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Proximate biochemical composition of some commercial marine fishes from Bay of Bengal, Bangladesh

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Abstract - Fish is known to be one of the cheapest sources of animal protein and other essential nutrients required in human diets. The knowledge of proximate biochemical composition of fishery species is fundamentally important for: the application of different technological processes, the characteristics post-mortem of species, as an aspect of quality of raw material and giving an idea of sexual stage. The study was conducted to determine the proximate biochemical composition of four marine fishes of the Bay of Bengal, Bangladesh. The study fishes were *Dasyatis americana*, *Dasyatis pastinaca*, *Dasyatis zugei* and *Gymnothorax favagineus*. From the study, it was found that *Dasyatis* americana contains highest protein, fat and ash concentration while *Dasyatis Pastinaca* holds highest concentration of moisture and lowest value of protein and fat. On the other hand, *Dasyatis zugei* hold lowest concentration of moisture and ash. Proximate biochemical composition of all species showed that their percentage of protein and fat content are good and can be a food item in parallel to the bony fishes.

Key words: Biochemical, analysis, ray, bony fish, nutrition and Bay of Bengal.

Introduction

Fish is known to be one of the cheapest sources of animal protein and other essential nutrients required in human diets (Agusa, 2007). They are also increasingly marketed for their health benefits to consumers (Schmidt, 2006). The nature and quality of nutrients in most animals is dependent upon their food type. Also, feeding habit of an individual fish species has great effect on its body nutrients composition (Lagler *et al.*, 1977). Foran *et al.* (2005) reported that, fish is a highly proteinous food consumed by a larger percentage of populace because of it's availability and palatability.

Fish is a major source of food for mankind all over the world from the times immemorial providing an important amount of animal protein in the diets of man. The importance of fish as source of high quality, balanced and

easily digestible protein, vitamins and fatty acids is well understood now. Fish having energy depots in the forms of lipids will rely on this biochemical composition of the whole body indicates the fish quality. Therefore, proximate biochemical composition of a species helps to assess its nutritional and edible value in terms of energy units compared to other species. Variation of biochemical composition of fish flesh may also occur within same species depending upon the fishing ground, fishing season, age and sex of the individual and reproductive status. The spawning cycle and food supply are the main factors responsible for this variation (Love *et al.*, 1980).

Variation of biochemical composition in fish body relates closely to feed intake (Oyelese, 2006). Fish takes in a wide range of foodstuffs from which it obtains the required nutrients for its proper growth and development. The percentage of water in the composition is a good indicator of the relative energy, protein and lipid content; the lower the percentage of water, the greater the lipids and protein content and the higher the energy density of the fish (Aberoumad, and Pourshafi, 2010). Proteins are not only necessary for hormonal and enzyme development (Wilson, 1986), but are also an important source of energy (Halver and Hardy 2002). Fats provide much of energy and the essential body fatty acids (Gatlin, 2010), while the minerals are a major component of bones, blood, and osmoregulation (Watanabe *et al.*, 1997). The body tends to assimilate nutrients in quantities it will satisfactorily utilize, and these quantities can be established by performing a proximate analysis on the carcass using standard procedures (Aberoumad and Pourshafi, 2010).

The Bay of Bengal is ever so illustrious for her magnificent fisheries resources in the world. Her territory of generous fisheries resources including waters are uniquely endowed for bringing bonanza for her adjoining areas. As a contiguous country, Bangladesh is well blessed by the highly diverse and enriched fisheries resources of the Bay of Bengal and hence coastal fisheries resource of this country is very flourishing and virtuously bountiful in this macrocosm. Bangladesh is one of the resourceful countries with its wide range of marine aquatic bio-diversities. It has about 714 km long coast line with 166,000 km2 EEZ with 1093 aquatic marine organisms including finfish, shellfish, shrimps, seaweeds, etc. There are about 1093 marine aquatic organisms where 44.35% are finfish, 32.23% shellfish, 15.10% seaweeds and only 8.32% are other organisms including shrimps (Fig. 1). Bangladesh is exploring its marine resources by only capturing the fishes from the sea. The marine capture fish is declining about 5% per annum (DoF, 2011). If it is continued, the total fish production will be held back in near future. So, it is the right time to think about how to increase the marine production, and the Mariculture initiatives should be taken now. Among the marine fishes, only shrimps are cultured in on-shore ponds. Some other species like sea bass, mullet and mud crab are also started to culture in the ponds in saline water traditionally in a limited scale. However, it has huge potentiality of off-shore Mariculture. In contrast, it could be concluded that there is no Mariculture exist in Bangladesh (Barua, 2011).

