ISSN 0975-6299 Vol 3/Issue 2/April – June 2012

International Journal of Pharma and Bio Sciences

RESEARCH ARTICLE BIOTECHNOLOGY

ASSESSMENT OF PROXIMATE AND MINERAL COMPOSITION OF TWENTY EDIBLE FISHES OF PARANGIPETTAI COASTAL WATERS

G.MARICHAMY*, M.A.BADHUL HAQ, R.VIGNESH, V.SEDHURAMAN AND A.R.NAZAR

Centre of Advanced Study in Marine Biology, Faculty of Marine Sciences, Annamalai University Parangipettai 608 502, Tamil Nadu, India

G.MARICHAMY
Centre of Advanced Study in Marine Biology, Faculty of Marine Sciences, Annamalai University Parangipettai 608 502,Tamil Nadu, India

ABSTRACT

The measurement of some proximate profiles such as protein contents, lipids and moisture contents in fish by products is often necessary to ensure that they meet the requirements of food regulations in nutrition aspects and commercial specifications. Minerals are essential nutrients, they are components of many enzymes and metabolism, and contribute also to the growth of the fish. The human body usually contains small amount of these minerals and the deficiency in these principal nutritional elements induces a lot of malfunctioning; as it reduces productivity and causes diseases. Fish received increased attention as a potential source of animal protein and essential nutrients for human. It should be considered that fish tissue presents elevated nutritional significance and therefore is a particularly optional dietary module. The objective of this work was to analyze the proximate and mineral composition of twenty edible fishes of parangipettai coast.

KEYWORDS

Proximate, nutrition, minerals, diet, edible

INTRODUCTION

Fish received increased attention as a potential source of animal protein and essential nutrients for human diets [1-4]. Fish meat contains significantly low lipids and higher water content than beef or chicken and is favored over other white or red meats [5, 6]. The nutritional value of fish meat comprises the contents of moisture, dry matter, protein, lipids, vitamins and minerals plus the caloric value of the fish [7-9]. Minerals are essential nutrients, components of many enzymes and metabolism, and contribute also to the growth of the fish [10]. The human body usually contains small amount of these minerals and the deficiency in these principal nutritional elements induces a lot of malfunctioning; as it reduces productivity and causes diseases[11]. Besides being used as food, fish is also increasingly demanded for use as feed. However, information concerning the chemical composition of freshwater fishes in general is valuable to nutritionists concerned with readily available sources of low-fat, high-protein foods such as most freshwater fishes [12-14]. Changes in fatty acid and amino acid concentrations were found to be useful as an index of freshness and decomposition of marinated fish in storage [15]. Likewise, different cooking methods affect the quality of fish meat [16]. Moreover, the measurement of some proximate profiles such as protein contents, lipids and moisture contents is often necessary to ensure that they meet the requirements of food regulations and commercial specifications [17].

Protein from fish tissue is characterized by a desirable amino acid composition. The tissue is also rich in vitamins A, D and the B group. In addition, fishes are a good source of micro and macro-elements such as calcium, phosphorus, selenium and manganese [18]. Muscle [19, 20] and waste of fish, such as the head are the key sources of very-long-chain (number of carbons ≥20) polyunsaturated fatty acids (n-3 VLC-PUFAs), which have beneficial and even therapeutic effects on human health [21-24]. Eicosapentaenoic (EPA, 20:5n-6) and docosahexaenoic (DHA, 22:6n-3) fatty acids have been the subject of innumerable studies in the past few decades, being important for their various benefits to human health, including lowering the risk of cardiovascular diseases [24-26], anti-inflammatory and antithrombotic effects [27], reduction of blood cholesterol levels and cancer prevention [28].

MATERIALS AND METHODS

Collection of sample

Twenty Specimens were collected by using gill net and some are by hand picking. After samples were identified using FAO sheet and field manuals, physical measurements were made for all the specimens. Samples were handled with cleaned stainless steel equipments. All samples were stored frozen until analysis. Only muscle tissue was analyzed for the determination of proximate composition, fatty acids and minerals. The edible portions of all fishes were calculated. The list of species used is listed in table 1.

