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Proximate composition and Ω -3 fatty acid profiling of two deep sea fish species collected from Indian coasts

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Abstract
Worldwide attention in the utilization of deep-sea fishes for human consumption has increased considerably in recent years because of its economic impact on production of food and feed formulations. The rationale of the current study was to examine the biochemical composition of two deep-sea fishes (*Lophius piscatorius* and *Kathetostoma averruncus*) available in Indian EEZ with respect to the concentrations of protein, lipids, and ω-3 fatty acids, which are essentially required for human healthcare. The results presented in this study demonstrated that deep-sea fishes of Indian EEZ with increased levels of macro and micronutrients of human healthcare and, therefore, may represent a potential resource for commercial food industrial applications. The fish species and their nutritional status, especially fatty acid composition are explicated here. The study shows that *L. piscatorius* contained 73.83±0.25% moisture which was comparable to that of *K. averruncus* (76.75±0.61%); the crude fat and protein content were also in a substantial amount in both of the species. The studied deep-sea fish species are a rich source of ω-3 PUFA, contained about 5.89±0.3 and 6.66±0.4 grams of EPA and 11.2±0.9 and 12.5±1.0 grams of DHA in *Kathetostoma averruncus* and *Lophius piscatorius* respectively.

Keywords: Deep sea fish, ω-3 fatty acids, *Kathetostoma averruncus*, *Lophius piscatorius*

1. Introduction
The declaration of the Exclusive Economic Zone (EEZ) in 1977 provides an enormous opportunity and challenge to the nation to utilize fully the inherited rich wealth of living and non-living offshore and deep sea fishery resources. The potential of the deep sea is not yet exploited in a profitable way for the human utilization because of the lack of proper awareness on their worth in human health. Thousands of deep-sea fish species are available in Indian waters and none among them is a part of our diet. People are in search of nutrient-rich foodstuff for daily intake but are not aware and not trying to be aware of the nutritional Excellency of marine food source, especially deep-sea fishes. Lipids and their constituent fatty acids are, along with proteins, the major organic constituents of fish, and they play major roles as sources of metabolic energy for growth including reproduction and movement, including migration [1]. Seafood is rich in long chains of ω-3 [2, 3] and the present study aims at the exploration of nutrient-rich food or food supplements those can be extracted or developed from easily available deep sea fish source as they contain essential and non-essential fatty acids in extensive amount.

L. piscatorius *K. averruncus*

Fig 1: Sample- Deep sea fishes

2. Materials and methods

Two deep-sea fish species namely *L. piscatorius* and *K. averruncus* collected from the west coast of India EEZ were used for the study. The collected samples were kept in the frozen condition until they were using for processing under laboratory condition. The samples were identified with the help of FAO fact sheet and Fish base online sites. The fish samples were washed, removed gut and fins and minced as a whole and the same is used for proximate analysis and fatty acid profiling.

2.1 Determination of proximate composition and fatty acids

In this study, moisture content was analyzed by drying the samples in a hot air oven at 105 °C. The total protein and crude fat were analyzed by the Micro-Kjeldahl method and Soxhlet extraction procedure respectively [4]. The total nitrogen was multiplied by 6.25 to get the crude protein in the fish meat. The crude lipids in the gutted fish samples were extracted using chloroform solvent. The determination of fatty acid profile of lipid extracted from fishes was carried out in Thermo Trace Gas chromatograph equipped with flame ionization detector and Varian FFAP column (25m 0.32mm 0.3µm #CP 7485) using N2 as the carrier gas. In GC, the oven temperature was initially held at 1100 C for 4 min and then set to increase up to 2400 C at a rate of 2.70 C min-1, held at 2400 C for 5 min. The values of the fatty acid composition of deep-sea fishes are represented as g/100g of total fatty acid.

Statistical analysis

Statistical analysis for triplicate values has been done and the results are expressed as mean ± S.D. A level of $p<0.05$ was used to designate significant differences among the samples. The Statistical analyses were done with the aid of statistical package program SPSS 16.0 for Windows.

3. Results and discussion

3.1 Proximate composition of deep sea fish samples

The proximate composition values of the studied fish species are represented as 'g%' per100g meat. The moisture content of *L. piscatorius* was found 73.83±0.25% and the protein content was in a sizeable amount (18.37±0.66%). The lipid content detected at 3.7±0.4% and the same in *K. averruncus* is 3.6±0.07% and its moisture content is 76.7±0.61%. From these values, we can understand that the moisture and fat content are inversely proportional to each other in deep-sea fishes. The deep-sea fishes are high in protein and low in fat [5] and the same result was found in the present study. *K. averruncus* indicated 19.66±0.29% crude protein and is the highest among studied fish species. As a good source of protein, it can be used for the production of dietary protein supplement. In *L. piscatorius* and *K. averruncus* 5.3±0.53%, 2.56±0.37% ash content was found.

