PROXIMATE COMPOSITION AND FATTY ACIDS PROFILE OF Sardinella longiceps, CLUPIDAE FROM TAMILNADU COAST, INDIA.

E. Venkadachalam[1*] and P.K. Karuppusamy[2]

[1&2]P.G. & Research Department of Zoology, Presidency College, Chennai – 05
e.venkat91@gmail.com[*]

ABSTRACT

The present study was focused on proximate composition and fatty acids profile of *Sardinella longiceps* collected from three different coastal areas like Chennai, Tuticorin and Kanyakumari. The samples were analyzed to estimate the proximate chemical compositions like protein, carbohydrate, lipid and ash content showed higher % in the fish collected from Chennai coastal area than Tuticorin and Kanyakumari fish sample. Fatty acid concentration also more or less found to be similar in the case of Chennai and Kanyakumari fish samples.

KEYWORDS

Sardinella longiceps, proximate composition, Fatty acids, Tamilnadu coast.

INTRODUCTION

India has vast potential resources in marine sector and it has 7, 517 kilometers of marine coastline including 3, 827 fishing villages, and 1,914 traditional fish landing centers distributed between West-Bengal, Odisha, Andhra Pradesh, Tamil Nadu and Pondicherry on the East Coast (DHA, 2014). Tamil Nadu and Pondicherry was 30% with an estimate of 10.72 lakh fishes landed. It is more essential for human diet, to raise the utilization of marine fish and its products (Burr, 1989). Furthermore, it has been linked to health benefits, such as the prevention of cardiovascular diseases and some types of cancer, including colon, breast and prostate (Marchioli, 2002; Sidhu, 2003). Fish constitutes a very important component of diet for many people, provides much needed nutrients for a healthy living. It is well understood and it has historically been more readily available to the poor, especially in the rural areas of many developing countries like India (Vijayakumar *et al*., 2014).

There may be group specific or even species difference in the biochemical composition. In general, the proximate composition and fatty acid composition of fish are varied from one to another species. It depends on age, sex and seasonal variations (Saritha *et al*., 2015). Fishes are very good dietary source of vitamin B complex, niacin amide, Folic acid and fatty acids. Oil sardine constitutes 5, 44, 684 and they formed around 29 % of the total marine fish landings and 59 % of the total pelagic finfish landing in Tamil Nadu. Other sardines formed 17% in the total catch and 35% in the pelagic finfish catch whereas oil sardine formed 12% in the total catch and 24% in the pelagic finfish catch. Sardine lipids with their high polyunsaturated fatty acid content are nutritionally important. Omega-3 PUFA from sardines, especially EPA and DHA are of particular interest because of their role in improving health and reducing the risk of chronic afflictions like cardiac diseases, autoimmune disorders, diabetes, even cancer (Simopoulos, 1991). Therefore, it is necessary to elucidate the major biochemical components like proximate composition and fatty acid composition. So, this study was undertaken to create a base line data on the nutritional quality in *S. longiceps* landed in three different coasts such as Chennai, Tuticorin and Kanyakumari.

MATERIALS AND METHODS

Study area

Commercially important fresh marine fish, *Sardinella longiceps* were collected in three areas of landing centers from southeast Coast of Chennai (13.12º N, 80.29º E), Tuticorin (8.75º N, 78.15º E) and Kanyakumari (8.12º N, 78.15º E).

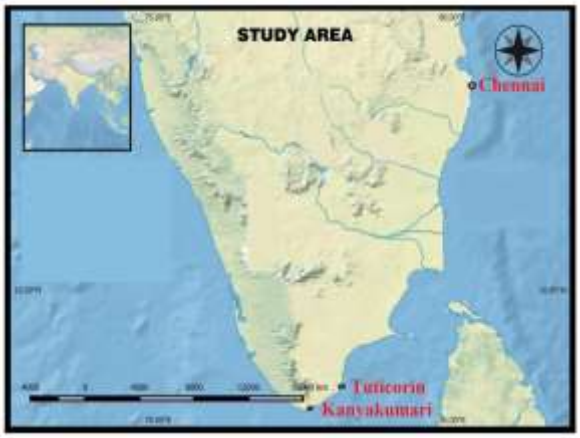

Fig. 1 study areas

Fig.2: *Sardinella longiceps* (Valenciennes, 1847)

Collection of samples

The collected fishes were kept in a cold ice box and transported immediately to the laboratory for further analyses. Fishes were identified based on their morphometric and meristic measurement. Fleshy tissues were removed from the fish and dried at 55ºC (constant temperature) for 24 hours in on oven. Then the dried tissues were powdered and used for the analyses of total fatty acids.

