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ORIGINAL ARTICLE **OPEN ACCESS**

Assessing the Major nutritional potential of Endoskeleton in wild *Penaeus* species along the Coramandal coast of Tamilnadu

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ABSTRACT
The present study was carried out to evaluate the proximate and mineral composition of wild catch available marine Penaeus species, for their nutritive importance. The proximate composition was determined by BIS method and the minerals such as Calcium, Sodium and Potassium were estimated by AAS method. All the experiments were replicated. The results showed significant difference (p < 0.05) in all the parameters, such as moisture content ranges from (3.83 to 19.31%), highest crude protein was observed in Metapenaeus monoceros. The crude fat content varies from (0.74 to 3.54 %) were P.monodon showed the highest lipid content (3.54 %). The average total ash content was observed in Penaeus species ranges from (4.07 to 8.77 %), two species, P. indicus and P. semisulcatus showed highest values of (8.36 and 8.77%), crude fiber content was observed as 1.85% in P.indicus and 1.93% in Metapenaeus monoceros. Among the species P. semisulcatus shows Calcium (1664 mg/100g) followed by sodium (919 mg/100g) and potassium (699 mg/100g). Most of the Penaeus species are rich sources of protein and calcium and vital trace minerals (Fe, Zn, and Cu). Among the study, Metapenaeus monoceros recorded with high amount of protein. P. semisulcatus and P.indicus were recorded for macro minerals, whereas the concentration of micro minerals are in permissible limits the range of FAO. Thus from the results the study revealed, the analyzed shrimp species were good sources of nutrients and minerals which could provide health benefits on dietary supplements.
Keywords: Penaeus species, Proximate, Dietary supplements

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INTRODUCTION

According to 2019 edition, The State of Food Security and Nutrition in the World about 11 percent (more than 820 million people) of the world's population remain undernourished. Seafood has been an important part of the human diet. Fish is one of the primary consumption with greater importance in the human diet owing to its superior nutritional quality. Many components of seafood are critical for a healthy well balanced meal. Seafood has numerous nutrition and health benefits which provide essential nutrients for developing infants and children. They are rich in protein which lowers in calories, total fat, and saturated fat and also high in vitamins and minerals when compared to other animal foods rich in protein. Consumption of more seafood in diet can decrease the risk of heart attack, stroke, and hypertension.

Ryota Hosomi *et al*., [1] revealed that seafood plays a significant role in the maintenance and promotion of health. An average daily recommended amount of 30-40% protein can be utilized in 4-ounce serving of fish or shellfish. The protein in seafood is also easier to digest because fin and shell fish has less connective tissue compared to that of red meat and poultry. Most fin fish and shellfish contain less than 5% total fat. Marine-derived long-chain omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) help to reduce the risk of heart disease and contribute to brain and vision development in infants.

Shrimp farming and wild catching is of the important fishing activities . As shrimp be consumed for their taste and for the benefit of vital like nutrients like omega-3-High Unsaturated Fatty acids, astaxanthin, essential amino acids, vitamins and minerals [2]. Mendil, [3] states that minerals plays an important role in maintaining body functions by maintain acid-base balance, haemoglobin, bones formation and teeth structure, and catalyze many metabolic reactions. Macro minerals are encompassing both bulk minerals (calcium, phosphorus, magnesium) and electrolytes (sodium, potassium, chloride), which are required milligrams to several grams per day. Micro minerals or trace elements (iron, zinc, copper, manganese, selenium, iodine, chromium, molybdenum) are required in amounts of a few milligrams or less per day. The deficiency of these important mineral elements induces a lot malfunctioning as it reduces productivity and causes diseases, such as inability of blood to clot, osteoporosis, anemia etc., [4]. Anwarul Islam [5] suggested that both wild shrimp and cultured prawns as a healthy choice of food consumption and a good source of animal protein like fin fish.

