STUDIES ON PROXIMATE COMPOSITION AND AMINOACIDS PROFILE OF *Sardinella longiceps*, CLUPIDAE FROM COASTAL TAMILNADU, 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 amino acids profile of *Sardinella longiceps* collected from three different coastal areas of Tamilnadu like Chennai, Tuticorin and Kanyakumari. This study aims to investigate the chemical composition, amino acid fractions in fish tissues. This study, revealed that moisture, protein, and fat are the main constituents of fish. Protein content showed higher % in the fish collected from Chennai coastal area than Tuticorin and Kanyakumari fish samples. Totally 21 Amino acids were estimated among which 13 Amino acids were in higher concentration in Chennai coast and 5 in Kanyakumari and 3 at Tuticorin. Protein was highest at Chennai coast in Proximate Composition amino acids profile were found to be present in Chennai > Kanyakumari > Tuticorin.

KEYWORDS

Sardinella longiceps, proximate composition, Amino acids, Coastal Tamilnadu.

INTRODUCTION

Marine fish species contributes extremely to the delivery of macro and micro nutrients in our normal food diet (Flowra and Tumpa, 2012). Fishes are very heterogeneous and highly specialized group evolved through biochemical adaptation and evolution, consisting approximately of 24, 000 species, showing extreme variations in size, shape, appearance etc. The habitat and food intake of these species are equally diverse. Some species are exclusively marine, while some are confined to fresh water habitats. Few fishes survive in marine as well as fresh water environments. Certain marine species migrate to fresh water for spawning. The widely different environmental conditions like temperature, salinity, pressure, availability of food etc, profound influence on the biochemical composition. Fish are most important source of animal protein and usually consuming at several place of the world due to it having high contents of protein, amino acids and nutraceuticals like polyunsaturated Fatty Acid (PUFA). It is more essential for human diet, to raise the utilization of marine fish and its products (Burr, 1989). Fish flesh is easily digestible because it contains long muscle fibers. 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). Additionally, the demand for protein rich food is increasing, especially in developing countries, stimulating the exploration of unexploited or non-traditional resources. Marine fishes are commercially valuable species and easy to cultivate in coastal areas and they are important for marine ecology and human diet, since it is an important source of nutrients. Consumption of marine fish provides an inexpensive source of protein with a high biological value, essential minerals and vitamins. Today people are more conscious about health foods and fish has got wide acceptance because of its special nutritional qualities. Fish and fishery products find the application as animal feeds. Formulation of such products needs proper data on the biochemical composition. Processing and preservation of fish and fishery products also need correct information on biochemical composition (Sheril Ann Shaji and Hindumathy, 2013).

There may be group specific or even species difference in the biochemical composition. Even within a species, variations occur for individual fish or lots of fish taken at different times or under different conditions (Stansby, 1962). Protein is the essential substance of life and accordingly exists in the largest quantity of all nutrients as a component of the living beings (Babu *et al*., 2010). Proteins are the major sources of metabolic energy and essential materials for the formation of cell and tissue membranes (Sargent, 1995). Fish tissue proteins contain 20 different amino acids including essential and non-essential of nutritional importance (King *et al*., 1990). They are required for the maintenance of growth, reproduction and synthesis of vitamins. All of the essential amino acids needed for good protein nutrition are present in fish meat. The protein content of fish is also important when considering quality and texture of the fish meat (Majid *et al*., 2011).

It has raised concentration due to it can prevent human cardiovascular disease, anti-inflammatory, anti-thrombotic effects, reduction of blood cholesterol level and prevention of cancer (Krisetherton *et al*., 2003). In general, the proximate composition and amino acid level composition of fish are varied from one to another species. It is depending on age, sex and season variations. The biochemical compositions are closely connected to feeding habit, migration and sexual changes in connection with spawning (Balogun and Talabi, 1985). As the world population is growing, the per capita consumption of seafood is also increasing rapidly. Because of health consciousness, the modern day man is interested in taking seafood more in view of its nutritional superiority than all other sources of food accessible (Sinduja *et al*., 2013). There was not much work on therefore this study was aimed to focus on proximate composition and Nutrient compound of the oil fish. Stunting has been a serious problem faced worldwide including in Indonesia. It is a form of chronic malnutrition in children under five. It is reported that one-quarter children have been affected globally (Semba R D, Shardell M *et al*.,2016). In this current scenario the dietary importance of seafood has raised considerably owing to scientifically known beneficial effects of consuming aquatic foods, fats and oil.