Chemical analysis

Protein, ash and fat were estimated in fish by the methods described by the Association of Official Analytical Chemists (2012). All analyzes were performed in three iterations. The carbohydrate content was calculated as follows (Mathew *et al*., 2014; Equation 1):

Total carbohydrates = 100 - (moisture + ash + protein + total lipids) %

Statistical analysis

Proximate compositions of fish were estimated by the conventional method Association of Official Analytical Chemicals (AOAC) on the basis of wet weight (AOAC, 1987). The results obtained were subjected to descriptive statistical analysis using SPSS. (Differences were considered to be significant when $p<0.05$). The level of moisture was determined by drying in a hot air oven at a temperature of 100+2ºC for 16 hrs and weighted for the weight loss. Dried samples were used to estimate the crude fat. The crude fat determined by solvent extraction method. Data is presented as mean and SE. The data normality and homogeneity were checked by Kolmogorov-Smirnov Test and Levene's respectively. The mean values of the data were compared between the two study localities for each proximate parameter for individual fish analyzed by student 't' test using Statistical Package of the Social Science (SPSS) version 20. The p value, less than 5 and 10% considered as a statistically significant. The correlation coefficient was performed to establish the relationship amid proximate parameters.

RESULTS

Proximate chemical composition

A comparative proximate analysis (%) was performed in the fishes collected from different coastal landing centers and statistically enlisted in (table 1). The results were showed significant difference ($p<0.05$) in the fish samples of three different coastal areas.

Higher content of protein was present in *Sardinella longiceps* of Chennai coastal area (49.36 %) followed by Kanyakumari (39.90 %) and Tuticorin (39.24 %). The highest carbohydrate content was observed in Chennai Coast (14.34 %). On the other hand, species from Tuticorin (8.35±0.02 %) and Kanyakumari (8.34 %) coast had similar amount of Carbohydrate. The lipid contents were recorded to be maximum in

Kanyakumari coastal fish sample (22.66±0.02[a]) and minimum in Tuticorin coastal fish sample (6.94±0.03[c]). In The case of ash content of the fish following sequence was observed in Chennai (4.35 %), Tuticorin (2.63 %) and Kanyakumari (1.95 %).

Table. 1 Proximate composition (%) of *Sardinella longiceps* in different coastal areas

Proximate composition (%)	Chennai	Tuticorin	Kanyakumari
Protein	49.36±0.03[a]	39.24±0.02[c]	39.90±0.05[b]
Carbohydrate	14.34±0.03[a]	8.35±0.02[b]	8.34±0.03[b]
Lipid	16.59±0.04[b]	6.94±0.03[c]	22.66±0.02[a]
Ash	4.35±0.01[a]	2.63±0.03[b]	1.95±0.03[c]

Results are the mean values of triplicate ± Standard deviation (SD) with significant difference at P<0.05. Identical lower case superscripts denote similar values horizontally.

Fatty acid composition

The fatty acid profile (g/ 100g) is evinced in the Table. 2 and it showed the different fatty acids derived from the muscle tissue of the selected fish. The fatty acid composition includes saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) including the EPA and DHA.

The SFAs present were palmitic acid (5.22 g) and margaric acid (0.39 g) seen more in the fish collected from Kanyakumari coast as well as the stearic acid (3.56 g) were highly present in the fish sample of Chennai coast.

The MUFAs including oleic acid showed a significant difference between the three coasts and highest concentration in the Kanyakumari (4.56 g) followed by Chennai (4.15 g) and lowest in Tuticorin (1.03 g).

PUFAs include α- linoleic acid, linoleic acid, morotic acid, EPA and DHA. Large amount of α-linoleic acid recorded in the fish collected from Kanyakumari (3.34 g) followed by Chennai (1.93 g) and Tuticorin (1.09 g). When linoleic acid is considered, Chennai (5.09 g) and Kanyakumari (4.98 g) coastal sample showed higher level. It is five times greater than the fish collected from Tuticorin (0.98 g) coast. Morotic acid were highly present in *S. longiceps* of Tuticorin (1.22 g) and lowest in Kanyakumari fish (0.29 g) respectively. The ratio of EPA/DHA result showed all fishes are good source of fatty acids and it can be highly recommended as the healthiest food for human nutrition.