MATERIAL AND METHODS

Wild shrimp samples namely, *Penaeus monodon, Penaeus semisulcatus, Penaeus indicus,* Metapenaeus *monoceros* each batch weight of 1 kg were freshly collected from the landing centres of different sites, southeast coast of India. The shrimp sample Penaeus *monodon* was collected from the Mandapam region (9°16'32.56"N, 79°7'25.03"E), Penaeus *semisulcatus and* Penaeus *indicus* from the Tuticorin region (8° 45' 50.9976'' N, 78° 8' 5.4024'' E) and *Metapenaeus monoceros* from Chennai region (13° 4' 2.7804'' N, 80° 14' 15.4212'' E) from south east coast of Tamilnadu.

The collected samples were washed thoroughly with tap water to remove the sand and other debris attached to the shrimp samples and kept it in ice cold box and carried to the laboratory. In the laboratory the shrimp samples were washed with deionised water and dissected the exoskeleton (head and shell) and endoskeleton (flesh) of the shrimps. The cleaned endoskeleton were kept in the hot air oven at 55°C for 17 hours [6]. The dried samples were ground into fine powder.

Proximate composition analysis

The content of moisture, ash, fat, protein, crude fiber were determined by the BIS method, Moisture (IS11623), Ash (IS 14433), Fat (IS 11721), Protein (IS 7219 : 1973) and Crude fiber (IS 10226).

Mineral analysis

The powdered samples were dissolved in 5mL of 5 N Nitric acid in a 100-mL volumetric flask, rinsed porcelain crucible each flushing with 10mL demineralized water in the same volumetric flask, and vortexed until homogeneous. The mixture was filtered with filter paper, discarded the first 10 mL filtrate, accommodated the subsequently filtrate and stored in the amber glass bottles, and used for quantitative analysis [7, 8, 9].

Mineral element determination

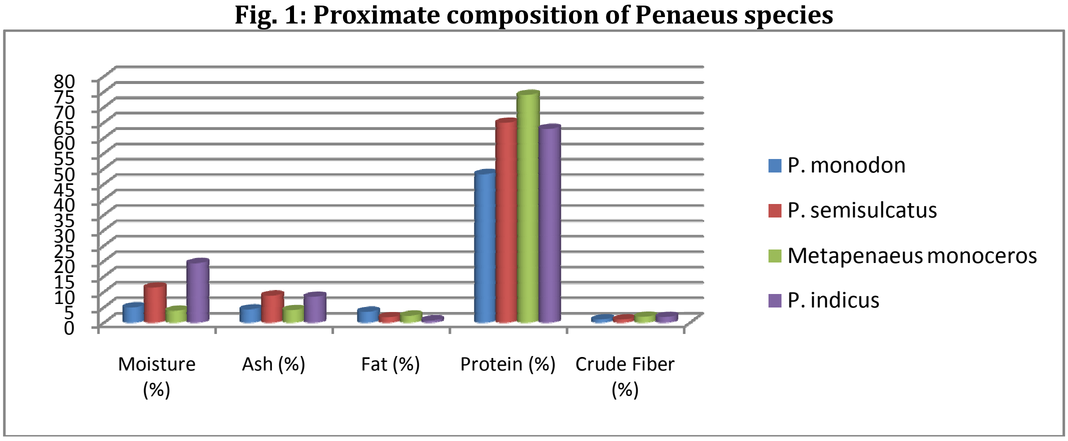
The filtered samples were determined by Atomic Absorption Spectrophotometer (Shimadzu, AA-7000). Minerals mentioned in the wave length.