Table 1
List of Marine fishes utilized in the study

Sl. No	Fish name	Sl. No	Fish name
1	*Congresox talabon*	11	*Hilsa ilisha*
2	*Arius dussumieri*	12	*Elutherenema tetradactylum*
3	*Dussumieria acuta*	13	*Sphyraena obtusa*
4	*Opisthopterus tardoore*	14	*Siganus javus*
5	*Scomberoides commersonianus*	15	*Carangoides malabaricus*
6	*Megalapsis cardyla*	16	*Rastrilliger kanagurta*
7	*Carangoides chrysophrys*	17	*Uppenus sulphureus*
8	*Caranx para*	18	*Liza partia*
9	*Secutor insidiator*	19	*Ihisha melastoma*
10	*Sardinella longiceps*	20	*Johinus borneersis*

Total Protein
The Folin-Ciocalten Phenol method of Lowery *et al.,* [29] was used for the determination of the total protein in the tissue.

Lipids
The lipid content was estimated by the procedure given by Folch *et al.,* [30].

Carbohydrates
The total carbohydrate was estimated by Phenol- Sulphuric acid method described by Dubois *et al* [31].

Water content
The total amount of water content in the fish was estimated by drying a known mass of fish muscle in a hot air oven at 70°C for 24hrs. The difference in weight before and after drying is the amount of moisture present and the result are represented in percentage of wet weight of the muscle.

Ash
The ash content was estimated by burning oven-dried sample in a muffle furnace at 550c by AOAC [32].

Trace metals
The analysis of trace metals was carried out using the method suggested by Alasalvar *et al*., [33].

.

RESULTS AND DISCUSSION

Proximate composition
In this present study we investigated the length-weight relationship and edible portion of the 20 different marine edible fishes. The proximate compositions from edible tissues were determined and the results were tabulated. Table 2 gives the data on length-weight relationship and edible portion of the 20 different fishes. Data on moisture, protein, fat and ash content expressed as percentage (%) composition per 100% of edible portion, of the twenty raw fish species are presented in Table 3(a & b). Wide variation in moisture content between species was observed in fishes ranging from 60-79%/100%. The moisture content of marine fish averaged 74%. The maximum water content was observed in *Secutor incidiator* while minimum was observed in *Scomberoides commersonianus* and it had significantly lower water content than the other fish species

Table: 2
Percentage composition of edible portions in fishes

Sl. No	Fish name	Length in cm	Weight in gm	Edible portion in gm	% of Edible portion
1	*Congresox talabon*	72.5	613	323.4	52.75
2	*Arius dussumieri*	20.8	126	82	65
3	*Dussumieria acuta*	18.1	98.9	54.3	54.9
4	*Opisthopterus tardoore*	19.1	134	75.1	56
5	*Scomberoides commersonianus*	28.5	142.9	80.4	56.2
6	*Megalapsis cardyla*	24.2	102	67.9	66.5
7	*Carangoides chrysophrys*	20.3	98.3	51.6	52.4
8	*Caranx para*	13.8	64.7	32.5	50.2
9	*Secutor insidiator*	10.3	26.8	8	29.85
10	*Sardinella longiceps*	18.2	60.32	34.7	57.5
11	*Hilsa ilisha*	19.9	76.98	40	51.9
12	*Elutherenema tetradactylum*	22	90.70	51.2	56.4
13	*Sphyraena obtusa*	28	127.20	62	48.7
14	*Siganus javus*	14	41.10	15.3	37.2
15	*Carangoides malabaricus*	13.6	19.10	8.2	42.9
16	*Rastrilliger kanagurta*	20.1	91.42	63.1	69
17	*Uppenus sulphureus*	16	58.72	36.9	62.8
18	*Liza partia*	19.4	69.22	33.3	48.1
19	*Ihisha melastoma*	18.1	56.60	37.1	65.5
20	*Johinus borneersis*	19.8	92.64	56.9	61.4

