International Journal of
Science Inventions Today
www.ijsit.com
ISSN 2319-5436
Research Article

ANALYSIS OF NUTRITIVE VALUES OF SOME SELECTED EDIBLE AQUATIC ANIMALS IN THENGAITHITTU ESTUARY, PUDUCHERRY.

S. Manikandan[1*], V. Ramalingam[2], Kakhuangailiu Gangmei[1], P. Hemaladkshmi[1], K. Aneha[1], Sahadiya Mandodan[1], Bhagyashree Bora[1], V. Abhisubesh[1] and Jibi Lukose[1].

[1]*Unit of Microbiology and Immunology, ICMR-Vector Control Research Centre, Department of Health Research, Ministry of Health and Family Welfare, Puducherry - 605006, India.*

[2]*Department of Zoology, Kanchi Mamunivar Centre for Post Graduate Studies, Lawspet, Puducherry-605008.*

ABSTRACT

Estuaries are sensitive ecosystems that serve as a transitional zone between the land and the sea thanks to their special physical, chemical, and biological characteristics. They are complex and delicate aquatic environments that receive a lot of nutrients and human-made garbage from the land and transmit them to the inshore sea. Several kinds of fish that are significant to the fishing industry use this location as a breeding and nursery habitat. The objective of current research was to investigate the proximate biochemical composition of the edible portions (muscle) of some fishes such as, *Mugil cephalus* and *Ictalurus punctatus*, crustaceans such as, *Fenneropenaeus indicus and Portunus sanguinolentus* and mussel *(Perna viridis)* available at Thengaithittu estuary, Puducherry, India. The results showed that the *Portunus sanguinolentus* had the highest value of crude Protein and Carbohydrate, Asian green mussel (*Perna viridis*) had the least. In the study, Asian green mussel had the highest value of moisture content and *Portunus sanguinolentus* had the least. The *Ictalurus punctatus* had the highest value of crude lipid and ash, lipid content least in *Perna viridis* and ash content minimum in *Portunus sanguinolentus*. This study provides the information on nutritive values of estuarine fish and shell fish consumed in Thengaithittu estuary at Puducherry are well documented, and therefore provides an essential baseline data for future levels of study which may be compared and evaluated.

Keywords: Thengaithittu estuary, channel cat fish, Asian green mussel, three spotted crab.

INTRODUCTION

Estuarine ecosystems are moderately enclosed bodies of water where river freshwater mixes with oceanic saltwater to create an integrated salinity environment. They enlarged from the landward border of saltwater or tidal influence seaward to the periphery between mixed salinity and oceanic saltwater. Estuaries are sensitive ecoregions with special chemical, biological, and physical characteristics that serve as an intermediate area of land and sea water. They are intricate and active aquatic ecosystems that consists of considerable amounts of nutrients derived from human waste of the land which are transmitted to the sea [1]. Nutrition is the essential requirement for all living creatures in the Universe. Each organism need to obtain nutrition in order to survive and to get energy. To provide a more nutrient-dense and aesthetically pleasing product to consumers, nutrition is the most important factor, along with factors like fatty acid composition, fat level, flavor, color, and texture [2,3]. The source of nutrition is obtained from variety of vegetables, fruits and meat etc. Besides in aquaculture, fish is a chief nutritional source which contains protein, lipid, carbohydrate and the other trace elements. Apart from fish, other aquatic organisms like crab, prawn, oyster, lobster etc., are also considered to be a nutritious food [4]. As a result of its relevance as a component of a healthy diet due to its content of high omega-3 fatty acids, low saturated fat, and good protein the consumption of seafood has recently been extensively advocated [5]. Because of their presumed high cholesterol levels, crustaceans, which make up the majority of seafood, are sometimes overlooked as healthy foods despite being key nutritional providers of protein and minerals [6]. Globally, the use of oceanic natural resources for human sustenance has risen quickly. Sea food is simply digestible because it has very small amount of connective tissue [7]. Shellfish are regarded as nutrient-dense sources of numerous minerals and premium proteins [8].