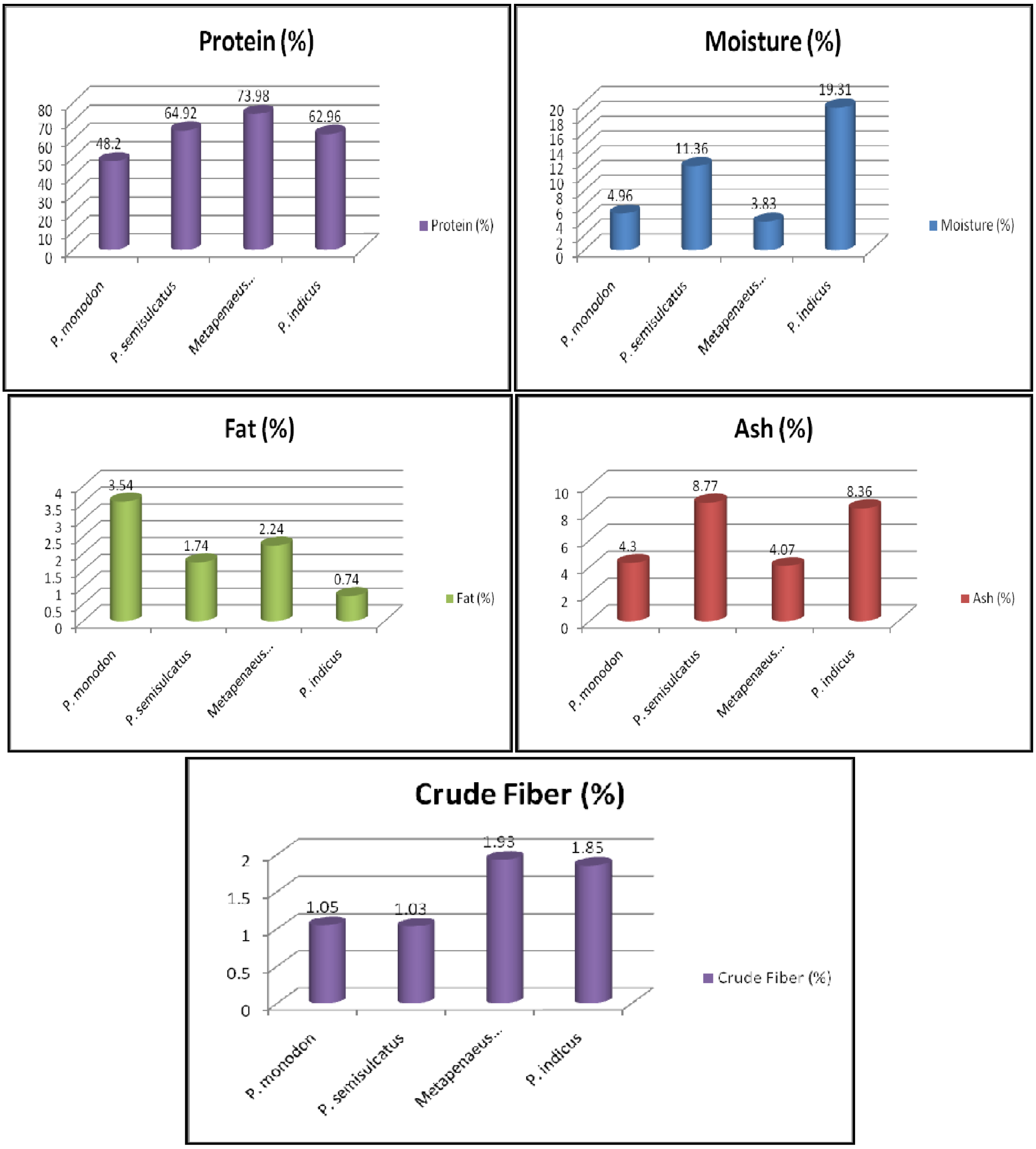
Minerals	Na	K	Ca	Mg	Fe	Zn	Cu
Wavelength (nm)	589.0	766.5	422.7	285.2	248.3	213.9	279.5