Table. 2 Fatty acid profile (g/100g) of *Sardinella longiceps* in different Coastal areas

FATTY ACID PROFILE (g/ 100g)		CHENNAI	TUTICORIN	KANYAKUMARI
SFA	Palmitic acid	1.67±0.02[b]	0.49±0.02[c]	5.22±0.03[a]
	Stearic acid	3.56±0.04[a]	1.56±0.02[c]	3.28±0.03[b]
	Margaric acid	0.34±0.03[a]	0.14±0.02[b]	0.39±0.05a
MUFA	Oleic acid	4.15±0.03[b]	1.03±0.02[c]	4.56±0.03[a]
PUFA	α-Linoleic acid	1.93±0.02[b]	1.09±0.03[c]	3.34±0.03[a]
	Linoleic acid	5.09±0.02[a]	0.98±0.01[c]	4.98±0.01[b]
	Morotic acid	0.34±0.03[b]	1.22±0.02[a]	0.29±0.02[c]
	EPA	0.61±0.02[c]	0.64±0.07[b]	0.72±0.02[a]
	DHA	0.51±0.04[a]	0.47±0.02[b]	0.46±0.04[b]
	EPA/DHA	**1.19**	**1.36**	**1.56**

Results are the mean value in triplicates ± Standard deviation (SD) with significant difference at P<0.05. Identical lowercase superscripts denote similar values horizontally.
SFA, MUFA and PUFA represent Saturated, Mono unsaturated and Poly unsaturated fatty acids respectively.

EPA and DHA represent Eicosatetraenoic and Docosahexaenoic acid respectively

DISCUSSION

The results of the present study revealed that the protein composition of *S. longiceps* have been highly recorded in Chennai and it was higher than the same species at Pondicherry Coast (Vijayakumar *et al*., 2013), Nagapattinam (Sinduja *et al*., 2013) and Pakistan (Munshi *et al*., 2005). Carbohydrate in the tissues exist as glycogen, free sugars and protein bound sugars, which serve as energy reserves for various metabolic processes. They are the major source of energy in animals, rapid depletion of stored carbohydrates primarily in tissue are used for the metabolism (Vijayavel *et al*., 2006). Lipids are highly efficient as sources of energy and they contain more than twice the energy of carbohydrates and proteins (Okuzumi and Fujii 2000). In the present study, the lipid content recorded maximum in Kanyakumari coastal fishes. This value was higher than the other Coast of *S. longiceps* (Ravichandran *et al*., 2011), *Sardinella gibbosa* (Kherun Nisha and Asadullah, 2008) and *Sardinella brasiliensis* (Bulla *et al*., 2011). The ash content result of the present study showed Chennai Coast fishes had higher concentrations when compare to other coastal fishes. It indicated, large amount of presence of minerals. Biochemical components such as protein, carbohydrate, and lipids are essential for body growth and maintenance (Okuzumi and Fujii, 2000). The spawning cycle and food supply are the main factors responsible for this variation (Love, 1980).

The obtained composition results of Indian mackerel showed predominantly saturated fatty acids followed by unsaturated fatty acids, both of which were present in a similar range. Unsaturated fatty acids are composed mainly of polyunsaturated fatty acids, which agrees with many studies, including those of Marichamy *et al.* (2009), Ganga *et al.* (2010) and Azim *et al.* (2018). Additionally, in a study on Atlantic mackerel, the fat content increased with an expected increase in food consumption and varied among years, seasons and geographic areas (catching grounds) in addition to individual variations in weight gain, as a higher total fat content is related to the feeding period and the size of the mackerel (Romotowska *et al.*, 2016, 2017).

Fatty acid composition (g/100g) of different crab species is presented in Table.2. In all the three species the main SFA, MUFA and PUFA were analyzed. Among saturated fatty acids, SFA was recorded rich amount in Kanyakumari fish's especially palmitic acid and stearic acid. These compounds hypothesized as not influenced by diet (Kleppel *et al*., 1998). This value was lower than the same species of Nagapattinam coast (Sinduja *et al*., 2013). Predominant amount of α- linoleic acid recorded in Kanyakumari as well as the linoleic acid recorded in Chennai and Kanyakumari. These results had higher amount than the oil sardine of west coast of India (Ambasankar and Balakrishnan, 2006), *Dussumieria acuta* and *Sardinella brachysoma* (Ravichandran *et al*., 2012).