Table 1: Proximate composition of deep sea fish samples ('g%' per100g meat)

Name of fish	Moisture	Crude protein	Crude fat	Ash
L. piscatorius	73.83±0.25	18.37±0.66	3.7±0.4	5.3±0.53
K. averruncus	76.7±0.61**	19.66±0.29*	3.6±0.07NS	2.56±0.37**

*Mean values ± S.D of determinations for triplicate sample. **$P<0.01$, *$P<0.05$, NS-Not Significant

3.2 Fatty acid profile of deep sea fish samples

The ω-3 Polyunsaturated Fatty acids (ω-3 PUFA), which are inextricably associated with major physiological and biochemical processes, are integral to the proper metabolic functioning of living organisms. Polyunsaturated fatty acids consisting of 20 carbon atoms (e.g. 20:3n−6, 20:4n−6 and 20:5n−3) are known precursors of eicosanoids, which have a wide range of physiological actions such as, assisting in blood clotting, the immune response, the inflammatory response, cardiovascular tone, renal function, neural function, and reproduction [6]. In the present study, it is observed that *K. averruncus* contains a significantly higher proportion of PUFA compared to that of *L. piscatorius*. It is interesting to note that *K. averruncus* is found to contain more monounsaturated fatty acids (C16:1 and C18:1) as compared to *L. piscatorius*. The deep-sea fish samples *L. piscatorius* and *K. averruncus* are of a good amount in all the fatty acids especially EPA (5.89±0.3%, 6.66±0.4%) and DHA (11.2±0.9%, 12.5±1.0%) respectively. The nutritional importance of fish consumption is in great extent associated with the content of polyunsaturated fatty acids especially omega-3 fatty acids (ω-3 FAs) and omega-6 fatty acids (ω-6FAs) [7].

Table 2: Fatty acid profile (g/100g fatty acid)

Fish samples		*L. piscatorius*		*K. averruncus*
Name of fatty acids	Palmitic acid	C16	24.1±2.1	21.9±2.1**
	Palmitoleic acid	C16:1	6.19±0.5	7.8±0.5**
	Stearic acid	C18	7.61±0.5	7.3±0.6**
	Oleic acid	C18:1	9.08±0.8	16.2±1.2**
	Arachidonic acid	C20:4	10.1±1.0	7.9±0.3**
	Eicosapentanoicacid	C20:5	5.89±0.3	6.66±0.4**
	Docosahexanoicacid	C22:6	11.2±0.9	12.5±1.0**

*Mean values ± S.D of determinations for triplicate sample, **$P<0.01$

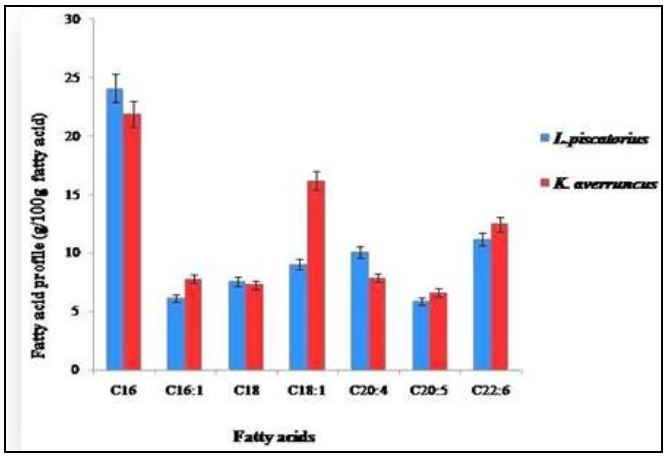

Fig 2: Chart showing the fatty acid composition of deep sea fish samples

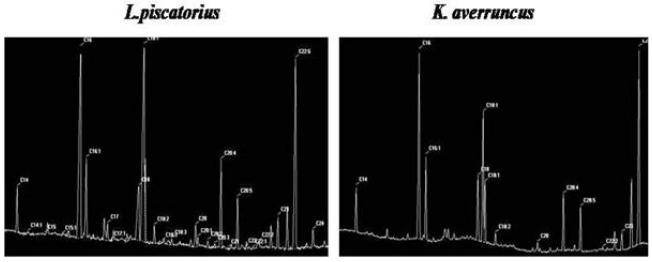

Fig 3: GC chromatogram of fatty acid composition of deep sea fish samples

Both the studied deep-sea fish species are consist of the essential fatty acids which are having a significant role in human physiological functions, which play inevitable roles in most of the vital biological functions taking place in human body especially in children and pregnant women. The proper exploitation and utilization of the deep sea fish may helpful in the maintenance of human health and remarkable changes in health problems related to improper nutrition and unhealthy food habit. So the fish species of interest indicate that they can be utilized for the food purpose as such or can be used to develop different types of health-enhancing fish products (Pharmaceutical or confectionary). The addition of omega-3 fatty acids to the diet lowers triglyceride levels, an effect that is pronounced in those with marked hypertriglyceridemia [8]. The triglyceride-lowering effect is not seen with plant sources of n-3 PUFA [9].