RESULTS

The proximate content of wild penaeus shrimp samples were determined and shown in the Fig. 1. From the results, In edible part of shrimp muscle, protein content was recorded as high and varied in species such as *Metapenaeus monoceros* (73.98%) followed by *P. semisulcatus* (64.92%), *P.indicus* (62.96 %) and lowest was recorded in *P.monodon* (48.2 %). The highest moisture content was observed in *P.indicus* (19.31%) while the lowest value was recorded in *Metapenaeus monoceros* as 3.83 %. Fat content of the wild shrimp species varied from varied from 0.74 % to 3.54%. Fiber content varies from 1.03 to 1.93%. The ash content, of the studied shrimp species varied from *P. monodon* 4.3 % to 8.77% *P. semisulcatus.*

Fig. 1: Proximate composition of Penaeus species



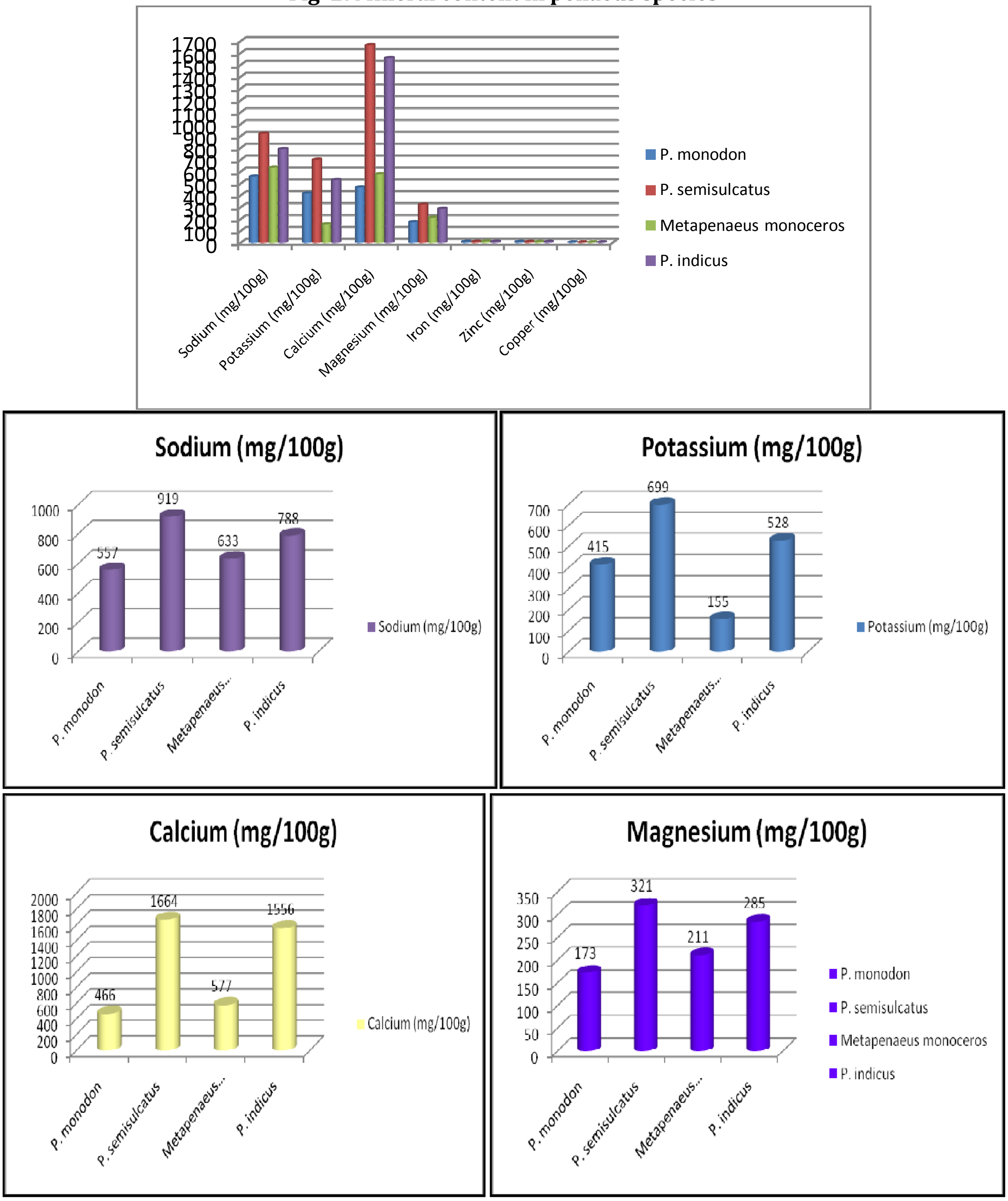


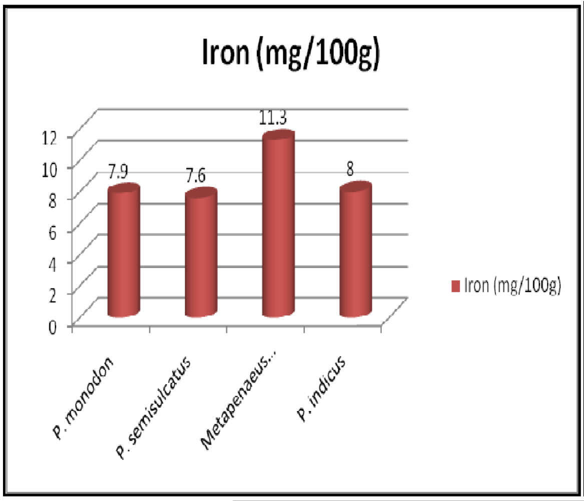
The mineral content of the study animals were presented in the Fig.2 showed the maximum content of calcium (1664 mg / 100g) in *P.Semisulcatus*, followed by the *P.indicus* (1556 mg/100g), *Metapenaeus monoceros* (577 mg/100g) and the minimum