The electric rays are a group of rays, flattened cartilaginous fish. They

are capable of producing an electric discharge, used to stun prey and for defense and contain high nutrient concentration. Deradoss (1983) studied on the nutritive values of Sharks, Skates and Rays caught from Protonova coast and found lipids 0.4% to 6.2% in the body and 12.5% to 84.4% in the liver in fresh condition. Moisture content was found to vary between 71.0% to 84.0%. Agarwal *et al.* (1972) found 72% moisture in fresh condition. Stirling (1972) worked for determining of moisture, protein ash and non protein nitrogen in the white body muscle, Shark body muscle, liver and gonads of European bass from Bay of Naples. He stated that the white body muscle has a high food value, being rich in protein and low in lipid. Dyer *et al.* (1961) studied on the proximate composition in various portions of the edible flesh of Atlantic Halibut (*Hippoglossus hippoglossus*) and concluded that it varied greatly, especially in lipid content.

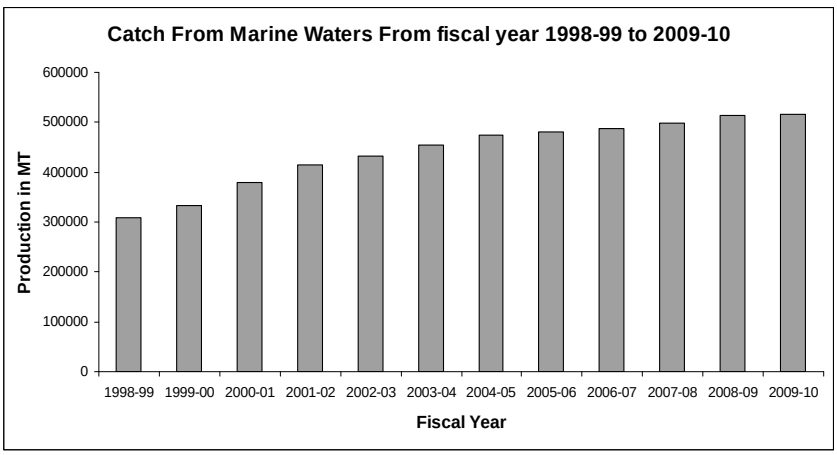

Figure 1. Production of marine fisheries of Bangladesh over the 10 years.

Although several studies deal with the proximate composition of biochemical components of many commercially important fishes (Qasim, 1972; Sinha and Pal, 1990; Das and Sahu, 2001; Patra *et al.*, 2010), but no work on similar lines has been carried out in commercially important electric ray fishes particularly from coastal water of Bangladesh. Therefore, the present study was undertaken to elucidate the dynamics of biochemical composition of muscle *Dasyatis americana* (southern stringray), *Dasyatis zugei* (Pale-edged stingray/sharp nose stingray) *Dasyatis pastinaca (*Common Stingray) and *Gymnothorax favagineus* (Laced Moray) collected from Bay of Bengal.

Materials and Methods

Collection of sample:

According to the consumer preferences and commercially available *Dasyatis americana* (southern stringray), *Dasyatis zugei* (Pale-edged stingray/sharp nose stingray) *Dasyatis pastinaca* (Common Stingray) and

Gymnothorax favagineus (Laced Moray) were selected for study. Triplicate of each 4 experimental marine fishes were collected from marine fisheries landing centers of Chittagong and different markets of Chittagong city; among the ray fishes only fresh samples were chosen for collection which was available in local markets for the consumer Chittagong is one of the oldest towns in Bangladesh at south east area of Bangladesh. Because of the biggest sea port, inland import and export facilities (Fig.2).