In general, marine food is not only scrumptious but also contains essential nutrients required for our wellbeing. Proteins, vitamins, and minerals abound in seafood. Some seafood has a low cholesterol content. Seafood helps people live longer after a heart attack and lowers their risk of developing heart disease. It also reduces body fat, it decreases blood pressure and aids in improving health. Because of the multifunction it serves in the body, it is particularly important in the diet. Some of the well-known sources of animal protein used for tissue growth and repair include fish, cattle, beacon, and chicken products. However, less valuable animals like crab may be employed to satisfy the protein needs of those who are less fortunate [9].

Mostly, the quality of biochemical composition of a whole body is an indication of animal superiority, determining its nutritional value in comparison to other organisms. These components including carbohydrates, proteins, and lipids form a crucial resource for evaluating the provision index of species like fish, prawns, crab, etc., which serve as a source of nutrient-dense seafood and as a valuable indicator of attaining their peak nutritive value. Since the nutritional value of any edible species is indicated by their biochemical components, knowledge of their chemical makeup is of utmost importance [10]. Only after evaluating the species' nutritional significance in terms of its nutritional benefits may a newer species is suggested for human use.

The current study was an attempt made to analyze and compare the proximate chemical composition of estuarine organisms such as ***Mugil cephalus*** **(Flathead grey mullet)**, ***Ictalurus punctatus*** **(Channel catfish)**, ***Fenneropenaeus indicus*** **(Indian white shrimp)**, ***Portunus sanguinolentus*** **(Three spotted crab)** and ***Perna viridis*** **(Asian green mussel)** from Thengaithittu estuary, Puducherry in east coast of India.

MATERIALS AND METHODS

Study site:

The study was undertaken in the Thengaithittu estuary region, Puducherry. The Thengaithittu estuary is situated 162 kilometers south of Chennai in the Southern part of Puducherry (Lat 11 59 N, long 79 50 E). Table 1 showing the description of the study area and Figure 1 showing the location map of the study area.

SL No	Region	Description
1	**South side of estuary**	Veerampatinam canals joins with estuary (Domestic wastes, drainage water, fisheries wastes)
2	**West side of estuary**	Ariyankuppam river joins with estuary (domestic sewage wastes, drainage water, poultry wastes dumping, industry effluents, LPG company wastes)
3	**East side of estuary**	Sea and fresh water
4	**North side of estuary**	A grand canal joins with estuary (the largest, domestic wastes drainage water canal in the city. Contains heavy metals, chemicals and plastics dumps from beverage industries and hotels)

Table 1: Description of study area

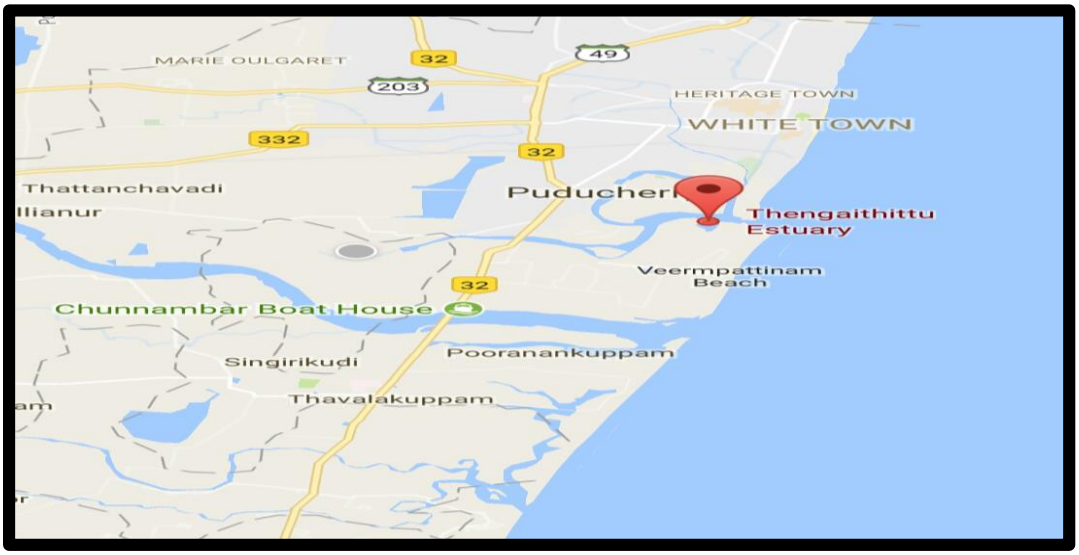

Figure 1: Map showing the study area- Thengaithittu estuary (Normal view).

