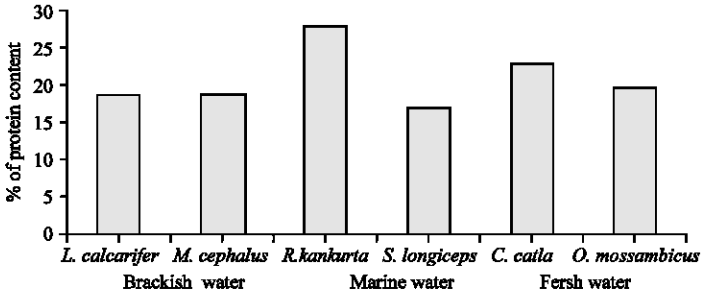


Fig. 3: Variation in protein content of fishes

any inverse relationships with lipid content. It is slightly that *S. longiceps* being a pelagic fish may have to survive constantly either to avoid predation or move fast in search of feed. These muscular activities need chemical energy which is stored in the form of muscle glycogen.

**Protein:** Analysis of protein were carried out in the total number of six fishes inhabiting three ecosystems namely brackish, fresh and marine water eco system. However, in the case of marine fishes the protein content showed much fluctuation. It ranged from 17.04 to 28.01%. In the case of *S. longiceps*, the protein content is the lowest (17.04%). Similar relationship was also observed between moisture and lipid content. The two fishes inhabiting fresh water eco system, the protein content varied from 19.72 to 22.84%. The range of variations is in between the values observed for the other fishes inhabiting the other two habitats (Fig. 3).

**Lipids:** The lowest level of 0.45% may indicate that the collected fishes may be in the non reproductive stage on young juveniles. Usually the lipid content of fishes increase before reproductive season or during the time of reproduction where much lipid is stored in the eggs for serving as a food for the growing fish. Presence of oil in the egg may aid buoyancy and retain the fish eggs with pelagic zone. The lipid profile of marine fishes was different in that the lipid content was higher in the case of *S. longiceps*, the value being 8.45%. In the case of *R. kanakurta*, the lipid content was moderate, the value being 0.65%. Presence of lipids in *S. longiceps* is the highest level justifies it being called oil *S. longiceps*. The importance of fish oil will be discussed in a different section. The pattern of variation in lipid content of fresh water fishes resembles as that of brackish water fishes. *C.catla* exhibited lipid content of 1.2% where as in *O. mossambicus* the lowest value of 0.45% was observed in Fig. 4.

**Fatty acid composition:** The composition of fatty acids in the selected fishes was studied using a gas chromatography. The results for brackish water were given in Table 1 and for marine fishes in Table 2 and for fresh water fishes in Table 3. It may be seen a total number of 37 fatty acids were found in total. C16: 0 Palmitic acid was shown and recorded the highest percentage of 35.0394 in *M. cephalus* and 39.414 in *L. calcarifer*. C22:0 (Behemic acid) was not observed in case of *L. calcarifer and M. cephalus* and c20:4n6 was not present in *L. calcarifer* and C22:6n3 was not observed in the case of *M. cephalus*.

The total number of fatty acids that are not present varied among the six species of fishes. The lowest number was one as in the case of *S.longiceps and R. kanakurta* and the maximum of four were found in the case of *O. mossambicus*. In the case of marine fishes taken for study, C18:0

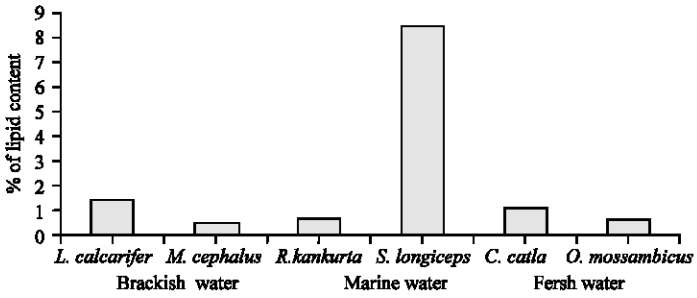


Fig. 4: Variation in lipid content of fishes

Table 1: Proximate composition of fatty acids in the muscle tissue of edible fin fishes