MATERIALS AND METHODS

Study area

Commercially important fresh marine fish, *Sardinella longiceps* were collected in three areas of landing centres from the coastal belt of Tamilnadu (13.12^{o} N, 80.29^{o} E), Tuticorin (8.75^{o} N, 78.15^{o} E) and Kanyakumari (8.12^{o} N, 78.15^{o} E).

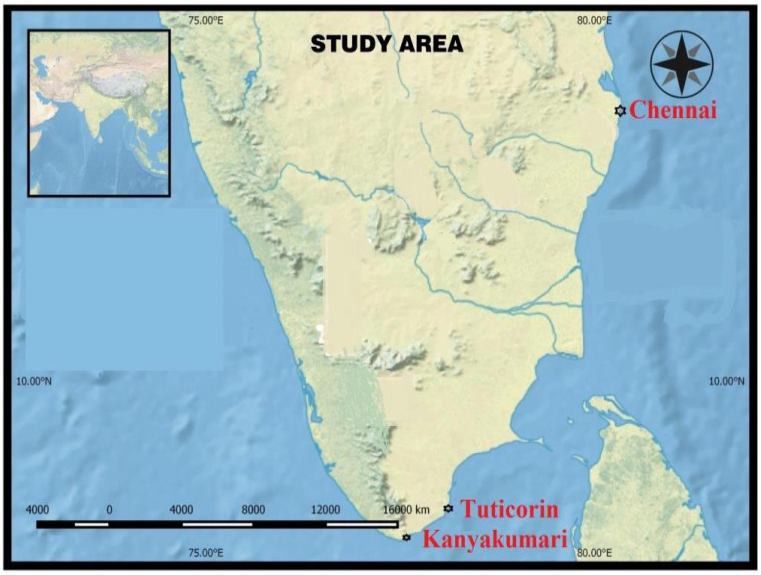


Fig. 1 study area

Collection and preparation of fishes

The collected fishes (fig 2) were kept in an ice box and transported immediately to the laboratory for further analyses. Fishes were identified based on their morphometric and meristic measurement (Jinghratan, 1978). Tissues were removed from the fish and dried at 55ºC (constant temperature) for 24 hours in a hot air oven. Then the dried tissues were powdered and used for chemical analysis and amino acid profile analyses.

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

Chemical analysis

Moisture, ash, protein, and fat were estimated in Indian mackerel 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

Data are presented as the mean ± standard deviation (n=3) and were analyzed by one-way analysis of variance (ANOVA) using Minitab 17 software. The significance level was $p < 0.05$.

RESULTS

Proximate chemical composition

The average chemical composition of the tested *S. longiceps* samples purchased from different markets in March was investigated and is shown 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

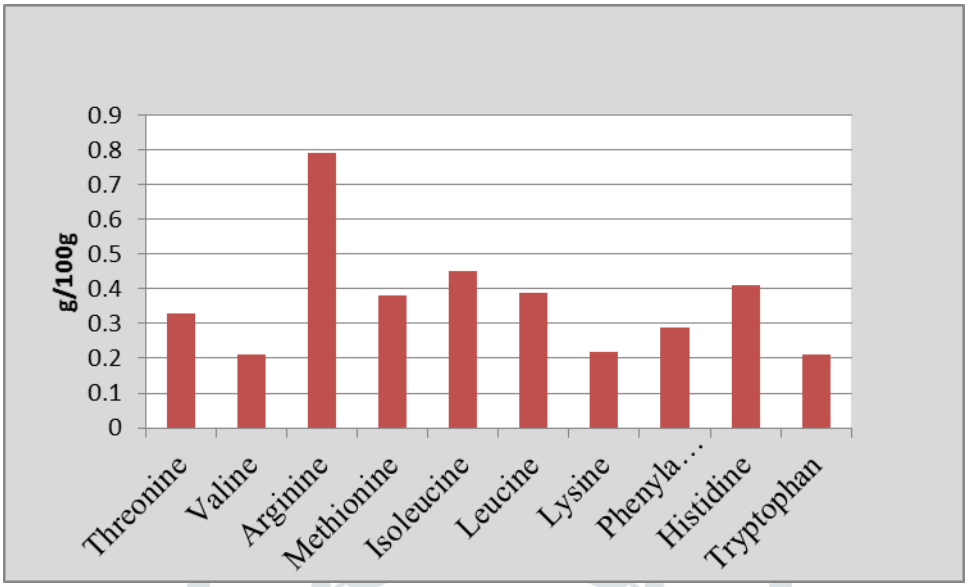
Proximate composition (%)	Chennai	Tuticorin	Kanyakumari
Protein	49.36 ± 0.03^{a}	39.24 ± 0.02^{c}	39.90 ± 0.05^{b}
Carbohydrate	14.34 ± 0.03^{a}	8.35 ± 0.02^{b}	8.34 ± 0.03^{b}
Lipid	16.59 ± 0.04^{b}	6.94 ± 0.03^{c}	22.66 ± 0.02^{a}
Ash	4.35 ± 0.01^{a}	2.63 ± 0.03^{b}	1.95 ± 0.03^{c}