content was found in the *P. monodon* (466 mg/100g). The sodium content of the shrimp species were found to be in the range of 557 mg/100g to 919 mg/100g, *P.semisulcatus* (919 mg/100g) showed the highest amount and *P.indicus* (788 mg/100g) followed by *Metapenaeus monoceros* (633 mg/100g) and *P. monodon* (577 mg/100g). *P.semisulcatus* shows the maximum content of potassium, the value 699mg/100g and followed by *P.indicus* (528 mg/100g), *Metapenaeus monoceros* (155 mg/100g) showed the lesser value of potassium. The Magnesium content of the shrimp species varied from 173 mg/100g (*P. monodon*) to 321mg/100g (*P.semisulcatus*). *Metapenaeus monoceros*.

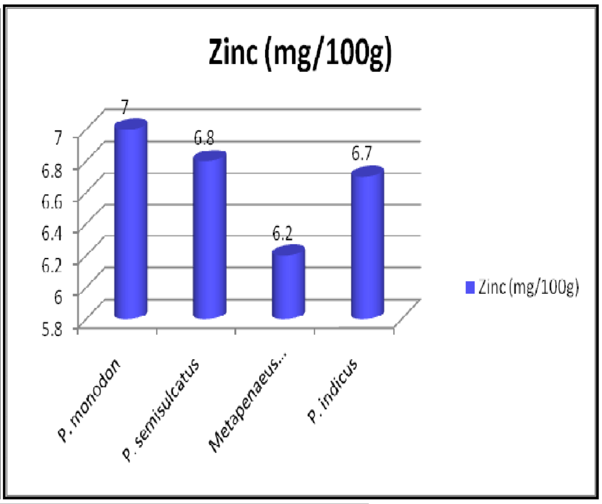
The trace minerals such as Iron (Fe), Zinc (Zn), Copper (Cu) were also determined. The iron content was recorded high in *Metapenaeus monoceros* (11.3 mg/100g) followed by *P.indicus* (8.0 mg/100g) similarly *P.monodon* (7.9 mg/100g) and *P.semisulcatus* (7.6 mg/100). Zinc was recorded in the range of 6.2 mg/100g to 7.0 mg/100g, *P.monodon* showed maximum content 7.0 mg/100g, followed by *P.semisulcatus*