Study species:

The study species were ***Mugil cephalus*** **(Flathead grey mullet)**, ***Ictalurus punctatus*** **(Channel catfish)**, ***Fenneropenaeus indicus*** **(Indian white shrimp)**, ***Portunus sanguinolentus*** and ***Perna viridis*** **(Asian green mussel)** selected based on the following criteria: Recognized as commonly consumed, caught relatively easily and recreationally and possess good taste in the Thengaithittu estuary, especially recognized to have a good source of nutritional content.

Sample collection and processing:

Fresh specimens of crab, fish, mussel and prawn were procured from the catching site of the Thengaithittu estuary, Pondicherry. Fishermen and locals use this location as one of their primary fishing grounds. A total of 60 samples from five different species were collected. The fish samples were immediately brought to the laboratory for nutritional examination. In order to preserve the samples before examination, they were placed in insulated containers with crushed ice. They had been frozen and covered in aluminum foil.

Crabs were taken and their surface skeleton was cleansed with distilled water to remove any waste particles present at the surface and the edible meat portion (muscle) of the crab was collected aseptically using sterilized scissors and forceps. The muscles were collected from arms (Pedi pulp) and abdomen region. The shrimp's endoskeleton and exoskeleton (head and outer body shell, or shell) were divided (i.e. edible muscles). The muscles were taken from the fish and mussel. Using a mortar and pestle, the dissected muscle tissues were homogenized. The proximate composition of the grounded muscles was processed right away.

Biochemical estimations:

The muffle furnace method was used to calculate the percentage of moisture and the amount of ash in a muscle sample. The whole protein content of the muscle sample was ascertained by means of the technique described by [11]. The total lipid was calculated using the [12] technique. Carbohydrate level in muscle part was estimated by the method proposed by [13] also known as Anthrone’s method. The tissues were digested with 30% KOH and glycogen was precipitated with ethanol. The precipitate was further treated with anthrone’s reagent and the glucose content was determined calorimetrically.

Statistical Analysis:

Statistical analysis including mean, standard error test was done using Microsoft excel (2010) package for windows.

Results and Discussion:

The primary components of aquatic species' edible parts include protein, carbohydrates, ash (minerals), water, and lipid (fat or oil). Proxy analysis refers to the study of these fundamental components. The outcome revealed the general chemical make-up of the investigated species (Table 2).

SL.NO.	SPECIES	Protein (g %)	Carbohydrate (g %)	Lipid (g %)	Moisture (g %)	Ash (g %)
1	**MULLET**	21.636 ± 0.881	1.232 ± 0.067	2.85 ± 0.058	77.4 ± 2.449	2.8 ± 0.1326
2	**CAT FISH**	19.864 ± 0.877	1.087 ± 0.070	3.142 ± 0.088	76.8 ± 1.4696	3.1 ± 0.1897
3	**PRAWN**	20.358 ± 0.866	0.87 ± 0.066	2.716 ± 0.088	74.2 ± 2.7129	2.72 ± 0.1166
4	**CRAB**	22.162 ± 0.796	1.262 ± 0.118	2.876 ± 0.161	69.6 ± 1.8547	2.44 ± 0.2154
5	**MUSSEL**	17.76 ± 0.835	0.79 ± 0.088	2.644 ± 0.122	79.2 ± 1.7204	2.62 ± 0.1326

Table 2: Proximate chemical compositions of studied organisms flesh samples.