Table: 3 *(a)*
Percentage Proximate Compositions of 20 Different Marine Fishes

	1	2	3	4	5	6	7	8	9	10
Edible portion	52.75	65	54.9	56	56.2	66.5	52.4	50.2	29.85	57.5
Protein	34.54	41.08	56.46	48.55	38.74	34.32	40.26	38.27	43.98	26.37
Lipids	16.2	19.52	8.9	5.42	18	9.525	16.275	11.325	20.975	20.1
Carbohydrate	5.83	6	5.9	3.2	4.1	3.38	2.87	1.64	5.8	6.41
Water	78.13	70.82	69.82	78.88	60.63	61.31	78.17	78.63	79.64	69.13
Ash	1.7	0.91	1.125	0.31	0.87	0.56	0.01	0.761	0.143	0.943

Table: 3 (b)
Percentage Proximate Compositions of 20 Different Marine Fishes

	11	12	13	14	15	16	17	18	19	20
Edible portion	51.9	56.4	48.7	37.2	42.9	69	62.8	48.1	65.5	61.4
Protein	37.17	46	57.61	40.98	35.8	48.3	37.94	36.57	42.29	41.02
Lipids	12.72	1.275	0.525	1.1775	1.17	6.825	16.15	8.75	18.47	8.05
Carbohydrate	4.51	2.09	6.44	4.42	5.41	3.8	6.7	5.35	2.24	3.74
Water	72.9	78.13	77	76.6	75.82	76.36	74.46	73.86	69.32	78.79
Ash	1.25	0.56	1.6	0.953	0.359	0.781	0.5	0.439	0.857	0.5

In this study the moisture and crude ash content of these fish species ranging from 60.63-79.64% and 0.01-1.7% respectively. Protein content of *Dussumieria acuta* and *Sphyraena obtusa* was the highest (57%) among all species, followed by *Opisthopterus tardoore* and *Rastrilliger kanagurta* (48%) and the others. The maximum value of protein content (dry weight) was observed in (26%) in *Sardinella longiceps* wide variation in protein content between species was observed in marine fishes ranging from 26-57%. However, the carbohydrate content was found maximum in *Sphyraena obtuse* (6.44%) and less in *Caranx para* (1.64%). There was variation in the lipid content of 20 different fishes as indicated in table 2. The lowest percentage of lipids were obtained in *Sphyraena obtuse*, (0.52%), *Siganus javus* (1.17%), *Elutherenema tetradactylum* (1.27%) and *Carangoidus malabaricus* (1.17%) while the highest lipid content was obtained in *Secutor incidiator* (20.97%), *Sardinella longiceps* (20.1%) and *Arius dussumieri* (19.52%) and it was closely followed by other fish species. In conclusion the routine analysis of fish proximate composition is an important in determining the nutrient composition of fishes and better understanding of human nutrition.

Minerals

The elemental concentrations of the twenty fish species are shown in figures 1-10. The elemental concentrations of the fishes are expressed in µg/g except for Cu and Mg which are expressed in mg/g dry weight for greater accuracy. The ranges of concentrations are as follows Al (13.44-508) Fig 1 ,Cd (0.16-0.76) Fig 2, Co (0.4-0.76) Fig 3, Cr (6.6-38.52) Fig 4, Fe (61.12-11.084) Fig 5, Mn (2.84-113.68) Fig 6 , Ni (0.84-26.4) Fig 7 , Zn (1.78-115.44) Fig 8 and Cu (9.12-1389.6) Fig 9. The Mg concentration (Fig 10) is expressed as 0.001-1.42 mg/g for greater accuracy. Zn is an essential mineral for humans was present in the amount of ranging from 1.78µ/g in *Sphyraena obtuse* up to 115.44 µ/g in *Secutor* incidiator.

