



COMPARATIVE STUDY ON THE PROXIMATE COMPOSITION OF PRAWN, LOBSTER AND PUFFER FISH FROM PAMBAN, RAMESWARAM ISLAND, SOUTH EAST COAST OF INDIA

Merline, X. and *Dr. Chitra, G.

*Assistant professor, Department of Zoology, Nirmala College for Women,

Coimbatore - 641018

Abstract

The present investigation has been designed to estimate the proximate composition of edible sea foods such as prawn (*Penaeus semisulcatus*), lobster (*Thenus orientalis*) and puffer fish (*Arothron immaculatus*). Selected marine edible species were collected from the landing centre at Pamban, Rameswaram Island. The collected samples were analyzed for their proximate composition including protein, carbohydrate, lipid, moisture and ash contents. The nutrient values varied among the three organisms. From the present results prawn and puffer fish had higher amount of protein content while lobster were rich in lipid and carbohydrate content. Our study suggest that three sea foods have shown to be good sources of nutrients while the prawn and puffer fish are particularly rich in protein, the lobster is rich in lipid content.

Key words: *Thenus orientalis*, *Penaeus semisulcatus*, *Arothron immaculatus*, Pamban, Rameswaram.

Introduction

Any life form in the sea is seen as food by man as seafood. This can range from fish, shellfish, shrimps, oysters, and so on. Demand for seafood is increasing worldwide due to increasing health consciousness. Millions of people suffering from malnutrition in our India, Protein deficiency may be minimized to some extent by making available cheaper fish meal items which are available to local communities. Edible Crustaceans, such as Crab, Prawn, Cray fish and Lobster constitute one of the major sources of nutritious food for human beings (Bugel *et al.*, 2001). Since seafood is recognized as a healthy food in terms of protein, unsaturated fatty acids and minerals, the demand for seafood in the global market is increasing.

Lobsters are invertebrates that feed mainly on fish and mollusks, but also consume plant life especially algae. Lobsters are rich in copper, selenium, zinc, phosphorus, vitamin B12, magnesium and vitamin E. They are highly prized, economically important seafood and can be profitable commodities in the waters they inhabit (Freitas *et al.*, 2007). A report suggests that individuals consuming shellfish like lobsters may reduce their risk of myocardial infarction by more than 50% (Yuan *et al.*, 2001).

The nutritive values of crustaceans depend upon their biochemical composition such as protein, amino acids, lipids, fatty acids, carbohydrates, vitamins and minerals. Among the seafood, prawns and shrimps contribute about 20-22% by volume of the world seafood market (FAO, 2014). Due to their nutritious nature, apart from the supply of good quality proteins, lipids, they also contain several dietary minerals such as calcium and iron, which are beneficial and vital and play a chief role in the maintenance of physiological and biochemical activities in human beings. Therefore prawns and shrimps are considered to be most popular species as it is a part of almost every nation's traditional meal rich in protein and minerals.

Compared to other sources of protein, fish are well known to be excellent sources of protein as they contain all the naturally occurring amino acids (Louka *et al.*, 2004). Puffer fishes (Family: Tetraodontidae, order: Tetraodontiformes), which are carnivorous, slow swimming fish and they can live in different ecosystem such as open sea, estuaries and freshwater areas (Sulistiono and Affandi 2004). Puffer fishes are non-target species and it is caught by incidentally or accidentally by trawl net and it is considered as trash fishes. Although these species are known to cause potential risk to humans, they contain potent and multifaceted neurotoxin called tetrodotoxin (TTX) that has been rarely detected in the muscles of fishes and it is also considered as a delicious food in few countries, particularly in China, Korea, Japan and Taiwan (Makoto *et al.*, 2000). Chunfai and Hoifu (1997) stated that puffer fishes contained rich amount of nutritional values in muscle. Yedukondala and Rukminisirisha (2013) stated that consumption of puffer fishes as an alternative food to meet the increasing food demand due to growing population and day-by-day collapse of natural resources.