From the results of our current study it is evident that protein content is at the maximum level in all our studied organisms, followed by the lipid content. Carbohydrate concentration is very minimal. The results have revealed that the protein content is maximum in crab followed by mullet> prawn> catfish and minimum in mussel (Figure 2). The similar kind of research article demonstrates that Sillago sihama (Forsskal), an economically significant fish from Zuari Estuary, Goa, was observed over a period of more than fifteen months from January 2004 to April 2005. The fish condition and seasonal differences in the biochemical constitution (lipid, moisture content, carbohydrate and, protein) were noted. The moisture content was between 76.2 and 79.6%. The lipid content ranged from 4.2 to 2.2%. The percentage of protein in the mixture was the highest, fluctuating from 19.1 to 24.96%, and the percentage of carbohydrates was the lowest, varying between 0.46 and 0.63%. The findings showed a substantial adverse association between the two components, with moistness content being in elevation when lipid was small during the greatest spawning (r = - 0.6, p 0.05). The month of November had seen the highest protein values and the lowest fat content. The body's store of carbohydrates did not seem to be greatly influenced by them [14].

The outcomes exhibited that the lipid content is higher in cat fish followed by crab> mullet> prawn and minimum in mussel (Figure 3), in the aspect of carbohydrate content is maximum in crab followed by mullet> catfish> prawn minimum in mussel (Figure 4), moisture level higher in mussel followed by mullet> catfish> prawn and minimum in crab (Figure 5) and ash content maximum in crab followed by mullet> catfish> prawn and minimum in mussel (Figure 6).

According to the prior articles, the proximate composition and metal accumulation of seven fish samples from diverse species (*Siganus javus, Perna viridis, Etroplus suratensis, Penaeus monodon, Mugil cephaluss, Scylla tranguebarica and Meretrix casta*) procured from Vellar estuary, East coast of India, were

evaluated. The levels of protein, lipid and carbohydrates, also vary from 11.81 to 20.34%, 1.15 to 2.65%, and 2.43 to 6.16%, respectively. Additionally, identified and discovered at normal levels were metals such as Cr, Fe, Cd, Cu, Mn, Co, Ni, Mg, and Zn [15].

Each value is Mean ± SEM of five animals

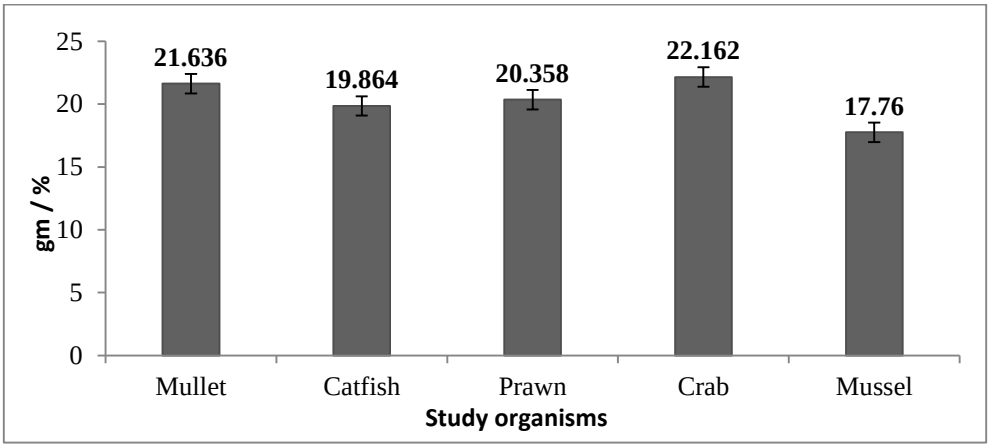

Figure 2: Protein content in observed organisms.