| Fatty acids | Name | *Lates calcarifer* | *Mugil cephalus* |
|---|---|---|---|
| C4:0 | Butyric acid | 0.6569 | 0.0314 |
| C6:0 | Caproic acid | 0.0989 | 0.0181 |
| C8:0 | Caprylic acid | 0.2793 | 0.0132 |
| C10:0 | Capric acid | 0.3374 | 0.0532 |
| C11:0 | Undecanoic acid | 0.0487 | 0.0776 |
| C12:0 | Lauric acid | 0.4272 | 0.3913 |
| C13:0 | Tridecanoic acid | 0.0642 | 0.041 |
| C14:0 | Myristic acid | 3.7741 | 13.3055 |
| C14:1 | Myristoleic acid | 0.2174 | 0.1672 |
| C15:0 | Pentadecanoic acid | 1.4501 | 0.8928 |
| C15:1 | Cis-10-Pentadecanoic acid | 0.1765 | 0.0679 |
| C16:0 | Palmitic acid | 39.4147 | 35.0394 |
| C16:1 | Palmitoleic acid | 8.8363 | 14.7123 |
| C17:0 | Heptadecanoic acid | 1.6126 | 1.4352 |
| C17:1 | Cis-10-heptadecanoic acid | 1.1332 | 0.1527 |
| C18:0 | Stearic acid | 13.6838 | 7.9002 |
| C18:1n9t | Elaidic acid | 12.9591 | 3.1209 |
| C18:1n9c | Oleic acid | 2.7633 | 0.8244 |
| C18:2n6t | Linolelaidic acid | 0.0267 | 0.352 |
| C18:2n6c | Linoleic acid | 0.2707 | 1.0756 |
| C20:0 | Arachidic acid | 1.1555 | 0.8587 |
| C18:3n6 | Linolenic acid | 0.5804 | 0.4629 |
| C20:1 | Cis-11-eicosenoic acid | 0.859 | 0.1447 |
| C18:3n3 | Linolenic acid | 0.1718 | 0.5777 |
| C21:0 | Heneicosanoic acid | 0.2696 | 0.326 |
| C20:2 | Cis-11, 14-eicosadienoic acid | 2.1903 | 2.0454 |
| C22:0 | Behenic acid | ---- | ---- |
| C20:3n6 | Cis-8,11,14-eicosatrienoic acid | 0.316 | 1.2646 |
| C22:1n9 | Erucic acid | 1.4826 | 8.1955 |
| C20:3n3 | Cis-11,14,17-eicosatrienoic acid | 0.6591 | 0.3304 |
| C20:4n6 | Arachidonic acid | ---- | 0.2816 |
| C23:0 | Tricosanoic acid | 1.0124 | 1.6114 |
| C22:2 | Cis-13,16-docosadienoic acid | 0.4357 | 1.4328 |
| C24:0 | Lignoceric acid | 1.9495 | 2.278 |
| C20:5n3 | Cis-5,8,11,14,17-eicosapentaenoic acid | 0.189 | 0.1759 |
| C24:1 | Nervonic acid | 0.2584 | 0.3425 |
| C22:6n3 | Cis-4,710,13,16,19-docosahexaenoic acid | 0.2134 | ---- |

(Stearic acid) shows 18.4589 percentages and C16:0 (Palmitic acid) shows 30.9229 percentages in *R. kanakurta and* in *S. longiceps* C14:0 (Myristic acid) was recorded the highest-24.2919 percent (Table 2).

In both *C. catla* and *O. mossambicus*, there were 37 numbers of fatty acids with less than five units. It was observed in Table 3, C22:6n3 (Docosahexaenoic acid) has recorded the highest percentage of 55.723 in the case of *O. mossambicus* and about four C13:0 (Tridecanoic acid), C16:1 (Palmitoleic acid), C18:2n6t (Linolelaidic acid), C22:0 (BehenicAcid) were absent in the same fresh

Table 2: Proximate compositions of fatty acids in the muscle tissue of edible fin fishes (Marine water)