PUFAs like EPA and DHA was showed better concentration in the study areas. International Society for the Study of Fatty Acids and Lipids (ISSFAL) suggests the intake of omega-3 fatty acids should be 0.65 g of DHA + EPA per day (0.22 g per day of each as a minimum) (Kolanowski *et al*., 2005). But, in the present study all the sampling sites showed more amount EPA and DHA when compared to the known standard. So, it's indicated that oil sardines are enriched with higher amount of fatty acids. They feed on micro planktons and phytoplankton, which is the chief food of *S. longiceps*. These micro planktons, also known as heterotrophic protests, tropically improve the algal quality for consumption for higher trophic organisms (Hardy and Keay, 1972). As an immediate prey, they improve the quality and quantity of lipids in the food web by forming fatty acids like DHA with higher levels of unsaturation (Klein Breteler, 1998). Regular consumption of omega 3 rich diets with appropriate content of EPA and DHA can prevent hypertension, cardiovascular diseases, type 2 diabetes, rheumatoid arthritis, Crohn's disease and reduce the risk of Dementia, Alzheimer's diseases, obesity, thrombosis, lung disease and cancer. (Dhanapal *et al*., 2012; Palanikumar *et al*., 2013; Radulovic *et al*., 2014).

CONCLUSION

From the study it is understood that the biochemical composition present in the fish sample is site specific and season. All the parameters analyzed in the *Sardinella longiceps* of Chennai coastal fish sample are rich, could be due to the abundant diver site of Zoo and phytoplankton than the other coast. The present study revealed that *S. longiceps* is a rich source of protein and lipids. Mono unsaturated fatty acids are the main constituents of lipids. The lipid profile showed high levels of oleic acid, linolenic acid, stearic acid and

palmitic acid which exert positive effects on the body by providing the main nutrients and preventing disease in the consumer.

RECOMMENDATIONS

The obtained results showed favorable dietary components, mainly protein and lipids, in *Sardinella longiceps* and highlighted the importance of the lipid profile on the health of consumers and the application of different technological processes to avoid rancidity in fish. Further studies should be conducted on the heavy metals, vitamin, and mineral contents of *S. longiceps* in different seasons and catching areas.

REFERENCES

1. Ambasankar K and Balakrishnan V, (2006). Indian Sardine (*Sardinella longiceps*) as a source of omega-3 fatty acids. *Animal Nutrition and Feed Technology*, 6: 283-287.
2. Azim, M. R., Hossain, M. M., Moushumy, M. A., Hoque, M. A., & Uddin, M. H. (2018). Physico-chemical characterization and microbial studies of the muscle lipid of Indian mackerel (*Rastrelliger kanagurta*) of the Bay of Bengal. *International Journal of Fisheries and Aquatic Studies*, 6(6), 268-272.
3. Bulla MK, Simionato JI, Matsushita M, Garcia Coro FA, Shimokomaki M, Visentainer JV and De Souza NE, (2011). Proximate composition and fatty acid profile of raw and roasted salt-dried Sardines (*Sardinella Brasiliensis*). *Food and Nutrition Science*, 2: 440-443.
4. Burr ML, (1989). Fish and cardiovascular system. *Progress in Food and Nutrition Science*, 13: 291-316.
5. DAH (2014). Dairying and Fisheries, Ministry of Agriculture, Gov. of India (available at: www.dahd.nic.in), Handbook on Fisheries Statistics 2014 Section F, *Fishery Resources*, 107.
6. Dhanapal K, Reddy GVS, Naik BB, Venkateswarlu G, Reddy AD and Basu S, (2012). Effect of cooking on physical, biochemical, bacteriological characteristics and fatty acid profile of Tilapia (*Oreochromis mossambicus*) fish steaks". *Archives of Applied Science Research*. (2):1142-1149.
7. Ganga, U., Radhakrishnan, C., & Anandan, R. (2010). Fatty acid signatures of the Indian mackerel Rastrelliger kanagurta (Cuvier) from the Arabian Sea along the Indian coast. *Journal of the Marine Biological Association of India*, 52, 8-13.
8. Hardy R and Keay JN, (1972). Seasonal variations in the chemical composition of Cornish mackerel, *Scomber scombrus* (L) with detailed reference to the lipids. *Journal of Food Technology*, 7:125-137.
9. KherunNisa and Asadullah, (2008). Seasonal variation in lipid composition of sardine (*Sardinella gibbosa*) from Karachi coast. *Journal of chemical Society*. 30 (3): 436-441.
10. Klein Breteler WCM, Schogt N, Baas M, Schouten S and Kraay GW, (1999). Trophic upgrading of food quality by protozoans enhancing copepod growth: role of essential lipids. *Marine Biology*, 135: 191-198.
11. Kleppel GS, Burjart CA and Hauchin L, (1998). Nutrition and the regulation of egg production in the Calonoid copepod *Acartia tonsa*. *Limnology and Oceanography*, 43: 1000-1007.
12. Kolanowski W, (2005). Bioavailability of omega-3 PUFA from foods enriched with fish oil, A mini review. *Polish Journal of Food and Nutrition Sciences*, l, 14/55 (4): 335-340.
13. Love RM, (1980). The chemical biology of fishes, Vol. 2. New York: Academic Press.
14. Marchioli R, (2002). Early protection against sudden death by n-3 polyunsaturated fatty acids after myocardial infarction: Time course analysis of the results of GISSI-preventions. *Circulation*, 105: 1897-1903.
15. Marichamy, G., Raja, P., Veerasingam, S., Rajagopal, S., & Venkatachalapathy, R. (2009). Fatty acids composition of Indian mackerel Rastrilliger kanagurta under different cooking methods. *Current Research Journal of Biological Sciences*, 1, 109-112.
16. Mathew, T., Ndamitso, M., Otori, A., Shaba, E., Inobeme, A., & Adamu, A. (2014). Proximate and mineral compositions of seeds of some conventional and non-conventional fruits in Niger state, Nigeria. *Academic Research International*, 5, 113-118.
17. Munshi AB, Ali SA and Shakir S, (2005). Seasonal variations in biochemical composition of Sardins and Mullet from Pakistani waters. *Journal Chemical Society of Pakistan*, 27(2): 190-193.