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.

Amino acid composition

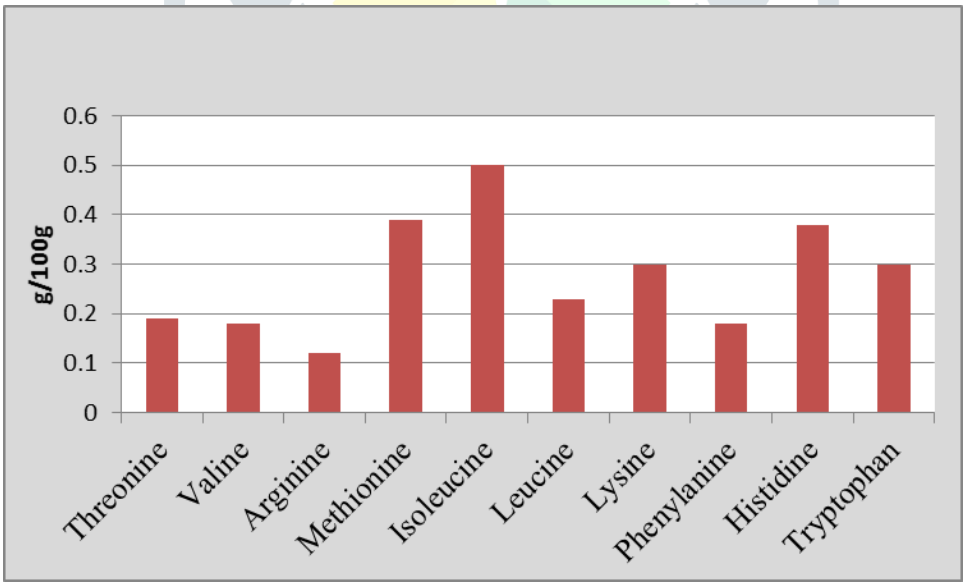
The EAA composition of *Sardinella longiceps* in Chennai coastal fish sample showed (Fig.3) higher concentrations of arginine (0.79 g) followed by isoleucine (0.45 g), histidine (0.41 g), Leucine (0.39 g) and methionine (0.38 g). While, the lower concentration of lysine (0.22 g), valine (0.21 g) and tryptophan (0.21 g) were also recorded.

The dominant EAA of the species in Tuticorin coast (Fig. 4) showed isoleucine (0.50 g), methionine (0.39 g) and histidine (0.38 g). On the other hand, lysine and tryptophan (0.30 g) as well as valine and phenylalanine (0.18 g) had similar Concentration of EAA. When comparing different EAA in *Sardinella longiceps* of Kanyakumari Coast (Fig. 5), isoleucine (0.53 g), methionine (0.43 g) histidine (0.39 g) and tryptophan (0.32 g) found to be in higher amount as well as threonine (0.20 g), valine (0.19 g) and phenylalanine (0.19 g) were recorded.