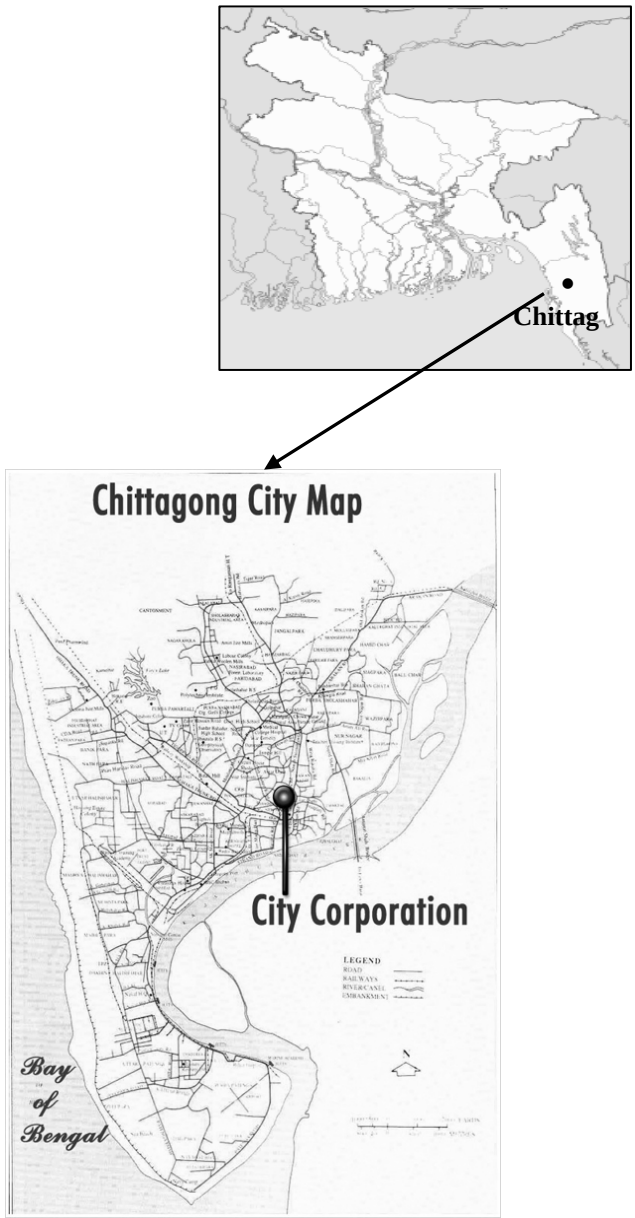

Figure 2. Geographical location of the study area Chittagong city.

Collected samples were brought to the Nutrition laboratory of Institute of Marine Sciences and Fisheries, Chittagong University for find out the nutritional compositions. The average weight and length of sampled fish ranged between 0.76 to 4.82 g and from 4.65 to 8.18 cm, respectively.

Analysis of Protein, Moisture, fat and Ash:

For the determination of the gross proteinous nitrogen in the fresh fish body muscle, the foiling Kjeldahl methods were used (Jacobs 1973; Maynard, 1970). The sample was made homogenous by cutting and mixing the flesh from the different parts of the body. Some amount of the flesh is than blend by blender. Fat content was estimated by the Sox'let method (Jackobs 1973; Maynard 1970). Moisture was determined by drying the sample at 105° C in an oven (Maynard, 1970). The sample was made homogenous by cutting and mixing the flesh from the different parts of the body. Some amount of the flesh is than blend by blender. Ash was obtained by the sample at 450° C. by subtracting ash content was determined (Maynard, 1970). Lipid was estimated by the method of Folch *et al.* (1957).