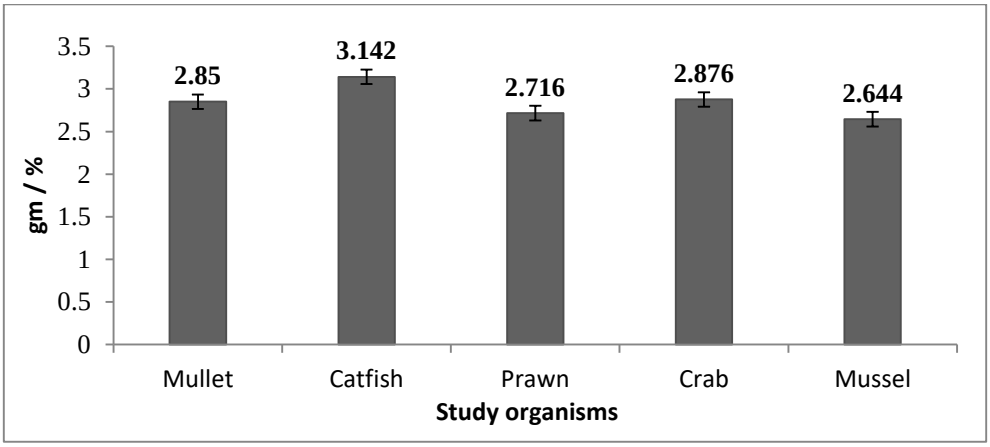

Figure 3: Lipid content in observed organisms.

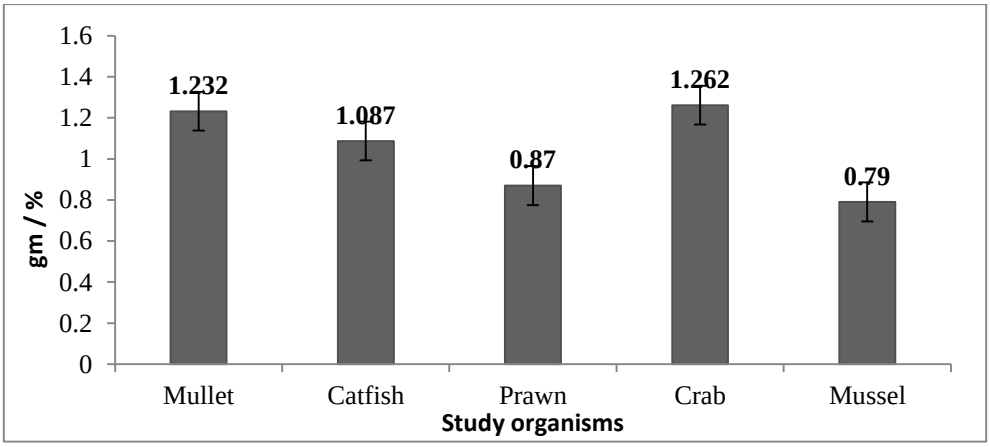

Figure 4: Carbohydrate content in observed organisms.

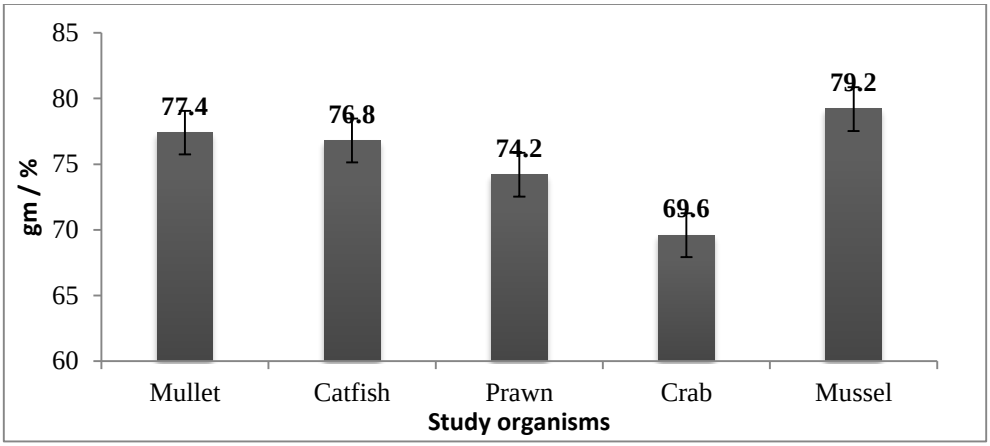

Figure 5: Moisture content in observed organisms.