| Fatty acids | Name | *Sardinella longiceps* | *Rastreillger kanakurta* |
|---|---|---|---|
| C4:0 | Butyric acid | 0.0018 | 0.1711 |
| C6:0 | Caproic acid | 0.0079 | 0.0757 |
| C8:0 | Caprylic acid | 0.0044 | 0.411 |
| C10:0 | Capric acid | 0.0147 | 0.224 |
| C11:0 | Undecanoic acid | 0.0132 | 0.4061 |
| C12:0 | Lauric acid | 0.5698 | 1.0778 |
| C13:0 | Tridecanoic acid | 0.08 | 0.0772 |
| C14:0 | Myristic acid | 24.2919 | 3.0689 |
| C14:1 | Myristoleic acid | 0.0473 | 0.0992 |
| C15:0 | Pentadecanoic acid | 1.4285 | 0.9614 |
| C15:1 | Cis-10-pentadecenoic acid | 0.031 | 0.1867 |
| C16:0 | Palmitic acid | 0.0013 | 30.9229 |
| C16:1 | Palmitoleic acid | 17.2926 | 2.9357 |
| C17:0 | Heptadecanoic acid | 2.1578 | 1.7651 |
| C17:1 | Cis-10-heptadecanoic acid | 0.1129 | 0.2475 |
| C18:0 | Stearic acid | 0.6503 | 18.4589 |
| C18:1n9t | Elaidic acid | 7.4248 | 5.1043 |
| C18:1n9c | Oleic acid | 4.9431 | 0.8255 |
| C18:2n6t | Linolelaidic acid | 1.6654 | ---- |
| C18:2n6c | Linoleic acid | 0.3872 | 1.5854 |
| C20:0 | Arachidic acid | 1.879 | 0.4082 |
| C18:3n6 | Linolenic acid | 0.7193 | 0.6236 |
| C20:1 | Cis-11-eicosenoic acid | 0.435 | 0.4354 |
| C18:3n3 | Linolenic acid | 0.9366 | 0.6269 |
| C21:0 | Heneicosanoic acid | 0.4994 | 0.3443 |
| C20:2 | Cis-11,14-eicocadienoic acid | ---- | 3.3655 |
| C22:0 | Behenic acid | 4.2039 | 0.3467 |
| C20:3n6 | Cis-8,11,14-eicosatrienoic acid | 0.5006 | 2.4142 |
| C22:1n9 | Erucic acid | 16.7126 | 0.1479 |
| C20:3n3 | Cis-11,14,17-eicosatrienoic acid | 0.5262 | 0.4568 |
| C20:4n6 | Arachidonic acid | 0.15 | 0.07 |
| C23:0 | Tricosanoic acid | 3.1398 | 3.6966 |
| C22:2 | Cis-13,16-docosadienoic acid | 0.1423 | 3.723 |
| C24:0 | Lignoceric acid | 1.8627 | 8.5063 |
| C20:5n3 | Cis-5,8,11,14,17-eicosapentaenoic acid | 6.5397 | 1.1169 |
| C24:1 | Nervonic acid | 0.5012 | 3.9207 |
| C22:6n3 | Cis-4,710,13,16,19-docosahexaenoic acid | 0.1256 | 1.1922 |

Table 3: Proximate compositions of fatty acids in the muscle tissue of edible fin.fishes (Fresh water)

| Fatty acids | Name | *Catla catla* | *Oreochromis mossambicus* |
|---|---|---|---|
| C4:0 | Butyric acid | 0.6569 | 0.0314 |
| C6:0 | Caproic acid | 0.0989 | 0.0181 |
| C8:0 | Caprylic acid | 0.2793 | 0.0132 |
| C10:0 | Capric acid | 0.3374 | 0.0532 |
| C11:0 | Undecanoic acid | 0.0487 | 0.0776 |
| C12:0 | Lauric acid | 0.4272 | 0.3913 |
| C13:0 | Tridecanoic acid | 0.0642 | 0.041 |
| C14:0 | Myristic acid | 3.7741 | 13.3055 |
| C14:1 | Myristoleic acid | 0.2174 | 0.1672 |
| C15:0 | Pentadecanoic acid | 1.4501 | 0.8928 |
| C15:1 | Cis-10-pentadecenoic acid | 0.1765 | 0.0679 |
| C16:0 | Palmitic acid | 39.4147 | 35.0394 |
| C16:1 | Palmitoleic acid | 8.8363 | 14.7123 |
| C17:0 | Heptadecanoic acid | 1.6126 | 1.4352 |
| C17:1 | Cis-10-heptadecanoic acid | 1.1332 | 0.1527 |
| C18:0 | Stearic acid | 13.6838 | 7.9002 |
| C18:1n9t | Elaidic acid | 12.9591 | 3.1209 |
| C18:1n9c | Oleic acid | 2.7633 | 0.8244 |
| C18:2n6t | Linolelaidic acid | 0.0267 | 0.352 |
| C18:2n6c | Linoleic acid | 0.2707 | 1.0756 |
| C20:0 | Arachidic acid | 1.1555 | 0.8587 |
| C18:3n6 | Linolenic acid | 0.5804 | 0.4629 |
| C20:1 | Cis-11-eicosenoic acid | 0.859 | 0.1447 |
| C18:3n3 | Linolenic acid | 0.1718 | 0.5777 |
| C21:0 | Heneicosanoic acid | 0.2696 | 0.326 |
| C20:2 | Cis-11,14-eicocadienoic acid | 2.1903 | 2.0454 |
| C22:0 | Behenic acid | ---- | ---- |
| C20:3n6 | Cis-8,11,14-eicosatrienoic acid | 0.316 | 1.2646 |
| C22:1n9 | Erucic acid | 1.4826 | 8.1955 |
| C20:3n3 | Cis-11,14,17-eicosatrienoic acid | 0.6591 | 0.3304 |
| C20:4n6 | Arachidonic acid | ---- | 0.2816 |
| C23:0 | Tricosanoic acid | 1.0124 | 1.6114 |
| C22:2 | Cis-13,16-docosadienoic acid | 0.4357 | 1.4328 |
| C24:0 | Lignoceric acid | 1.9495 | 2.278 |
| C20:5n3 | Cis-5,8,11,14,17-eicosapentaenoic acid | 0.189 | 0.1759 |
| C24:1 | Nervonic acid | 0.2584 | 0.3425 |
| C22:6n3 | Cis-4,710,13,16,19-docosahexaenoic acid | 0.2134 | ---- |