There is a lot of research on proximate composition (moisture, ash, lipid, crude protein, and carbohydrate contents) of fish. However, there is a neglect of other edible aquatic sea foods. The nutritional benefits of seafood have encouraged its continuous consumption. It may therefore be imperative to determine their nutritional composition in order to help make informed decision when aquatic products are to be consumed. Therefore, the present study is aimed to probe into the aspects for the evaluation of proximate composition of basic biochemical constituents including proteins, lipids, carbohydrates, ash and moisture to assess the nutritional significance of lobster (*Thenus orientalis*), shrimp (*Penaeus semisulcatus*) and puffer fish (*Arothron immaculatus*).

Materials and Methods

The aquatic sea foods, lobster (*T. orientalis*), prawn (*P. semisulcatus*) and puffer fish (*A. immaculatus*) were bought directly from fishermen at their landing site Pamban, Rameswaram Island, South East Cost of India. The samples were taken in ice cold box to the laboratory, upon arrival all the samples were weighed, washed thoroughly and the fillets were taken for determination of the proximate composition.

Biochemical analysis

The protein content of the samples were estimated by following the method of Lowry *et al.*, (1951), carbohydrate content by Hedge and Hofreiter (1962), lipid content by Folch *et al.*, (1957), ash and moisture contents were measured by AOAC (2005).

Results

The percentage mean proximate compositions of the three marine sea foods are presented in table 1. From the results the moisture content of all three samples ranged from 74.4 ± 0.04 to $78.1 \pm 0.15\%$. The highest moisture content was recorded in puffer fish ($78.1 \pm 0.15\%$) followed by lobster (77.0 ± 1.0) and lowest in prawn sample ($74.4 \pm 0.04\%$). The protein content is higher in prawn ($21.6 \pm 0.1\%$) followed by puffer fish ($19.1 \pm 0.01\%$) and least in lobster ($18.30 \pm 0.01\%$). Carbohydrate content was highest in lobster ($2.7 \pm 0.15\%$) followed by prawn ($1.45 \pm 0.01\%$) and lowest in puffer fish ($0.45 \pm 0.02\%$) then the two other organisms. The lipid contents are similar to what was observed in carbohydrate content in following order being highest in lobster > prawn > puffer fish. Ash content was highest in prawn ($2.4 \pm 0.07\%$) followed by the lobster ($1.8 \pm 0.07\%$) and puffer fish ($1.4 \pm 0.1\%$) has least ash content.

Discussion

Moisture content of a given samples is the measure of its water content. From the result puffer fish had the highest moisture content ($78.1 \pm 0.15\%$) followed by the lobster ($77.0 \pm 1.0\%$) and prawn ($74.4 \pm 0.04\%$). The percentage of moisture in the composition of prawn is a good indicator of the relative energy, protein and fat contents (Barua *et al.*, 2012). The proportion of moisture in shrimp varies widely between 65 - 90 % although it is normally in the range of 70- 75%. The present results were in agreement with this statement. In puffer fish, moisture level is beneficially influenced in locomotory stabilization of the organism. The skin of fish is soft compared to the thick carapace of lobsters and crabs. This allows for easy permeability of water through skin water interface, as such can easily acquire more water into its body. High moisture content is good for organisms as it will allow enzymatic reactions go on smoothly. However, high moisture content can also be disadvantageous by making the fish susceptible to spoilage by microbes, increasing oxidative degradation of polyunsaturated fatty acids and ultimately decrease the quality of fish thereby reducing its preservation time (Omolara and Omotayo, 2009). Similar work was done by Karunanidhi *et al.*, (2017) reported that the highest moisture content in *A. immaculatus* (75.0%) collected from Gulf of Mannar Marine Biosphere Reserve, South India. Aydın *et al.*, (2013)

reported that highest and lowest values of moisture contents of 78.47% and 76.48%, respectively, in marine puffer fish, *L. sceleratus*.

Protein has been reported to be the most vital biomolecule in crustaceans, from eggs to adulthood and is conspicuously dominant in young phases (Varadharajan and Soundarapandian, 2014). From the present results prawn had the highest protein content (21.6%) of the three sea foods. The high amount of protein content recorded for shrimp species in this study may be attributed to their high protein dietary intake which included algae, diatoms, crustaceans, mollusks and partly digested fishes (Osibona, 2005). Prawns are considered to be high-range protein containing dietary substances. Generally the biochemical composition of any organism known to reflect its nutritional quality and is being influenced by several biotic and abiotic factors including season, size of the animal, food, temperature and stage in the life cycle. Crustacean group of animals play an important role in the food chain cycle as they are being consumed in large numbers by human beings. Due to their delicious nature, high protein and good amino acid content several crustaceans are preferred as food stuffs for human consumption (Banu *et al.*, 2016). Comparing human consumption preference in the selected three organisms, prawn, which had the highest protein value, is the most preferred.

