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Research Note

Proximate Composition and Fatty Acid Profiling of Four Marine Fish Species of Gujarat Coast

G. K. Sivaraman[1], V. Renuka[1], A. K. Jha[1], V. Susmitha[1], P. R. Sreerekha[2], S. Vimaladevi[2], K. K. Asha[2], R. Anandan[2]*, Suseela Mathew[2] and B. P. Mohanthy[3]

[1] *ICAR-Central Institute of Fisheries Technology, Matsyabhavan, Veraval - 362 269, India*
[2] *ICAR-Central Institute of Fisheries Technology, P.O. Matsyapuri, Cochin - 682 029, India*
[3] *ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata - 700 120, India*

Quality and nutritional value of food are important, since there is an increasing awareness on the need for consumption of healthy diet among the public. Fish and fishery products are vital constituents of a healthy diet as it includes essential fatty acids, amino acids, vitamins, minerals and other functional nutritional components. Although there is an increased awareness on the importance of exploring nutritive significance of fish in human nutrition, there is little information on the biochemical composition and nutritive values of fishes available in Gujarat coast. In the present study, four marine fishes of Gujarat coast such as dagger-tooth pike conger *(Muraenesox cinereus)*, large scale tongue sole (*Cynoglossus arel*), goldband goatfish *(Upeneus moluccensis)* and saddle grunt (*Pomadasys maculatus)*, which are abundantly available in West coast of Indian waters, were evaluated for their proximate composition and fatty acid content.

Dagger-tooth pike conger (Plate 1a), a member of the Eel group, is a major commercial species with annual catches reaching about 350,000 tons globally. It occurs in the Red Sea, on the coast of the northern Indian Ocean, and in the East Pacific from Indo-China to Japan. It is a traditional food in Japanese cuisine, where it is known as hamo. *C. arel*, commonly known as the large scale tongue sole is a species of sole fish (Plate 1b) commonly found in muddy and sandy bottoms of the Indo-West Pacific and Indian Ocean. *U. moluccensis* (Plate 1c) commonly known as goldband goatfish is a native of the Atlantic, Indian and Pacific Ocean. *P. maculatus* (Plate 1d), is an edible ray finned fish distributed mainly in the Indo-West Pacific region.

Veraval is one of the largest fish landing centres of Gujarat and it is situated in Saurashtra Coast (Lat. 20° 54'N, Long. 70° 22'E) about 185 Km from Rajkot. The samples for the study were collected from the landings of commercial trawlers in the two important landing centres at Veraval i.e. Old Light House and Bhidya. The fishes of 6-10 numbers each were collected by random sampling during post monsoon period, as these fishes were a major catch. The catch was segregated species wise. The fishes collected were kept in ice box and brought to the laboratory. Fish were measured to the nearest cm (total length). The mean length (in cm) and total length range (in cm) was recorded for the fishes. The life stages (adult, sub-adult and juvenile) were determined based on total length. Morphometric analysis of fish samples revealed that *M. cinereus, C. arel and U.*

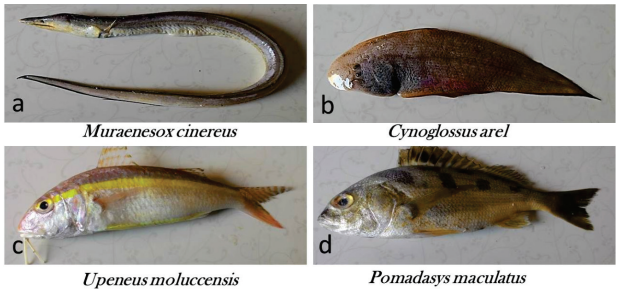

Plate 1: Photographs of a) *Muraenesox cinereus,* b) *Cynoglossus arel,* c) *Upeneus moluccensis and* d) *Pomadasys maculatus*

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* *E-mail: kranandan@rediffmail.com*

moluccensis were in adult stage of growth and *P. maculatus* was in sub-adult stage of growth.

Moisture content of the fish samples was determined by gravimetric method (AOAC, 2000). Protein content of the fish samples was determined by Kjeldhal Method (AOAC, 2000). Crude fat in the fish sample was estimated using a soxhlet apparatus by continuous extraction of fat using petroleum ether (AOAC, 2000). Ash content in the fish samples were determined gravimetrically based on methods outlined in AOAC, 2000. Fatty acid methyl esters (Metcalfe et al., 1997) of the lipid extracted by the method of Folch et al. (1957) were analyzed using Thermo Electron S P A Trace Gas Chromatograph Ultra (Milan-Italy) equipped with Chrompack capillary column (CP-FFAP CB for fatty acids: 25m x 0.32mm x 0.3μm) and flame ionization detector. Peaks were identified by comparing retention times with fatty acid methyl esters (FAMEs) standards. Results were expressed as gram percentage of fatty acid in terms of total fatty acids.

Data were analyzed using SPSS (Scientific Package of Social Science) version 16.0. The mean, standard deviation (SD), and one-way ANOVA test followed by Duncan post-hoc analysis were performed to compare differences in protein, moisture, fat, ash and fatty acid composition of fish species.