water species. In *C.catla*, C16:0 (Palmitic Acid) has recorded the highest percentage of about 35.1811. The C22:0 (BehenicAcid) and C20:5n3 (-Eicosapentaenoic Acid) were absent in the same fresh water species.

## DISCUSSION

The chemical composition of the different fish species will show variation depending on seasonal variation, migratory behavior, sexual maturation, feeding cycles, etc. These factors are observed in wild, free-living fishes in the open sea and inland waters. Fish raised in aquaculture may also show variation in chemical composition but in this case several factors are controlled, thus the

chemical composition may be predicted. To a certain extent the fish farmer is able to design the composition of the fish by selecting the farming conditions. It has been reported that factors such as feed composition, environment, fish size and genetic traits all have an impact on the composition and quality of the aqua cultured fish (Reinitz *et al*., 1979). Basal insulin concentrations were unaltered by fish oil without or with glyburide; however, postprandial insulin concentrations were decreased by fish oil (Zambon *et al*., 1992). Kasim (1993) showed that among diabetics, initial studies showed deterioration of glucose tolerance with fish oil consumption.

Investigations focused on the influence of FA composition on reproduction characteristics of fish addressing mainly egg and larval quality and their survival characteristics (Vazquez *et al*., 1994). A concise review of studies on the prevention of thrombosis in laboratory animals and in humans emphasized the important role of n-3 PUFA which affects cellular responses in platelets, monocytes and endothelial cells (Nordoy, 1994).

Proximate composition of fish have been investigated less than those of warm blooded animals and hence the present study was started as an attempt to calculate the total caloric contents of the major commercial food fishes. The moisture content in the case of the two brackish water fishes namely *Lates calcarifer* and *Mugil cephalus* varies from 77.6 to 81.3% and the highest is found in *Lates calcarifer*. In the case of two fishes collected from marine habitat namely *Rastreillger kanakurta* and *Sardinella longiceps* the water content is 70.02 to 80.13% when compared to the brackish water fishes, the range of variation is slightly higher. The moisture content of sardines in natural was 74.27 g/100 g, decreasing during the preservation period in all treatments, reaching 52 g 100 $g^{-1}$. The chemical constituents of Ghanaian fermented fish condiment obtained from retail outlets were moisture content 50 g/100 g, protein value 16.80-21.90 g/100 g and $pH^3$ 6.0 (Sanni *et al*., 2002).

Analysis of protein were carried out in the total number of six fishes inhabiting three ecosystems namely brackish, fresh and marine water eco system. However, in the case of marine fishes the protein content showed much fluctuation. The percentage of proteins in fishes is drastically higher than that of milk and cheese which is carried out by Omotosho *et al*. (2011) and as well as higher than poultry feed with protein content of 11.34% (Prabakaran and Dhanapal, 2009). This behaviour could be explained taking into account that, during the depletion period, once the lipid reserves are spent in severe depletion situations, the fish could survive at the expense of muscle protein (Yeannes and Almandos, 2003). It's interesting to know that the carbohydrate content did not vary much either between two habitats or among the six fishes. The highest amount of carbohydrate was found in *L. calcarifer*. A similar picture was obtained in the case of marine fishes namely *R.kanakurta* and *S. longiceps*.