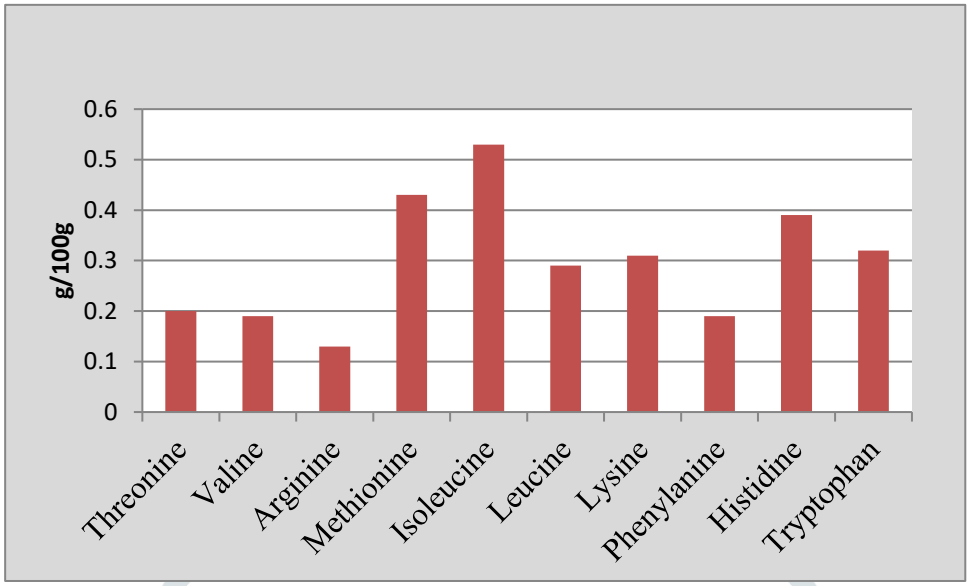
Ar>Iso>His>Leu>Meth>Thre>Phe>Lys>Val>Try

Fig.3 Essential amino acid composition of *Sardinella longiceps* at Chennai coast



Iso>Meth>His>Ly>Try>Leu>Thre>Phen>Val>Ar

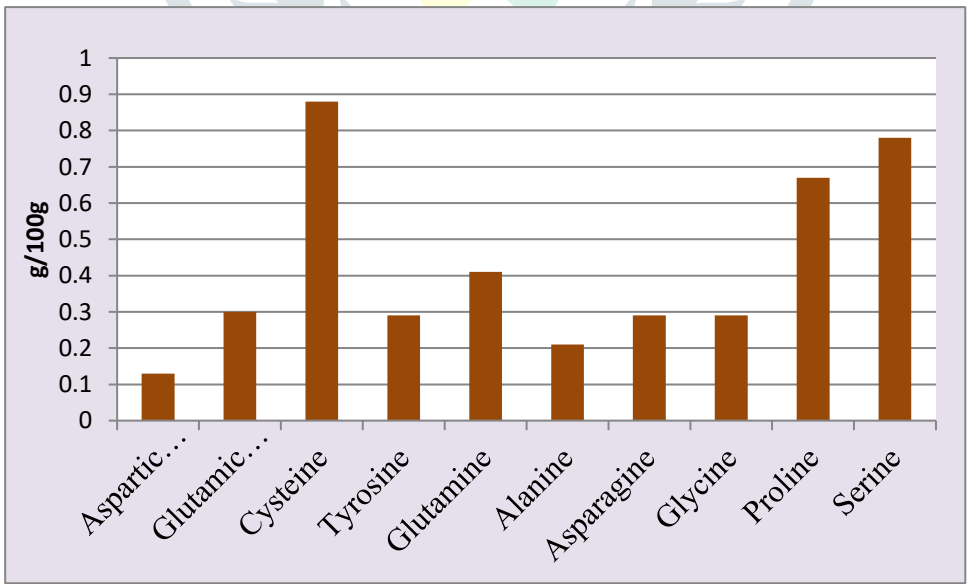
Fig.4 Essential amino acid composition of *Sardinella longiceps* at Tuticorin coast