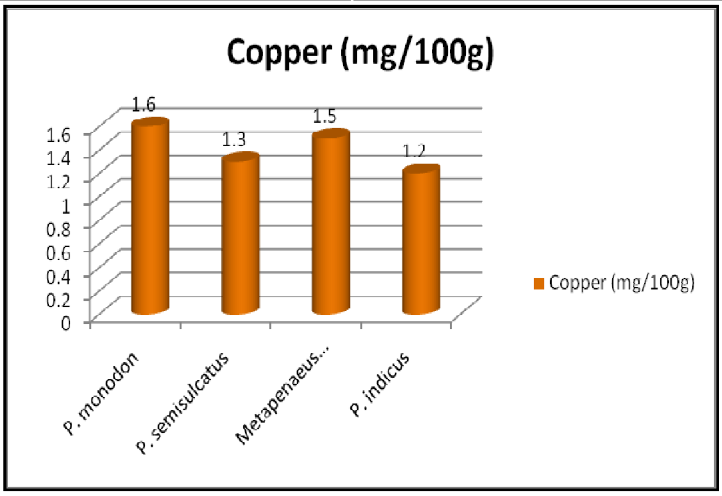
(6.8 mg/100g), similarly *P.indicus* (6.7 mg/100g) and Copper varied in the species from 1.2 mg/100g (*P.indicus*) to 1.6 mg/100g (*P.monodon*).

Fig. 2: Mineral content in penaeus species









DISCUSSION

The present study investigated the proximate composition and mineral contents of wild catch *Penaeus* species of south east coast of Tamilnadu, India. Our result in support with the study report [10] who studied the percentage of moisture content in the peeled tails of shrimp samples collected from coastal waters of Nellore varied from 76.3% to 80.8% with an average of 78.6 %. Typically most of sea foods, the total moisture content of fresh shrimp nearly 80% of the body weight. This result compares well with 80.5% and 77.2% reported in earlier studies for black tiger shrimp and white shrimp, respectively. Sriket *et al.,* [11] and Akonor *et al.,* [12] reported that the low moisture content in dried shrimps is encouraged to safeguard the product from microbial attack and enzymatic action and therefore prevent spoilage. The present result revealed that the low amount of moisture, as well as dietary fiber and ash content found in all the species. The results of ash content in the penaeus species samples which coincides with the study report of Diler *et al.,* [13], the average values of ash for *Penaeus semisulcatus* were reported as 4.06%. Similarly the present study observed the range of ash content was 4.07 to 8.77%. The result found in the crude fiber content was low, similarly Syed Raffic Ali *et al.,*[14] observed Crude fiber content was quite low in the edible parts of *P.mondon* (0.19%) and *F.indicus* (0.17%). Contradictory were findings [15].who recorded a higher level of crude fiber content (8.2%) in edible and (8.7%) non-edible portions of Penaeus *indicus* whereas our results recorded with low fiber content.

Sufficient fat in the diet is essential for the absorption of some vitamins and as a source of essential fatty acids. The fats found in the shell fish are predominantly polyunsaturated fatty acids (PUFA). The fat content of shell fish varies with species but they have a low content, lipid content falls between 0.5% to 5.5% for the prawns and shrimp [16]. Our result shows the range of fat content was 0.74 % to 3.54% respectively. The intake of PUFA has been considered important in human nutrition. Fish lipids have shown a positive effect in preventing certain diseases like cardiovascular diseases. Omega-3 fatty acids found in fatty fishes are known to be essential in the growth of children and prevent coronary heart disease. The DHA is important for optimal brain and neurodevelopment in children and on the other hand EPA helps to improve the cardiovascular health [17]. Mostly shell fish has low amount of fat content, according to that the percentage of fat varies from 0.74 % to 3.54%. In the fish and meat the content of dietary fiber was less [18], the current studies shows the percentage of fiber from 1.03 to 1.93% only. There is no significant difference was observed in the ash content, the results was 4.3 % to 8.77%.