Figure:1
Composition of Al in fishes

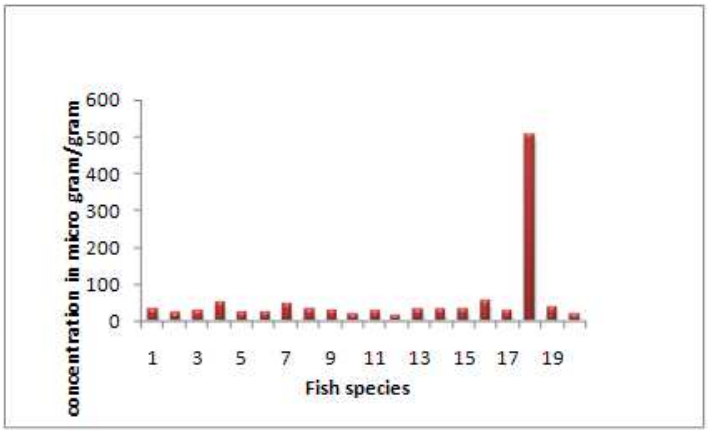


Figure:2
Composition of Cd in fishes

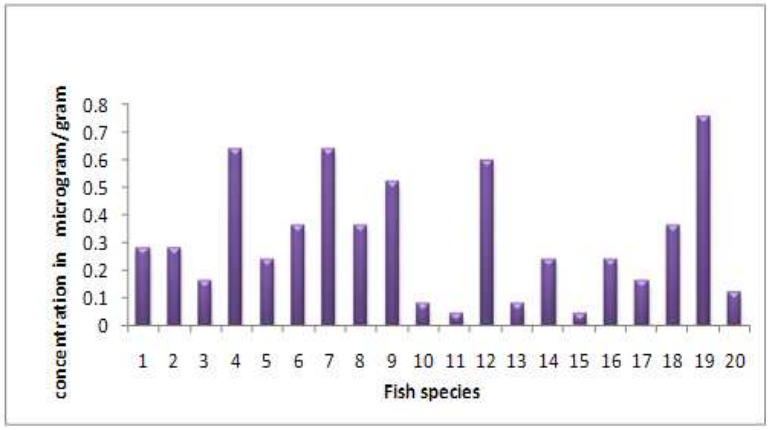


Figure:3
Composition of Co in fishes

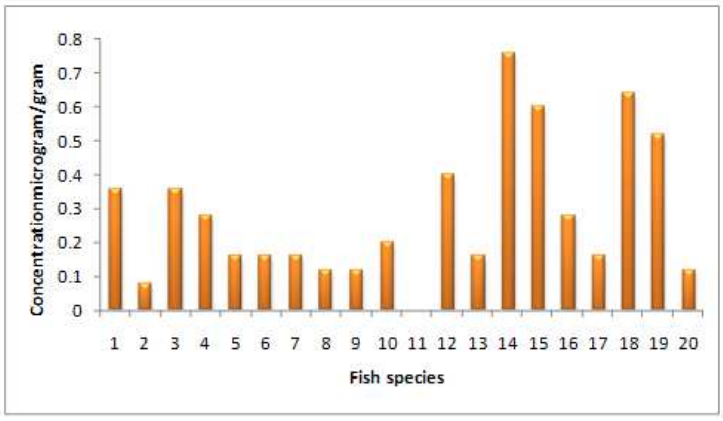


Figure:4
Composition of Cr in fishes

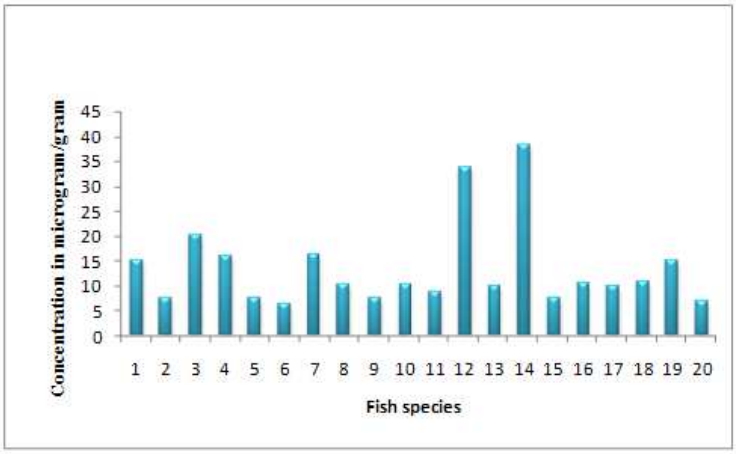


Figure:5
Composition of Fe in fishes

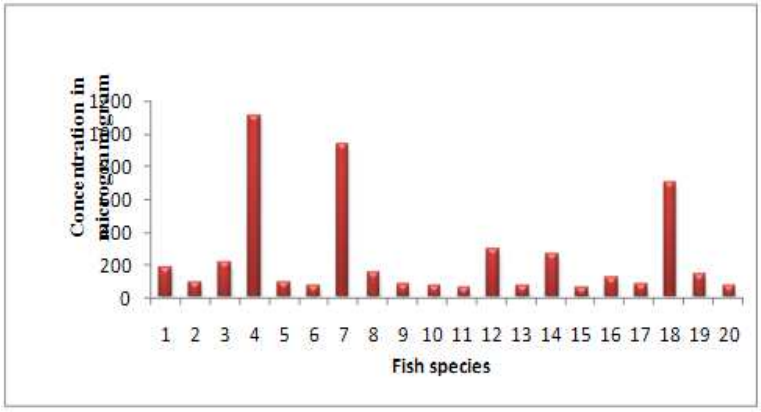


Figure:6
Composition of Mn in fishes

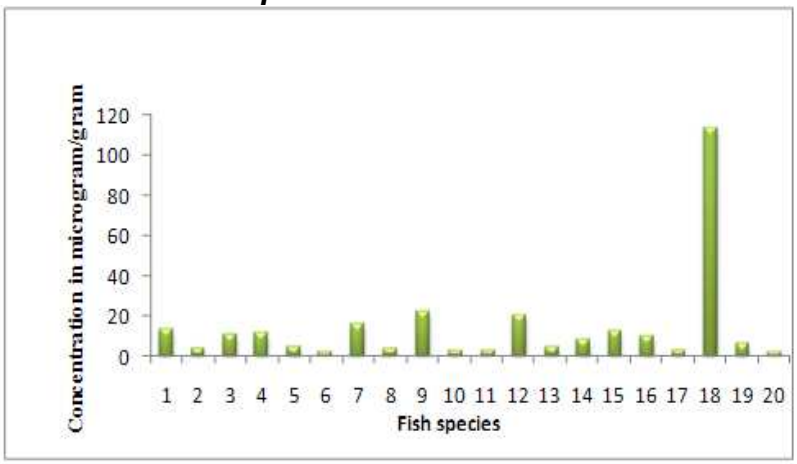


Figure:7
Composition of Ni in fishes

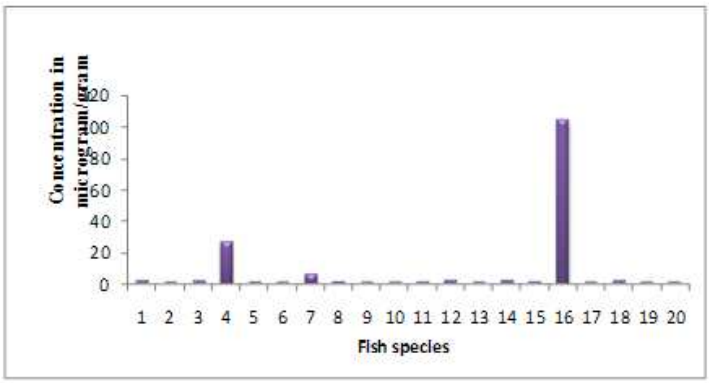


Figure:8
Composition of Zn in fishes

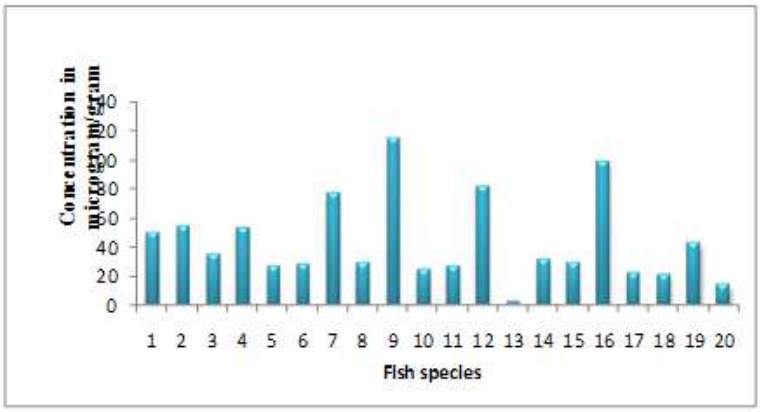


Figure:9
Composition of Cu in fishes

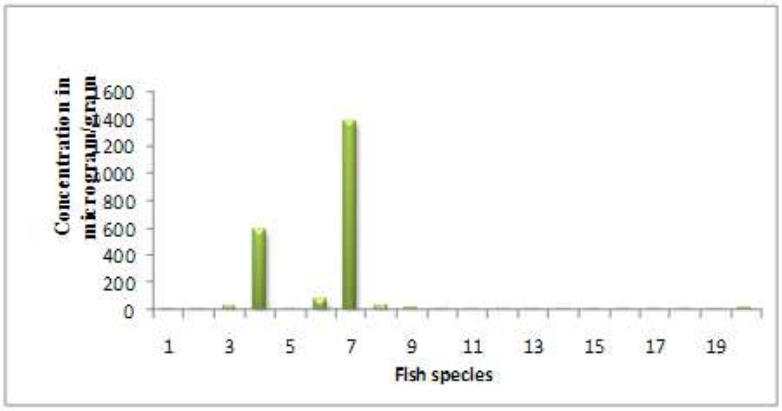
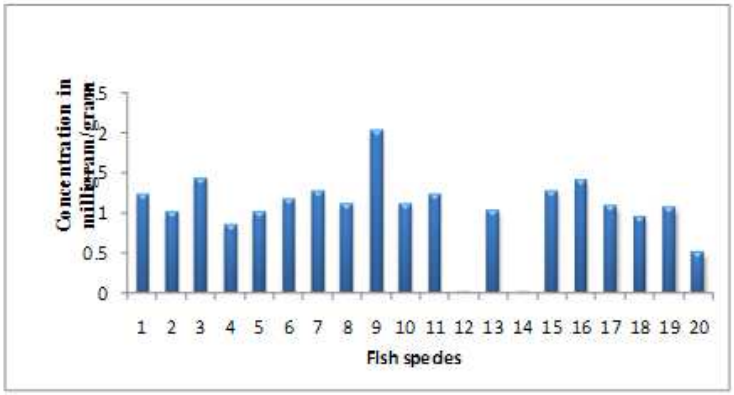


Figure:10
Composition of Mg in fishes



Among the ten nutrient elements investigated the most abundant was Mg followed by Fe and Al. Cu levels ranged from 9.12 µ/g in *Sardinella longiceps* to 1389.6 µg/g in *Carangoides chrysophrys*. Compared with other fish species *Carangoides chrysophrys* is notably higher in Cu value. Ni is ranged from less than 1µg/g in Arius dussumieri to 26.4µg/g in *Opisthopterus dardoore*. Zn is known to be involved in most metabolic pathways in plants, animals and hormones. The Al compound of the twenty different fish species of this study similar that the above results. Iron has several vital functions in the body. It serves as a carrier of oxygen to the tissues from lungs by red blood cell haemoglobin, as a transport medium for electrons, within cells and as an integrated part of important enzyme systems in various tissues. Adequate iron in the diet is very important for decreasing the incidence of Anemia, which is considered a major health problem, especially in young children. Sea foods especially darker fleshed fish, are reasonably good sources of iron, supplying 1-2mg/100g of muscle (Kinsella,1998). Iron contents of these fishes considerably higher composition in *Opisthopterus dardoore* (1.10µg/g), followed by *Carangoides chrysophrys* (9.42µg/g), *Siganus javus*(268.48µg/g), *Dussumieria acuta* (219.444µg/g) and *Ilisha melastoma* (140.52 µg/g) The Mg content was found to be higher level in all species more than 1µg/g. The Mn content of these fishes were found to be the range of 2.25 – 113.68 µg/g. Relatively very low levels of Cd and Co were observed in the tissues of tested fish samples Cd and Co concentration were observed in the tissues of tested fish samples Cd and Co concentrations were observed less than 1 µg/g. Among these Cd and Co concentrations, most of the fishes had below detectable limit values. The concentration of Cd in the tissues varied from 0.16 – 0.76 µg/g and the concentration of Co varied from 0.36 – 0.76 µg/g. Chromium concentrations of all these fishes analyzed ranged from 6.6 µg/g – 38.52µg/g. Cobalt is beneficial for human because it is part of Vitamin B12. The cobalt concentrations in these fishes were ranged from 0.0 – 0.76 µg/g. Both the Co and Cr values are not effective for human bodies and it is favorable to the human nutrients.