Iso>Met>His>Try>Lys>Leu>Thre>Val>Phen>Ar

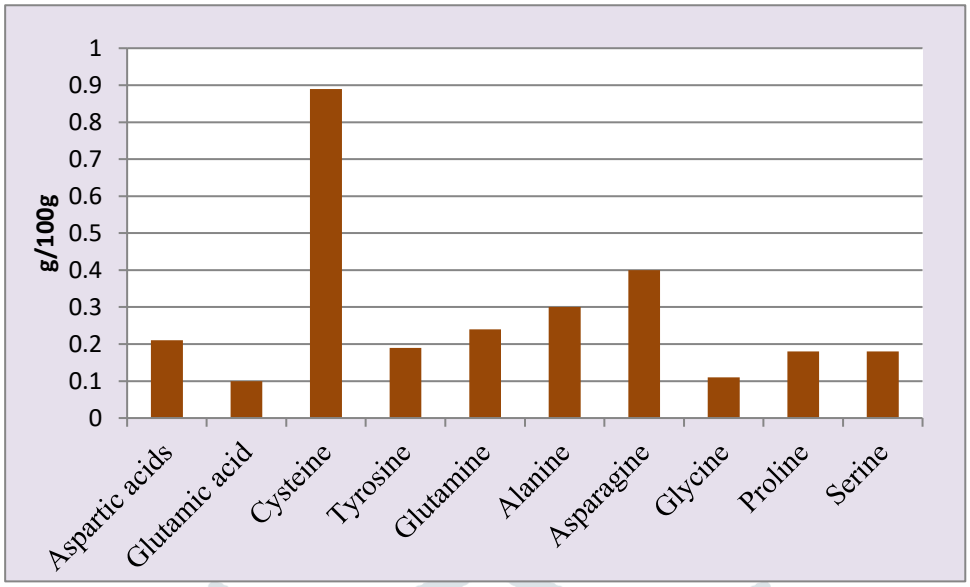
Fig.5 Essential amino acid composition of *Sardinella longiceps* at Kanyakumari coast

Among non-essential amino acid (NEAA) composition in *Sardinella longiceps* of Chennai coast (Fig. 6), cysteine (0.88 g) seems to be the most dominant followed by serine (0.78 g), proline (0.67 g), and glutamine (0.41 g). Asparagine and glycine (0.29 g) were found to be present equally. The NEAA of *Sardinella longiceps* in Tuticorin coast is illustrated in (Fig. 7). Cysteine (0.89 g) was the higher than the other NEAA and then followed by asparagine (0.40 g), alanine (0.30 g), glutamine (0.24 g), aspartic acids (0.21 g), tyrosine (0.19 g), proline (0.18 g), serine (0.18 g), glycine (0.11 g) and glutamic acid (0.10 g). In the case of Kanyakumari Coast (Fig. 8), the highest NEAA content was seen in Cysteine (0.95 g) followed by asparagine (0.40 g) and alanine (0.30 g). Proline and serine (0.19 g) as well as Glutamic acid and glycine (0.11 g) were found.



Cys>Ser>Pro>Glu>Glu.A>Try>Asp>Gly>Ala>Asp.A

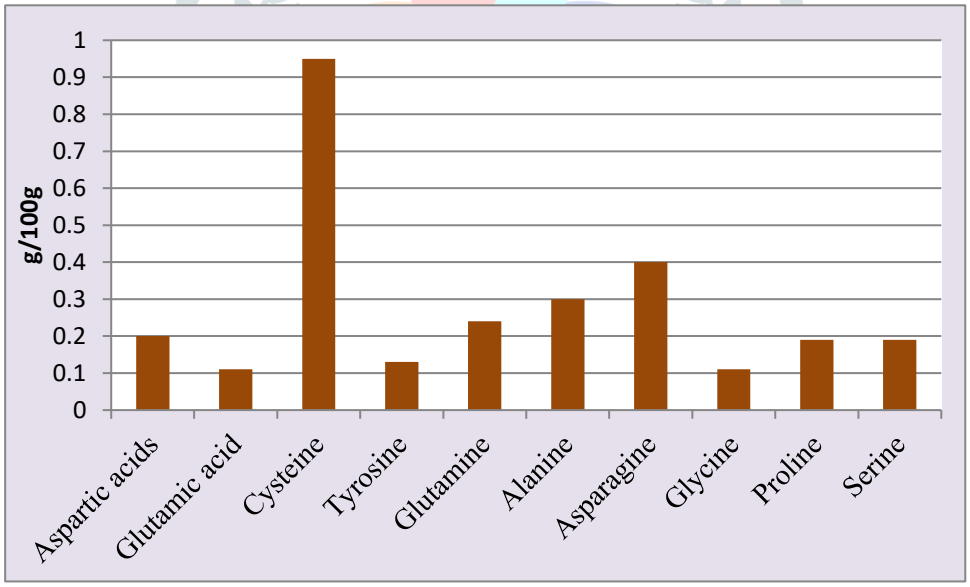
Fig.6 Non-essential amino acid composition of *Sardinella longiceps* at Chennai coast