Human body cannot produce certain amino acids but has to get from the daily diet. Shrimp is great source of protein with essential amino acids, boosting up to 77% of its calories. V.Venugopal [17] stated that the freshwater prawn (*M. rosenbergii*) contains 83.2% protein, According to Sambhu *et al.,* [18], the protein level in *P. indicus* was varied from 44.62 to 80.87%. Protein plays the vital role in the nutritional content of the shrimps. J.Pal *et al.,*[19] expressed the digestibility of fish proteins is high i.e. 85-95%. Fish protein is mainly responsible for building and repairing muscle tissues, improving immunity and blood quality. Mohanty [20] stated that fish protein play an important role in preventing protein-calorie malnutrition, the protein immunoglobins can act an important defense against bacterial and viral infections and helps in the maintenance of electrolyte and water balance in human system. Syed Raffic Ali *et al.,*[15] reported that 23.60% of crude protein in the edible parts of P.monodon. Ahkam El-Gendy *et al.,* [21] studied the protein contents in the female edible muscle of P. semisulcatus from Mediterranean Sea (Alexandria) and market (India) were higher than that of males and concluded the highest protein content present in the India's female P. semisulcatus (37.99 g/100g). Vardi Venkateswarlu [10] was observed the protein content in 52.4% in *P.indicus* and 48.6% in *P.monodon* and 39.8% in *P.vannamei* respectively. Our results indicated that the study animal shows the maximum protein value, Metapenaeus *monoceros* shows 73.98%) followed by P.*Semisulcatus* (64.92%), P.*indicus* (62.96 %) and P.*monodon* (48.2 %).

Kumaran *et al.,* [23] reported that marine foods are very rich sources of both macro and micro mineral components. Figures 2 (a) – 2 (g) show the mineral composition of (P. semisulcatus, P. *indicus*, P.*monodon* and Metapenaeus *monoceros*). In this study, samples contained appreciable concentrations of Ca, Na, K and Mg were investigated and suggesting that these shrimp species are a good source of nutrient minerals. The levels of micro minerals (Zn, Cu and Fe) analyzed were also within tolerable limits [22].

Among the four penaeus species investigated the most dominant macro mineral was calcium found in the P.semisulcatus (1664 mg/100g) followed by P.*indicus* (1556 mg/100g). This is similar to the report of Y.Yanar *et al.,* [24], wild P. semisulcatus (107.36 mg/Kg) included higher than the cultured P. semisulcatus (89.77 mg/Kg). Calcium is the most abundant mineral in the body with 99% found in teeth and bone. Only 1% is found in serum. Other than hard tissue structure formation, Calcium metabolism involves other nutrients including protein, vitamin D, and phosphorus, blood clotting, muscular contraction and also a messenger in the cell signaling. Appropriate calcium intake has shown many health benefits, such as reduction of hypertensive disorders of pregnancy, lower blood pressure particularly among young people, prevention of osteoporosis and colorectal adenomas, lower cholesterol values, and lower blood pressure in the progeny of mothers taking sufficient calcium during pregnancy [25]. Lactose intolerance due to lactase deficiency is a common cause of low calcium intake.