CONCLUSION

Consumption of fishes and other marine products has always been a major factor in the economy and nutrition of the coastal inhabitants. India with its immense coastal line has tremendous potential in terms of marine food capital. Fishes are a potential source of minerals such as potassium, phosphorus, iron, sodium,

magnesium, iodine and calcium. Mineral components are very must needed for human nutrition. The trace elements like Iron, manganese and iodine which are essential for normal tissue metabolism and for maintenance of health are ample in fishes. The major source of exposure of humans to heavy metals is through food ingestion. For adequate physiological function, humans require adequate intakes of some essential elements such as sodium, calcium, potassium, magnesium, manganese, selenium, chromium (III), copper, cobalt, iron and zinc. However, humans may be exposed to harmful non essential elements such as arsenic, silver, lead mercury, cadmium and nickel mainly through drinking water consumption, fresh and processed foods and through occupational exposures. In conclusion the routine analysis of fish proximate composition is an important in determining the nutrient composition of fishes and better understanding of human nutrition.

REFERENCES

1. Kromhout D, Feskens EJ, Bowles CH., The protective effect of a small amount of fish on coronary heart disease mortality in an elderly population. Int. J. Epidemiol, 24: 340-345, (1995).
2. Zenebe T, Ahigren G, Boberg M., Fatty acid content of some freshwater fish of commercial importance from tropical lakes in the Ethiopian rift valley. J. Fish Biol, 53: 987-1005, (1998a).
3. Arts MT, Ackman RG, Holub BJ., Essential fatty acids in aquatic ecosystems: a crucial link between diet and human health and evolution. Ca. J. Fisheries Aquatic Sci, 58: 122–137, (2001).
4. Fawole OO, Ogundiran MA, Ayandiran TA, Olagunju OF., Mineral Composition in some selected fresh water fishes in Nigeria. J. Food Safety, 9: 52-55, (2007).
5. Neil JS., Fish consumption, fish oil, lipids, and coronary heart disease., Circulation, 94: 2337-2340, (1996).
6. Nestel PJN., Fish oil and cardiovascular disease: lipids and arterial function. Am. J. Clin. Nutr., 71: 228-231, (2000).
7. Evangelos SL, Aggelousis G, Alexakis A., Metal and proximate composition of the edible portion of 11 freshwater fish species. J. Food Comp. Anal., 2: 37-381, (1989).
8. Chandrashekar K, Deosthale YG., Proximate composition, amino acid, mineral, and trace element content of the edible muscle of 20 Indian fish species. J. Food Comp. Anal., 6: 195-200, (1993).
9. Steffens W Freshwater fish- wholesome food stuffs., Bulg. J. Agric. Sci., 12: 320-328, (2006).
10. Glover CN, Hogstrand C., Amino acids of in vivo intestinal zinc absorption in freshwater raibow trout. J. Exp. Biol., 205: 151-158, (2002).
11. Mills CF. the mineral nutrition of livestock. EJ Underwood, (Ed.), Common Wealth Agricultural Bureaux: 1- 9, (1980).
12. Sadiku SOE, Oladimeji AA. Relationship of proximate composition of Lates niloticus (L), synodontis schall. Res. Commun., 3: 29- 40, (1991).
13. Mozaffarian MD, Rozenn NL, Lewis HK, Gregory LB, Russell PT, Davis SS., Cardiac benefits of fish consumption may depend on type of fish meal consumed. Circulation. 107: 1372-1382, (2003).
14. Foran JA., Carpenter DO, Hamilton MC, Knuth BA, Schwager SJ Risk- based consumption advice for farmed Atlantic and wild pacific salmon contaminated with dioxins and dioxin- like compounds. Environ. Health. Persp, 33: 552-556, (2005).
15. Ozkan O., Changes in amino acid and fatty acid composition during shelf-life of marinated fish. J. Sci. Food Agric., 85: 2015-2020, (2005).