It may be seen that 37 fatty acids have been found in the different species taken from the three different habitats namely brackish water, fresh water and marine water. In the case of marine fishes, the fatty acid C22:0 (BehenicAcid) was present but it was not observed in the other two habitats namely brackish and marine habitat. Such a pattern clearly shows that habitat has an impact on the biochemical composition of fishes especially fatty acids. C16:0 (Palmitic Acid) was the major component fatty acids in all the species analyzed and it was one of the predominant saturated acids in all the species examined. Fish having energy depots in the form of lipids will rely on this. Species performing long migrations before they reach specific spawning grounds or rivers may utilize protein in addition to lipids for energy, thus depleting both the lipid and protein reserves, resulting in a general reduction of the biological condition of the fish. In human nutrition fatty acids such as linoleic and linolenic acid are regarded as essential since they cannot be

synthesized by the organism. In marine fish, these fatty acids constitute only around 2% of the total lipids which is a small percentage compared with many vegetable oils. However, fish oils contain other polyunsaturated fatty acids which are essential to prevent skin diseases in the same way as linoleic and arachidonic acid. As members of the linolenic acid family (first double bond in the third position, w-3 counted from the terminal methyl group), they will also have neurological benefits in growing children. One of these fatty acids, eicosapentaenoic acid (C20:5 w 3), has recently attracted considerable attention because Danish scientists have found this acid high in the diet of a group of Greenland Eskimos virtually free from arteriosclerosis. Investigations in the United Kingdom and elsewhere have documented that eicosapentaenoic acid in the blood is an extremely potent antithrombotic factor (Simopoulos, 1991).

Even though the fat content is comparatively lesser than the meat value 16.7% (Quasem *et al*., 2009) the DHA and PUFA value is some what higher in fishes in the present finding. In fatty fish, lipid amounts depend largely on the time of their capture around the year and are localized under the skin, around the intestines or in the white muscle. The oil content varies also from species to species. In fat fish, it can reach up to 21% (herring) and 18% (sardines). Researchers have suggested that ovarian development and normal maturation of bloodstock are related to the lipid nutritional status in several shrimp species (Ravichandran *et al*., 2009). Some tropical fish also show a marked seasonal variation in chemical composition. West African shad (*Ethmalosa dorsalis*) shows a range in fat content of 2-7% (wet weight) over the year with a maximum in July (Watts, 1957). Corvina (*Micropogon furnieri*) and pescada-foguete (*Marodon ancylodon*) captured off the Brazilian coast had a fat content range of 0.2-8.7 and 0.1-5.4%, respectively (Ito and Watanabe, 1968). It has also been observed that the oil content of these species varies with size, larger fish containing about 1% more oil than smaller ones. Several marine fish species are rich in n-3 Polyunsaturated Fatty Acids (PUFA) such as Eicosapentaenoic Acid (EPA) or Docosahexaenoic Acid (DHA). This is attributed to the hpid composition of plankton. There is strong evidence suggesting that consumption of fish containing high levels of these fatty acids is favorable for human health and has a particularly beneficial effect in preventing cardiovascular diseases. As based on this broad review it is clearly understood that present finding is similar and correlated with the previous research findings.

However, freshwater fish species can also serve as a valuable source of essential fatty acids. Compared with marine fish species, freshwater fish contain, in general, higher levels of CIS PUFA but also substantial concentrations of EPA and DHA. Moreover, as Harris (1996) has noted, the potential for benefit remains high, since dietary fish oils affect a myriad of potentially atherogenic processes In addition, the fatty acid composition of freshwater fish species is characterized by high proportions of n-6 PUFA, especially linoleic acid and arachidonic acid. Therefore, the ratio of total n-3 to n-6 fatty acids is much lower for freshwater fish than for marine fish, ranging from 1 to about 4. However, keeping freshwater fishes on diets containing higher amounts of fish oil results in marketable fish with substantial levels of n-3 PUFA.

## CONCLUSION

In the current finding it is concluded that marine fishes are the good source of PUFA's and DHA and as well as proteins than the other two habitats. It is well understood from the current investigation that each habitat group of fishes has its own nutritional value parameters with sense to their different food preferences. The nutritional parameters are attributed to the diet which they consume and their ecological conditions.

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