Sodium and potassium are widely distributed in the shellfish [28]. Sodium is the principal elements in the extracellular fluid. It maintains the acid-base equilibrium of the body fluids. 85% of the sodium found in the blood and lymph fluid. For the glycogenesis process, Potassium also required to transfer of phosphate from ATP to pyruvic acid. In the nerve cell transmission, the Na^+ / K^+ pump maintains the gradient of a higher concentration of sodium extracellularly and a higher level of potassium intracellularly in the ratio of 3:2 [26]. Our present report recorded shows the highest content of sodium (919 mg/100g) and potassium (699 mg/100g) in the P. *semisuclatus* followed by the P. *indicus* (788 mg/100g of sodium and 528 mg/100g of potassium) respectively. T. Jose Fernandez *et al.,* [27] studied the minerals and trace elements in the coastal and deep sea shrimp and reported that the second leading content of sodium in F.*indicus* (6902 ppm)

Anne Marie Uwitzone [30] stated that Magnesium is the fourth most abundant mineral in the human body after calcium, potassium, and sodium. Magnesium activates more than 600 enzymes and influences extracellular calcium. Magnesium may improve bone health both directly and indirectly, as it helps to regulate calcium and vitamin D levels. According to a Binghao Zhao *et al.,* [31] increasing magnesium intake may lower a person's risk of stroke. They report that for each 100 mg per day increase in magnesium, the risk of stroke reduced by 2%. In many studies, researchers have linked high magnesium diets with diabetes. Jennifer Beatriz *et al.,* [32] reviewed the effect of magnesium supplementation on insulin resistance in humans suggests that taking magnesium supplements can also improve insulin sensitivity in people with low magnesium levels. This study observed that P.semisulcatus has the highest value of magnesium content and leading by P.indicus.

Iron is considered as a trace mineral, requirement of iron is higher than that of other trace minerals. E. Silva, [29] observed the shrimp muscle can be a good iron source (88.9 mg/g dry weight). Kohgo [33], the amount of iron in haemoglobin accounts for about two thirds of the mass of iron in the human body.

The bone marrow is thus the prime iron consumer in the body, since this is where erythropoiesis takes place. Bone marrow erythroblasts require large amounts of iron for hemoglobin synthesis [34]. While some causes of anaemia include diseases such as thalassaemia or malaria, around 50% of the prevalence of iron deficiency is due to inadequate dietary Fe intake or poor absorption of Fe from the diet [35]. Our current study reported that when compared with the zinc, iron content was high in the Metapenaeus *monoceros* (11.3 mg/100g) followed by the P.*indicus* (8.0 mg/100g).
Copper aids in the formation of bone and cartilage and helps the body use iron properly. This study reported the copper ranges from 1.2 mg/100g (P.*indicus*) to 1.6 mg/100g (*P.monodon*).The Cu concentrations found in three shrimp species **(***Macrobrachium* spp**,** *Parapenaeus* spp., *Penaeus* spp.) were below the FAO permissible limit of 30 mg/kg. [36]. The average daily intake of copper has been estimated to range from 0.5 to 0.7 mg for infants 6 months of age or less up to 2-3 mg for adults.
Human body has no specialized zinc storage system. Daily intake of Zinc is required for the human body. The U.S. Food and Drug Administration (FDA) recommend 11 mg/day of zinc for men and 8 mg/day for women [38]. U.S. National Research Council set a Tolerable Upper Intake for adults of 40 mg/day [37]. This study reveals that zinc ranges from 6.2 mg/100g to 7.0 mg/100g, P.*monodon* shows the maximum content as 7.0 mg/100g, followed by P.*semisulcatu*s (6.8 mg/100g), similarly P.*indicus* (6.7 mg/100g).

CONCLUSION

Shrimp is an excellent source of dietary protein as that of red meat. *Penaeus* species are rich source of protein and calcium and vital trace minerals (Fe, Zn, Cu). Among the study animals, *Metapenaeus monoceros* shows high amount of protein. *P. semisulcatus* and *P.indicus* were the richest source of macro minerals. The concentration of micro minerals are in the range of FAO permissible limits, The results of the study revealed that analyzed shrimp samples were good sources of nutrients and minerals could provide health benefits if consumed in moderate level Only those who are at a clear risk of CVD and diabetics may avoid this, until the dietary cholesterol controversy is settled.

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CITATION OF THIS ARTICLE

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