16. Prapasri P, Kunchit J, Eakkarach K, Kriengkrai V, Yupaporn N, Lalita B Proximate composition of raw and cooked Thai freshwater and marine fish. J. Food Comp. Anal, 12: 9-16, (1999).
17. Waterman JJ., Composition and Quality of Fish. Torry Research Statation. Edinburgh. Window H, Stein D, Scheldon R, Smith JR (1987). Comparison of trace metal concentrations in muscle of a benthopelagic fish Coryphaenoides armatus from the Atlantic and Pacific oceans. Deep Sea Res., 34: 213-220, (2000).
18. Kolakowska A, Kolakowski E. In: Scientific Session of the Committee for Food Technology and Chemistry, PAN, Poznán: 14-15, (2000).
19. Justin KC., The influence of feed supply time on the fatty acid profile of Nile tilapia (*Oreochromis niloticus)* fed on a diet enriched with n-3 fatty acids. Food Chem, 80:489-493, (2003).
20. Visentainer JV., Influence of diets enriched with flaxseed oil on the α-linolenic, eicosapentaenoic and docosahexaenoic fatty acid in Nile tilapia (*Oreochromis niloticus*). Food Chem, 90, (4), 557-560, (2005).
21. Ackman RG. Fish is more than a brain food. In: International Institute for Fisheries Economics and Trade Proceedings, Quebec: 115-125, (2000).
22. Garcia DJ., Omega-3 long chain PUFA nutraceuticals. Food Tech, 52, (1): 44-49, (1998).
23. Kolanowski W, Swiderski F, Berger S., Possibilities of fish oil application for food products enrichment with omega-3 PUFA. Int. J. Food Sci Nutr, 50(1):39-49, (1999).
24. Dyerberg J, BANG HO., Homeostatic function and platelet polyunsaturated fatty acids in Eskimos. Lancet, 2:433-435, (1979).
25. Firbank EC., Eicosapentaenoic acid and docosahexaenoic acid from fish oils: differential associations with lipid responses. The Journal of Nutr, 87(5): 435-445, (2002).
26. Penny M., Fish consumption, fish oil, omega-3 fatty acid and cardiovascular disease. Circulation, 106: 2747-2757, (2002).
27. Simopoulos AP., Omega-3 fatty acids in inflammation and autoimmune diseases. J Amer Coll Nutr, 21(6):495-505, (2002).
28. Lee KW, Lip GHH., The role of omega 3 fatty acid in the secondary prevention of cardiovascular disease. Int J Med, 97(7):465-480, (2003).
29. Lowry OH, Rosebrough AL, Farr and Randall R.J., Protein measurement with the folin phenol reagent. J. Biol. Chem., 193: 265-275, (1951).
30. Folch J, Lees M and Sloane Stanley GH., A Simple method for the isolation and Purification of total lipids from animal tissues. J. Biol. Chem, 226: 497-509, (1957).
31. Dubois SM, Gilles KA, Hamilton JK. Rebers PA and Smith F., Colorimetric determination of amounts of major phospholipids classes and their fatty acids composition in erythrocyte membranes using high performance liquid chromatography and gas chromatography. J. Chromatography. 598: 33-42, (1956).
32. AOAC. Association of Official Analyhcal Chemists. Official Methods of Analysis of AOAC International 15tlh .E dn. Washngton, DC, USA, (1990).
33. Alasalvar C, Taylor KDA, Zubcov E, Shahidi F and Alexis M., Differentiation of Cultured and Wild sea bass (*Dicentrarchus labrax*): Total Lipid Content, Fatty acid and Trace Mineral Composition. Food Chem, 79: 145-150, (2002).