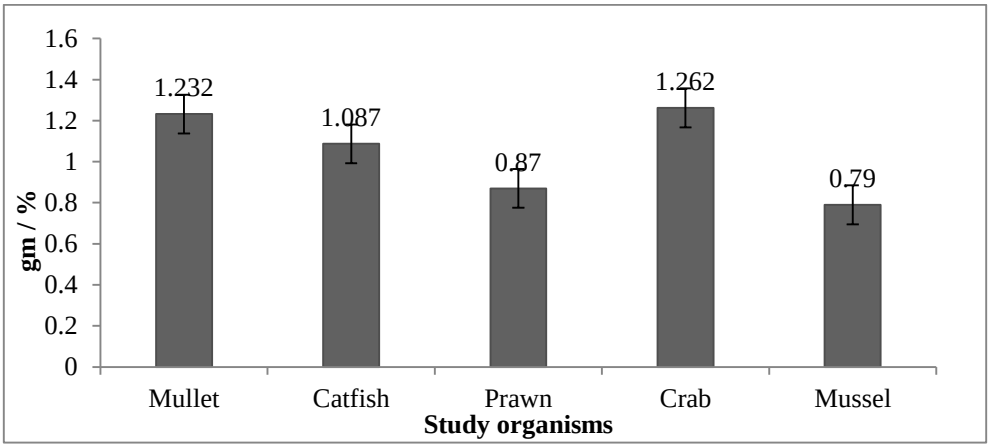

Figure 6: Ash content in observed organisms.

The overall results of our current findings showed that the contents of protein (17.76%-22.16%), lipid (2.64%-3.142%), carbohydrates (0.79%-1.26%) and ash (2.44%-3.1%) were found almost stable in all samples collected from study site. Total moisture contents varied from 69.6% to 79.2 among the study species. The edible portion of the three spotted crab and channel cat fish have good source of protein, carbohydrate and lipid.

One recent study showed the nutritional value of nine economically significant marine fish species' muscular tissues. Cu, Hg, Cr, As, Pb, Zn and Cd concentrations in the muscles (the eatable part) and tissues (the gill and liver) of fish caught in the East China were also measured, and the values of the target hazard quotient (THQ) and the carcinogenic risk (TR) were computed for measuring the risk to human health. In these species, there were significant differences in the near-surface chemical makeup of the fish muscles (P 0.05). The range of fish species' muscle protein content was 12.36 to 23.41%. The range of the fishes' muscle lipid content was 0.48 to 2.54%. In comparison to muscles, the potential of livers and gills to accumulate heavy metals was higher (save for Cr). Fish living in the demersal layer of the water column gathered more heavy metals than those in the middle-upper layer, which is where most fish reside. This suggests that the water layer in which most fish

are found also impacts the fish's tendency to accumulate (except Cu). The levels were under the permitted threshold for humans, according to the estimated daily intake (EDI), target hazard quotient (THQ), hazard index (HI), and carcinogenic risk (TR) assessments for potential human health risk implications. However, As and Cr's carcinogenic risk (TR) was nearly at the crucial level (10−4). Therefore, it is advised that heavy metal levels in the Dachen fishing ground region be continuously monitored in order to protect the healthiness and welfare of human consumption [16].

Another study reported that estuary fish are an economically significant species and are simple to grow in coastal locations. The benchmark used to assess and evaluate the nutritional value of food sources is its biochemical constitution. Consuming marine and estuarine fish offers a low-cost source of protein with a high nutritional value, as well as vital minerals and vitamins. The proximate composition of the major *Clupeidae* (*Sardinella longiceps, S. gibbosa, Nematalosa nasus, and Ilisha melastoma) and Engraulidae (Stolephorus indicus, S. commersonni, Thryssa mystax, and T. malabarica*) species in the Thengaithittu estuary is investigated for its.The most of the fish had protein values between 14 and 21%, and the normal moistness content fluctuated from 67 to 73%. The protein content of *T. mystax and S. commersonni* was high (21.3% and 19.2%, respectively). *S. longiceps* exhibited a high lipid content (6.3%), whereas other species' lipid contents ranged greatly from 2.4% to 6.3%. Carbohydrate concentration ranged from 0.8% in *S. commersonni* to 4.82% in *N. nasus*, and ash content ranged from 1.42% to 4.9% [17].

However, it must be taken into account that a variety of elements, including biological variances, environmental conditions, and seasonal changes, have an impact on the biochemical constitution of fish.