Lipids are an alternative energy source in times of fasting and starvation. In the current study lobster had the highest lipid content ($0.19 \pm 0.01\%$) followed by the prawn ($0.15 \pm 0.02\%$) and least in puffer fish ($0.08 \pm 0.00\%$). The lipid content was significantly higher in lobster. Lipids are important in the structural and biological functioning of the cells. In crustaceans, not only do lipids function as the main organic reserve and source of metabolic energy but are also indispensable in maintaining cellular integrity. Generally, lipids act as major food reserve together with protein and may fluctuate periodically due to environmental variable like temperature (Varadharajan and Soundarapandian, 2014). The differences in proximate composition could be due to structural makeup of their bodies. The skin of animals in comparison to carapace is a rich area of fat. The three species can be ideal diet foods. The results were in line with the findings of Ali *et al.*, (2017) who reported that the range of lipid content in *P. monodon* and *F. indicus* caught from Chennai coast varied from 0.91 ± 0.13 to 0.71 ± 0.13 . Chowdhury *et al.*, (2019) reported that the percentage of lipid content in the fish muscle fluctuated from 1.57% to 2.32% in *Leiodon cutcutia* and from 0.92% to 1.71% in *Dichotomys fluviatilis*.

Carbohydrates serve as precursors for the synthesis of dispensable amino acids and certain nutrients, which in free and bound state along with proteins as protein-bound sugars and glycogen. Carbohydrate content was higher in lobster and prawn, least value was recorded in puffer fish. Several factors are known to influence carbohydrate content, in different tissues of crustaceans including gonad developmental stage, starvation, feeding rates, physical activity and other physiological conditions of the animal. From the results obtained, it is very clear that carbohydrate content of muscle tissue registered relatively very low compared to proteins and lipids, the other important organic molecules of the cellular environment (Banu *et al.*, 2016). Glycogen in marine animals may be the reason for low values of carbohydrates recorded in the present study and carbohydrates does not contribute much to the reserves in the body like lipids (Das and Sahu 2001). The results were in line with the findings of Karunanidhi *et al.*, (2017) who reported that the range of carbohydrates content in *A. hispidus*, *T. oblongus*, *L. guentheri* and *A. immaculatus* collected from Gulf of Mannar Marine Biosphere Reserve, South India varied from $0.7 \pm 0.3\%$ to $1.3 \pm 0.2\%$. Ayanda *et al.*, (2018) observed the carbohydrate content (0.13%) of lobster Makoko River, Lagos, Nigeria. Islam *et al.*, (2017) observed that the carbohydrate level in wild shrimp (*Penaeus monodon*) and prawn (*Macrobrachium rosenbergii*) in the range of 0.91% and 0.17%.

Ash content is one of the least studied biochemical constituents of crustaceans. It is the inorganic remnant of burnt organic matter. The results showed that ash content in the three marine sea foods in the order prawn > lobster > puffer fish. High ash content in shrimps is due to the high level of chitin strengthened by a high level of calcium metal in the exoskeleton. Chitin is a linear polymer of acetyl D-glucosamine that has properties similar to cellulose in many respects (MacDonald *et al.*, 1998). The differences in the concentration of minerals may be influenced by different factors including seasonal changes, age, sex, size, and sexual maturity, food source and availability in the respective habitat of organisms and other factors such as water chemistry, salinity, temperature and contaminants (Hassan, 1996). Eswar *et al.* (2014) stated that two coastal puffer species, *Lagocephalus lunaris* and *Lagocephalus inermis* contain about 0.96% and 1.27% ash content in the proximate composition respectively. Yuqi *et al.* (2014) stated that the puffer fish, *Leiodon cutcutia* is a good source of three minerals such as calcium, phosphorous and iron.