Cys>Asp>Ala>Glu>Asp.A>Tyr>Pro>Ser>Gly>Glu.A

Fig.7 Non-essential amino acid composition of *sardinella longiceps* at Tuticorin coast

Over all comparison of total EAA content (Table.2) of *Sardinella longiceps*, fish collected from Chennai Coast showed more ΣEAA (3.41) than the other coastal areas, Tuticorin (2.77) and Kanyakumari (2.98) showed variation. While, total NEAA content of *Sardinella longiceps* was the highest in Chennai (4.25) coast followed by Kanyakumari (2.82) and Tuticorin (2.8)



Cys>Asp>Ala>Glu>Asp.A>Pro>Ser>Tyr>Gly>Glu.A

Fig.8 Nonessential amino acid composition of *Sardinella longiceps* at Kanyakumari coast

Table. 2 Comparison of amino acid composition (g/100g) in *Sardinella longiceps* in different coastal areas of Tamil Nadu.

AMINO ACIDS	CHENNAI (g/ 100g)	TUTICORIN (g/ 100g)	KANYAKUMARI (g/ 100g)
Threonine	0.33±0.03^{a}	0.19±0.02^{b}	0.20±0.02^{b}
Valine	0.21±0.02^{a}	0.18±0.01^{a}	0.19±0.03^{a}
Arginine	0.79±0.05^{a}	0.12±0.02^{b}	0.13±0.02^{b}
Methionine	0.38±0.45^{a}	0.39±0.03^{a}	0.43±0.03^{a}
Isoleucine	0.45±0.05^{a}	0.50±0.05^{a}	0.53±0.02^{a}
Leucine	0.39±0.04^{a}	0.23±0.03^{b}	0.29±0.03^{b}
Lysine	0.22±0.02^{b}	0.30±0.02^{a}	0.31±0.02^{a}
Phenylalanine	0.29±0.01^{a}	0.18±0.02^{b}	0.19±0.01^{b}
Histidine	0.41±0.09^{a}	0.38±0.03^{a}	0.39±0.01^{a}
Tryptophan	0.21±0.02^{b}	0.30±0.01^{a}	0.32±0.03^{a}
Total EAA	**3.41**	**2.77**	**2.98**
Aspartic acid	0.13±0.02^{b}	0.21±0.02^{a}	0.20±0.05^{a}
Glutamic acid	0.30±0.05^{a}	0.10±0.02^{b}	0.11±0.03^{b}
Cystiene	0.88±0.08^{a}	0.89±0.10^{a}	0.95±0.04^{a}
Tyrosine	0.29±0.04^{a}	0.19±0.02^{b}	0.13±0.01^{c}
Glutamine	0.41±0.03^{a}	0.24±0.03^{b}	0.24±0.03^{b}
Alanine	0.21±0.04^{a}	0.30±0.04^{a}	0.30±0.07^{a}
Asparagine	0.29±0.04^{b}	0.40±0.05^{a}	0.40±0.05^{a}
Glycine	0.29±0.02^{a}	0.11±0.01^{b}	0.11±0.04^{b}
Proline	0.67±0.07^{a}	0.18±0.03^{b}	0.19±0.04^{b}
Serine	0.78±0.07^{a}	0.18±0.02^{b}	0.19±0.02^{b}
Total NEAA	**4.25**	**2.8**	**2.82**
EAA/ NEAA	**0.80**	**0.98**	**1.05**

Results are the mean values triplicates ± Standard deviation (SD) with significant difference at P<0.05.
Identical lower case superscripts denote similar values horizontally.
EAA and NEAA represent Essential and Non Essential Amino Acids, respectively

DISCUSSION

Knowledge of the proximate composition of fishes are essential to estimate their energy value and to plan the most appropriate industrial and commercial processing (Hanna *et al*., 1980). The biochemical composition (%) showed (Table. 1) significant differences (p<0.05) between three different coastal areas of *S. longiceps*. 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 content of *S. longiceps* was highly present in Chennai coast, then in Tuticorin and Kanyakumari coast. 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).