18. Okuzumi M and Fujii T, (2000). Nutritional and functional properties of squid and Cuttle fish, Japan national cooperative association of squid processors, Tokyo, Japan, 223.
19. Palanikumar M, Annathai AR, Shakila RJ, Shanmugam SA, (2014). Proximate and major mineral composition of 23 medium sized marine fin fishes landed in the Thoothukudi coast of India, *Journal of Nutritional and Food Sciences*, 4: 1.
20. Radulovic Z, Paunovic D, Petrusic M, Mirkovic N, Miocinovic J, Kekus D, Obradovic D, (2014). The application of autochthonous potential of probiotic *Lactobacillus plantarum* 564 in fish oil fortified yoghurt production. *Archives of Biological Sciences*, 66(1). 15-22.
21. Ravichandran S, Kumaravel K and Florence PE, (2011). Nutritive composition of some edible fin fishes. *International Journal of Zoological Research*, 7: 241-251.
22. RaviChandran S, Sharmila Joseph FR, Kanagalakshmi R and Ramya MS, (2012). Variation in nutritive composition of two commercially important marine fin fishes. *International Journal of Zoological research*, 1-9.
23. Romotowska, P. E., Gudjónsdóttir, M., Karlsdóttir, M. G., Kristinsson, H. G., & Arason, S. (2017). Stability of frozen Atlantic mackerel (*Scomber scombrus*) as affected by temperature abuse during transportation. *Lebensmittel-Wissenschaft + Technologie*, 83, 275-282. http://dx.doi.org/10.1016/j.lwt.2017.05.024.
24. Romotowska, P. E., Karlsdóttir, M. G., Gudjónsdóttir, M., Kristinsson, H. G., & Arason, S. (2016). Seasonal and geographical variation in chemical composition and lipid stability of Atlantic mackerel (*Scomber scombrus*) caught in Icelandic waters. *Journal of Food Composition and Analysis*, 49, 9-18. http://dx.doi.org/10.1016/j.jfca.2016.03.005.
25. Saritha K, Mary D and Patterson J, (2015). Nutritional status of green Mussel *Perna Viridis* at Tamil Nadu, Southwest coast of India. *Journal of Nutrition and Food Science*, S14: 003.
26. Sidhu KS, (2003). Health benefits and potential risks related to consumption of fish or fish oil. *Regulatory Toxicology and Pharmacology*, 38: 336-344.
27. Simopoulos AP, (1991). Omega-3 fatty acids in health and disease and in growth and development. *American Journal of Clinical Nutrition*, 54: 438-463.
28. Sinduja A, Gopalakrishnan and Sakthivel A, (2013). Comparative studies on nutritional value of normal and tumor tissue, S*ardinella longiceps* (valenciennes, (1847)) from Nagapattinum Southeast coast of India. International *Journal of Science and Invention Today*, 2(5): 432-443.
29. Vijayakumar N, Sakthivel D and Anandhan V, (2014). Proximate composition of Clupeidae and Engraulidae inhabiting Thengaithittu estuary Puducherry- Southeast coast of India. *International Journal of Science Inventions Today*, 3(3): 298-309.
30. Vijayavel K, Anbuselvam C, Balasubramanian MP, Deepak Samuel V and Gopalakrishnan S, (2006). Assessment of biochemical components and enzyme activities in the estuarine crab *Scylla tranquebarica* from naphthalene contaminated habitants. *Ecotoxicology*, 9(5): 469-476.