Conclusion

From the present result, it could be concluded that, the three sea foods have shown to be good sources of nutrients which are essential for the maintenance of a healthy body. Prawn and puffer fish are particularly rich in protein, the lobster is rich in lipid content, however, our findings revealed that both lobster and shrimp are good sources of proteins and can serve as an alternative source of high quality protein for human consumption. From the results it is clear that *Arothron immaculatus* have the nutritional value like other edible fin fishes, but their main problem is the presence of Tetrodotoxin (TTX) which is deadly for human being (Kiernan *et al.*, 2005). So, if the risk of this toxin can be eliminated from the fish muscle before cooking then the studied puffer species can be used as significant fish protein sources. Government and private fisheries sectors should look forward to solve the problem with puffer fish toxin.

Table 1: Proximate composition of prawn, lobster and puffer fish

Parameter	Puffer fish (<i>Arothron immaculatus</i>)	Prawn (<i>Penaeus semisulcatus</i>)	Lobster (<i>Thenus orientalis</i>)
Moisture (%)	78.1±0.15	74.4±0.047	77.0±1.00
Protein (%)	19.1±0.10	21.6±0.10	18.3±0.01
Carbohydrate (%)	0.45±0.02	1.45±0.01	2.70±0.15
Lipid (%)	0.08±0.00	0.15±0.02	0.19±0.01
Ash (%)	1.40± 0.10	2.40±0.07	1.80±0.07

References

- Ali, S.S.R., Ramachandran, M., Chakma, S.K. and Asrar, M. 2017. Proximate composition of commercially important marine fishes and shrimps from the Chennai coast, India. *International Journal of Fisheries and Aquatic Studies*, 5(5): 113-119.
- AOAC, 2005. Official methods of analysis. 8 Edn, Association of Analytical Chemists, Gaithersburg, MD.
- Aydin, M., Tufan, B., Sevgili, H. and Kose, S. 2013. Seasonal changes in proximate composition and fatty acid profile of puffer fish (*Lagocephalus sceleratus Gmelin, 1789*) from the Mediterranean Sea of Turkey. *Journal of Aquatic Food Production Technology*, 22: 178 - 191.
- Banu, S.K.S., Hareesh, K. and Reddy, M.S. 2016. Evaluation of Nutritional status of Penaeid Prawns through Proximate Composition Studies. *International Journal of Fisheries and Aquatic Studies*, 4(1): 13-19.
- Barua, P., Pervez, M.A., Sarkar, D. and Sarker S. 2012. Proximate biochemical composition of some commercial marine fishes from Bay of Bengal, Bangladesh. *Mesopot. Journal of Marine Science*, 27: 59 - 66.
- Bugel, S.H., Sandstrom, B. and Larsen, E.H. 2001. Absorption and retention of selenium from shrimps in man. *Journal of Trace Elements in Medicine Biology*, 14: 198 - 204.
- Chowdhury, I.A., Md. Hasan, R., Parveen, S., Dey, S.K. and Md. Billah, B. 2017. Proximate composition of two puffer fish species, *Leiodon cutcutia* and *Dichotomyctere fluviatilis* of Bangladesh. *Jahangirnagar University. Journal of Biological Science*, 8(1): 25-33.
- Chunfai, Yu. and Hoifu, Yu. P. 1997. A preliminary study of puffer fishes and their toxins found in Hong Kong waters. *Journal of Food Hygienic Society of Japan*: 38 : 460 - 463.
- Das, A.V.S. and Sahu, B.K. 2001. Biochemical composition and calorific content of fishes and shellfishes from Rushikulya estuary, south Orissa coast of India, *Indian. Journal of Fish*, 48: 297 - 302.
- Eswar, A. Kathirvel, K., Anbarasu, R., Ramamoorthy, K., Sankar, G., Suvitha, S. and Manikandarajan, T. 2014.. Proximate composition and fatty acid analysis of puffer fish, *lagocephalus inermis* (Temminck and schlegel, 1850) and *lagocephalus lunaris* (Bloch and schneider, 1801) from parangipettai, South East Coast of India. *Internal Letters of Natural Science*, 12 (1): 21 - 29.
- FAO, 2014. World Aquaculture and Fisheries Statistics. FAO Publication, Rome, Italy.
- Floch, J., Lees, M. and Sloane-Stanley, G.H. 1956. A simple method for the isolation and purification of total lipids from animal tissues. *Journal of Biological Chemistry*, 226: 497-509.
- Freitas, R., Medina, A. and Castro, M. 2007. Reproductive biology of spiny lobster *Panulirus regius* from the north-western Cape Verde Islands. *African Journal of Marine Science*, 29(2): 201 - 208.