Table 1 depicts results of the mean (n=3) percentage of moisture, protein, fat and ash contents of four marine fishes under this study. Moisture content was comparatively higher in *C. arel* which was 77%, than the other three species where it was in the range of 73.05-75.84%. Protein content was high in *U. moluccensis* and *M. cinereus* compared to other two species. Based on the fat content, fishes are classified as lean fish (fat content <5%), medium fat fish (fat content 5-10%) and fatty fish (fat content >10%) (Suriah et al., 1995). According to this, the selected fishes are classified as lean fish. Fat content was lowest in *M. cinereus* compared to other three species.

Fatty acid composition of the four marine fish species studied is given in Table 2. In general, saturated fatty acid content were slightly higher than that of mono and poly unsaturated fatty acid content. *C. arel* had high amount of SFA compared to all other species. All the four fishes studied under this investigation showed significantly higher level of omega-3 fatty acids, Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) as compared to that of omega-6 fatty acid (arachidonic acid). EPA content is significantly higher in *C. arel*, whereas DHA was found to be in higher concentration in *P. maculatus*. Linoleic acid and Linolenic acid were present only in traceable quantity in all four fishes. PUFA play vital role in alleviating many diseases such as cardiovascular disease, diabetes, inflammatory diseases and rheumatoid arthritis (Berbert et al., 2005; Simopoulus, 1991; Anandan et al., 2007). EPA and DHA are reported to have beneficial effect on foetal development, proper neuronal and cellular functions and healthy aging (Swanson et al., 2012, Obulesu al., 2014). Maintaining sufficient levels of EPA in diet has been shown to lower the risk of deterioration of cognitive function during aging (Robinson et al., 2010; Natalia et al., 2012). EPA and DHA are vital components of the cell membrane and are responsible for maintaining fluidity of cell membrane. Adequate amount of DHA is needed for the proper foetal development as brain, central nervous system and retina are primarily depend on DHA during the growth in womb (Singh, 2005).

In conclusion, findings of the present study suggest that all the four fishes [dagger-tooth pike conger, large scale tongue sole, goldband goatfish and saddle grunt are rich sources of edible protein and

Table 1. Proximate composition (%) of four species of marine fishes of Gujarat coast (n=3)

Fish species	Moisture %	Protein %	Fat %	Ash %
Muraenesox cinereus	74.99±0.18^{b}	21.65±2.64^{b}	1.76±0.02^{a}	1.60±0.04^{a}
Cynoglossus arel	77.25±0.14^{d}	17.85±1.41^{a}	2.23±0.04^{b}	2.61±0.06^{a}
Upeneus moluccensis	73.05±0.36^{a}	21.62±0.12^{b}	2.25±0.04^{b}	2.68 ±0.48^{b}
Pomadasys maculatus	75.84±0.13^{c}	19.85±0.02^{a,b}	2.19±0.01^{b}	1.57±0.01^{b}

Different superscript lowercase letters (a–d) in same column show significant differences at $p<0.05$

Table 2. Fatty acid composition (g%) in terms of total fatty acids of four marine fishes of Gujarat coast (n=3)

Carbon No:	Fatty acids	*M. cinereus*	*C. arel*	*U. moluccensis*	*P. maculatus*
Saturated fatty acids					
C14	Myristic acid	5.24±0.18^{c}	10.64±0.51^{d}	2.99±0.15^{b}	2.41±0.14^{a}
C15	Pentadecyclic acid	-	1.52±0.03	-	-
C16	Palmitic acid	29.9±1.13^{c}	28.4±1.5^{b,c}	27.3±1.28^{b}	21.55±1.02^{a}
C17	Margaric acid	1.49±0.06^{a}	1.94±0.04^{c}	1.75±0.06^{b}	1.9±0.04^{c}
C18	Stearic acid	8.53±0.23^{a}	10.54±0.42^{c}	9.55±0.38^{b}	10.39±0.36^{c}
C20	Arachidic acid	1.24±0.03	3.28±0.12	-	-
C24	Lignoceric acid	-	-	-	17.31±0.29
	Total SFA	46.4±2.1	56.32±2.3	41.53±1.63	53.56±1.95
Monounsaturated fatty acids (MUFA)					
C16:1	Palmitoleic acid	7.92±0.31^{c}	6.59±0.28^{b}	6.44±0.19^{b}	3.66±0.12^{a}
C18:1	Oleic acid	19.89±0.48^{d}	10.37±0.21^{a}	17.45±0.19^{c}	13.93±0.47^{b}
C20:1	Gadoleic acid	-	2.44±0.08	-	-
	Total MUFA	27.81±1.21	19.4±0.36	23.89±1.08	17.59±0.63
Polyunsaturated fatty acids (PUFA)					
C20:4	Arachidonic acid	5±0.14^{b}	3.98±0.11^{a}	4.16±0.18^{a}	7.4±0.56^{c}
C20:5	Eicosapentaenoic acid	6.85±0.21^{b}	13.06±0.68^{c}	5.98±0.15^{a}	6.11±0.21^{a}
C22:6	Docosahexaenoic acid	5.66±0.12^{b}	5.01±0.22^{a}	10.28±0.28^{c}	12.49±0.16^{d}
	Total PUFA	17.51±0.61	22.05±0.78	20.42±0.43	26±0.56

Different superscript lowercase letters (a–d) in same row show significant differences at $p<0.05$

omega-3 fatty acids, which are essential for the maintenance of structural and functional integrity of living beings. However, further studies have to be carried out to explore the possibility of utilizing these marine fishes for the development of food products and/or dietary supplements capable of attenuating malnutrition associated deficiency and/or disorders.

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