CONCLUSION

The present study findings indicate that the consumption of fish, prawn, crab and mussel available in Thengaithittu estuary, Puducherry had the good source of protein, carbohydrate, lipid, ash and moisture content. This study provides information and importance on nutritive values of estuarine fish, crab, prawn and mussel consumed in Thengaithittu estuary, Puducherry, India as well as gives an essential baseline data with which future levels may be compared and evaluated.

Acknowledgements:

The first author acknowledges the M.Phil. guide Dr. V. Ramalingam. Author also acknowledges to the Director, Kanchi Mamunivar Centre for Post Graduate Studies, Pondicherry for proving the facilities.

REFERENCES

1. Shruthi, M.S., Sushanth, V.R. and Rajashekhar, M. (2011). Diatoms as indicators of water quality deterioration in the estuaries of Dakshina Kannada and Udupi districts of Karnataka. *International journal of environmental sciences*, 2 (2): 996-1006.

2. Haard, N.F. (1992). Control of chemical composition and food quality attributes of cultured fish. *Food Research International,* 25: 289-307.
3. Rasumussen, R.S. (2001). Quality of farmed salmonids with emphasis on proximate composition, yield, and sensory characteristics. *Aquaculture Research,* 32: 767-786.
4. King, I., Childs, M.T., Dorsett, C., Ostrander, K.G. and Monsen, E.R. (2002). Shellfish: proximate composition, minerals, fatty acid, and sterols. *Journal of the American Dietetic Association*, 90: 677-685
5. Gil, A. (2002). Polyunsaturated fatty acids and inflammatory disease. *Biomedicine and Pharmacotherapy,* 56: 388-396.
6. Mathew, A.E. (1999). Trace elements in health and disease. *Nutrition,* 33 (1): 23-32.
7. Connor, W.E. and Lin, D.S. (1982). The effects of shellfish in the diet upon the plasma lipid levels in humans. *Metabolism*, 31: 1046-1051.
8. Leu, S., Jhaveri, S.N., Karakoltsidis, P.A. and Constantinides, S.M. (1981). Atlantic mackerel (*Scomber scombrus, L*): seasonal variation in proximate composition and distribution of chemical nutrients. *Journal of Food Science*, 46: 1635.
9. Ramalingam, S.T. (2001). Modern Biology 2nd Edit. Printed by Africana-fep publish.Ltd. 386-396.
10. Soundarapandian, P., Varadharajan, D. and Ravichandran, S. (2014). Biochemical composition of edible crab, *Portunus vigil (fabricius). Journal of Marine Science Research Development*, 3, 4172/2155-9910, 1000119.
11. Lowry, O.H., Rosebrough, N.J., Farr, A.L., and Randall, R.L. (1951). Protein measurement with the folin-phenol reagent. *Journal Biological Chemistry*, 193: 205-275.
12. Folch, J., Lees, M. and Stanley, S. (1957). A simple method for the isolation and purification of total lipids from animal tissues. *Journal of Biological Chemistry*, 226 (1): 497-509.
13. Hassid and Abraham, (1957). Chemical procedures for analysis of polysaccharides, Arcadia Press New York, 3: 34-36.
14. Shamsan, E.F. and Ansari, Z.A. (2010). Biochemical composition and caloric content in the sand whiting *Sillago sihama* (Forsskal), from Zuari Estuary, Goa. *Indian Journal of Fisheries*, 57 (1): 61-64.
15. Marichamy, G., Shanker, S., Saradha, A., Nazar, A.R. and Badhul Haq, M.A. (2011). Proximate composition and bioaccumulation of metals in some finfishes and shellfishes of Vellar Estuary (South east coast of India). *European Journal of Experimental Biology*, 1 (2): 47-55.
16. Huang, H., Li, Y. and Zheng, X. (2022). Nutritional value and bioaccumulation of heavy metals in nine commercial fish species from Dachen Fishing Ground, East China Sea. *Scientific Reports,* 12: 6927.
17. Vijayakumar, V., Sakthivel, D. and Anandhan. V. (2014). Proximate composition of *Clupeidae* and *Engraulidae* inhabiting Thengaithittu estuary Puducherry- South East Coast of India. *International Journal of Science Inventions Today*, 3(3): 298-309.