The fishes are naturally having all the fatty acids and the vital and nutritional components in their body. Lipids and specific fatty acids are the preferred source of metabolic energy for growth, reproduction and swimming in fish especially marine fish as evidenced by the very high oil levels (more than 20% of the wet weight) [10]. Studies on the fatty acid composition of several species of teleosts, cephalopods, and crustaceans from the Mediterranean Sea found that all of them had a n−3/n−6 ratio of more than 1, confirming the great importance of these fish and shellfish as a dietary source of n−3 PUFA for humans [11]. The amount of all the fatty acid may vary in different seasons, because the atmospheric changes, age, and physiological functions can cause variation in body constitution. An inverse relationship between temperature and content of unsaturated fatty acids, particularly EPA and DHA, has been reported for several poikilotherms [12]. Reducing the intake of saturated fat and dietary cholesterol and avoiding excess calories, which can lead to obesity, remains the cornerstone of the dietary approach to decreasing the risk of atherosclerotic vascular disease [13]. In the present study, the fish species selected for the analyses have a considerable amount of all the essential fatty acids and inclusion of these fishes in the diet may help to stabilize health alternations those may arise because of the scarcity of vital nutrients in the human body.

4. Conclusion

Confusion is still there among the common people, whether the deep sea fishes can be utilized for food purpose or not. From ancient years, people prefer coastal and freshwater fishes to deep-sea fishes may be because of inappropriate nutritional studies and awareness on their health importance. The present study reveals that the fish species used for nutritional analysis are composed of the considerable amount of protein and health important fatty acids which are having vital roles in the maintenance of physiological functions especially in children, aged people and pregnant women. Proteins are essential for the proper growth, maintenance of structural stability of body tissues and enzymatic reactions in the human body. All the fatty acids mainly DHA and EPA are very important in the proper development of the fetus during pregnancy. The brain damage of the developing embryo may occur if there is any failure in the intake of the above mentioned fatty acids. This may finally result in the formation of an unhealthy population in the society. The effective utilization of the easily available and nutrient-rich deep-sea fishes in human diet will definitely help to reduce the malnutrition risk among suffering population and thus can develop a healthy generation as well.

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6. References

1. Tocher DR, Metabolism and Functions of Lipids and Fatty Acids in Teleost Fish. Rev. Fish. Sci. 2010; 11:107-184
2. Chow CK, Fatty Acids in Foods and their Health Implications third ed. CRC Press, 2008, 166
3. Miliou H, Fintikaki M, Tzitzinakis M, Kountouris T, Verriopoulos G. Fatty acid composition of the common octopus, *Octopus vulgaris*, in relation to rearing temperature and body weight. Aquaculture. 2006; 256:311-322
4. AOAC. Official Methods of Analysis (Hormitz, W.ed.) 15thedn. (Horwits W and Latimer G 1990, 2000.
5. Stanby ME, Olcott HS. Composition of Fish in Industrial Fishery Technology. J.A. Dassow, Ed. Chapman & Hall. London, 1963.
6. Tocher DR. Glycerophospholipid metabolism, Biochemistry and Molecular Biology of Fishes. Metabolic Biochemistry. Elsevier 1995; 4:119-157
7. Marichamy G, Raja P, Veerasingam SV, Rajagopal S, Venkatachalapathy RV. Fatty acids composition of Indian mackerel Rastrilliger Kanagurta under different cooking methods. Current Research. J Bio. Sci, 2009; 1(3):109- 112

8. Pownall HJ, Raynaud AS, Harper E, Choi S, Rohrback K, Pao Q *et al*. Effect of 12 weeks of dietary fish oil, polyunsaturated fat, monounsaturated fat in the human plasma lipoprotein structure and composition. Proceedings of the Scientific Conference on Omega-3 Fatty Acids in Nutrition, Vascular Biology, and Medicine, Houston, Tex. 1994, 64-78
9. Kestin M, Clifton P, Belling GB, Nestel PJ. n-3 Fatty acids of marine origin lower systolic blood pressure and triglycerides but raise LDL cholesterol compared with n-3 and n-6 fatty acids from plants. Am J Clin Nutr. 1990; 51:1028-1034
10. Tocher DR. Metabolism and Function of Lipids and Fatty Acids in Teleost fish. Rev. Fish. Sci. 2003; 11(2):107-184
11. Passi S, Cataudella S, Marco P, Simone F, Rastrelli L. Fatty acid composition and antioxidant levels in muscle tissue of different Mediterranean marine species of fish and shellfish. J. Agric. Food Chem. 2002; 50:7314-7322
12. Hazel JR. Effects of temperature on the structure and metabolism of cell membranes in fish. Am. J. Physiol. 1984; 246:R460-R470
13. Stone NJ. Fish consumption, fish oil, lipids, and coronary heart disease, Circulation. 1996; 94:2337-2340.