It is known that fish protein is of good quality, containing a good amount of essential amino acids, and is highly digestible and a major source of energy (Bahurmiz *et al*., 2017) estimated 15.1-22.4% protein in Indian mackerel. Amino acids are the building blocks of proteins and also play a central role as intermediates in metabolism (Baldwin, 2003). Food and tissue proteins contain 20 different amino acids of nutritional importance. Amino acids are nutritionally dispensable or nonessential (Harper and Yoshimura, 1993). In addition, amino acid molecules are linked together to form proteins. The muscle is apparently the main protein storage location in fishes. From the present study, the amino acid compositions (g/100g) of different coastal areas of fishes were represented in table. 2. There are 10 essential amino acids (EAA) and non-essential amino acids (NEAA) reported in three locations.

The amino acid analysis showed a significant difference between the types and location with the presence of all essential and non-essential amino acids (EAA and NEAA) ($p<0.05$) respectively. Among three locations, the total EAA was moreover equally present. Higher amount threonine was recorded in Chennai fishes. This value was lower than the other study of oil sardine of Nagapattinam coast (Sinduja *et al*., 2013) and kerala coast (Shaji and Hindumathi, 2013). While, the arginine was highly accumulated by Chennai fish and it is lower than the Nigerian fish *Clarias anguillaris*, *Oreochromis niloticus* and *Cynoglossus senegalensis* (Adeyeye, 2009). Similar amount of methionine was recorded in all sampling locations of *S. longiceps*. Methionine is powerful antioxidant and a good source of sulphur, which prevents disorders of the hair, skin, and nails, assists the breakdown of fats, thus helping to prevent a build up of fat in the liver and arteries that might obstruct blood flow to the brain, heart, and kidneys. It helps to detoxify harmful agents such as lead and other heavy metals, helps diminish muscle weakness, prevents brittle hair, protects against the effects of radiation, beneficial for women who take oral contraceptives because it promotes the excretion of oestrogen, reduces the level of histamine in the body which can cause the brain to relay wrong messages, helpful to individuals suffering from schizophrenia (Bruce Barber, 2013).

Higher amount of isoleucine estimated in Kanyakumari and Tuticorin fishes. But the leucine recorded maximum in Chennai fish. Isoleucine and leucine help to promote healing of muscle tissue, skin and bones. Leucine is recommended for those recovering from surgery, carbohydrate and lipid metabolism and growth hormone production (Shen and Wang, 1990). Histamine is an indispensable amino acid involved in many metabolic functions including the production of histamines, which take part in allergic and inflammatory reactions. It plays very important role in maintaining the osmoregulatory process and is related to energy production or is used in other metabolic pathways during certain emergencies harsh conditions (Abe and Ohmama, 1987).

NEAA of *S. longiceps* of different coast showed statistically significant differences ($p<0.05$) between the fishes. The sardines of Chennai Coast contained higher amount of total NEAA when compared to Tuticorin and Kanyakumari Coast. Protein and amino acid variations may indicate an increase in the biosynthesis of various proteins, including hormones, enzymes, and lipoproteins involved in mating, fertilization and normal development of embryo in decapods (Rosa and Nunes, 2003). Above the EAA and NEAA are determined to the taste of oil sardine fish. Accordingly (Sikorski, 1990), the presence of arginine, glycine, alanine, serine and threonine gives taste sweetness, while arginine, leucine, valine, methionine, phenylalanine and histamine give bitter taste and high content of free arginine enriches sweet taste and yields a seafood like flavour. Meanwhile lipids are the important biochemical components of marine food webs because they are carbon rich and provide a concentrated source of energy (Parrish, 1988) and also lipids are now examined routinely as biomarkers in ecological studies and as tools to understand large-scale oceanographic processes (Budge *et al*., 2006).

CONCLUSION

From the study it was understood that the biochemical composition present in the fish sample was depends on temporal variations. Proximate and amino acids analysed in the study of Chennai coastal fish sample showed maximum, that could be due to the abundant diver site of Zoo and phytoplankton than the other coastal areas of the present study.

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