- Hassan, M. 1996. Influence of pond fertilization with broiler dropping on the growth performance and meat quality of major carps, Ph.D. thesis, University of Agriculture, Faisalabad, Pakistan.
- Hedge, J.E and Hofreiter, B.T. 1962. In: Carbohydrate Chemistry, 17 (Eds. Whistler R.L. and Be Miller, J.N.), Academic Press, New York.
- Islam, A., Mondal, S., Bhowmik, S., Islam, S. and Begum, M. 2017. A comparative analysis of the proximate composition of wild and cultured prawn (*Macrobrachium rosenbergii*) and shrimp (*Penaeus monodon*). International Journal of Fisheries and Aquatic Studies, 5(4): 59 - 62.
- Karunanidhi, K., Rajendra, R., Pandurangan, D. and Arumugam, G. 2017. First report on distribution of heavy metals and proximate analysis in marine edible puffer fishes collected from Gulf of Mannar Marine Biosphere Reserve, South India. Toxicology Reports, 4: 319 – 327.
- Kiernan, M. C., Isbister, G. K., Lin, C. S. Y., Burke, D. and Bostock, H. 2005. Acute Tetrodotoxin induced neurotoxicity after ingestion of puffer fish. Annals of neurology, 57(3): 339 - 348.
- Louka, N., Juhel, F. and Allaf, K. 2004. Quality studies on various types of partially dried vegetables texturized by controlled sudden decompression: general patterns for the variation of the expansion ratio. Journal of Food Engineering, 65(2): 245 - 253.
- Lowry, O.H., Rosenbrough, N.J., Farr, A.L. and Randall, R.J. 1951. Protein measurement with Folin Phenol Reagent. Journal of Biological Chemistry, 193: 265 - 275.
- MacDonald, P., Greenhalgh, J.F.D. and Morgan, C.A. 1998. Animal Nutrition, 5th edition: Longman Publication, 607.
- Makoto, O. Yoshimichi, F., Fumio, T. and Shingo, I. 2000. Fatty acid composition of total lipids in puffer fish mea. Food Preservation Science, 26: 333 - 338.
- Omolara, O. and Omotayo, O. 2009. Preliminary Studies on the effect of processing methods on the quality of three commonly consumed marine fishes in Nigeria.” *Biokemistri*, 21(1): 1 - 7.
- Osibona, A.O. 2005. Comparative study of proximate composition, amino acids, fatty acids and aspects of the biology of some economic fish species in Lagos State, Nigeria (PhD thesis, p. 218). Department of Marine Sciences, University of Lagos, Lagos.
- Sulistiono, T.W. and Affandi, R. 2004. Banana fish (*Tetraodon lunaris*) diet in Mayang waters, West Java. Indonesian Journal of Idiology, 2004
- Varadharajan, D. and Soundarapandian, P. 2014. Proximate composition and mineral contents of freshwater crab *Spiralothelphusa hydrodroma* (Herbst, 1794) from Parangipettai, South East Coast of India. Journal of Aquaculture Research and Development, 5(2): 1- 6.
- Yedukondala, P. and Rukminisirisha, I. 2013. Changes in the muscle biochemical composition of *Lagocephalus spadiceus* (Richardson, 845) and *Lagocephalus lunaris* (Bloch and Schneider 1801) off Visakhapatnam, East Coast of Indi. International Journal of Scientific and Research Publications, 3(7): 2250 - 3153.
- Yuan, J. M., Ross, R. K., Gao, Y. T. and Yu, M.C. 2001. Fish and shellfish consumption in relation to death from myocardial infarction among men in Shanghai, China. American Journal of Epidemiology, 154(9): 809 - 816.
- Yuqi, L., Liya, W. and Ningping, T. 2014. Analysis and evaluation of nutritional composition of farmed male puffer fish (*Takifugu obscurus*). In SHS Web of Conferences (Vol. 6, p. 03010). EDP Sciences.