Results and Discussion

From the present study, it was found that among the four species highest protein content 19.08% was recorded for the species *Dasyatis Americana* and lowest content 17.15% for *Gymnothorx favagineus,* highest fat content 2.01% was recorded for the species *Dasyatis americana* and lowest content 0.99% for *Dasyatis pastinaca,* ash content 9.43% was recorded for the species *Dasyatis americana* and lowest content 6.71% for *Dasyatis zugei and* highest moisture content 78.19% was recorded for the species *Dasyatis pastinaca* and lowest content 76.50% for *Dasyatis zugei.* On the other hand, highest mineral composition 2.80% was estimated for the species *Gymnothorx favagineus* and lowest amount was recorded 2.40% for species *Dasyatis pastinaca*. Highest Lipid concentration 5.0% was observed for *Dasyatis pastinaca* and lowest level 3.90% for the species of *Gymnothorx favagineus* (Table 1).

Concentration of Protein content in the muscle of four electric ray ranges was found 17.15% to 19.08%. The highest protein content (19.08%) was recorded for the species *Dasyatis americana* and the lowest fat content (17.15%) was recorded for the species *Dasyatis Pastinaca.* Council of scientific and industrial research (CSIR), India (1962) found 20.04%, 19.27% and 16.92% protein content in whip ray (*Himantuara uarnak*) which is close agreement with the result of the present study. Concentration of Fat content in the muscle of four electric ray ranges was found 0.99% to 2.01%. The highest fat content (2.01%) was recorded for the species *Dasyatis americana* and the lowest fat content (0.99%) was recorded for the species *Dasyatis Pastinaca.*

Jeong *et al.* (1998) recorded 0.74%, 3.66% and 9.19% total lipid in electric ray (*Narke japonica*) which have a close similarity to the present observed results. Deradoss (1983) studied on the nutritive values of Sharks, Skates and Rays caught from Protonova coast. He studied that proximate composition of Sharks, Skates and Rays varied in the different seasons of year and from specimen to specimen and even in the same specimen from

part of the lipids were observed 0.4% to 6.2% in the body muscle which have a close similarity to the present observed results. Concentration of Ash content in the muscle of four electric ray ranges was found 6.71% to 9.43%. The highest ash content (9.43%) was recorded for the species *Dasyatis americana* and the lowest ash content (6.71%) was recorded for the species *Dasyatis zugei.*

Table 1. Proximate Composition of 4 commercially important marine fishes of Bay of Bengal

Species Name	Protein	Fat	Moisture	Ash
Dasyatis Americana	19.08	2.01	76.68	9.43
Dasyatis zugei	18.20	1.85	76.50	6.71
Dasyatis pastinaca	17.85	0.99	78.19	9.43
Gymnothorx favagineus	17.15	1.6	77.31	8.71

Hossain (1990) recorded 7.74%, 6.66% and 9.80% total ash in marine fishes which have a close similarity to the present observed results. Concentration of Moisture content in the muscle of four electric ray ranges was found 76.50% to78.19%. The highest Moisture content ray was recorded *Dasyatis Pastinaca* (78.19%) and the lowest content ray was recorded *Dasyatis zugei* (76.50%). Agarwal *et al.* (1972) studied the moisture content and gave an idea of self stability of white pomfret (*Stromateus cinereus*). They recorded 72% of moisture in fresh filets of white pomfret. CSIR (1962) recorded 77.50%, 69.26% and 88.08%. Moisture in whip ray respectively which have a close similarity to the present observed results.

Conclusion

Proximate composition of all species showed that their percentage of protein and fat content are good and can be used as a food item in parallel to the bony fish at low cost. From the above result and finding clear about that the four species (*Dasyatis americana*, *Dasyatis zugei*, *Dasyatis pastinaca, Gymnothorax favagineus*) are suitable for our daily diet.

Reference

Agusa, T., Kunito, T., Sudaryanto, A., Monirith, I., Kan-Atireklap, S., Iwata, H., Ismail, A., Sanguansin, J., Muchtar, M., Tana, T.S. and Tanabe, S. 2007. Exposure assessment for trace elements from consumption of marine fish in Southeast Asia. Environmental Pollution, 145(3): 766-777.

Agarwal, S.R., Kumta, U.S. and Sreenivisan A. 1962. Dehydroirradiation process for white pomfret (*Stromateus cinereus*). Journal of Food Science, 37: 837-840.

Aberoumad, A and Pourshafi, K. 2010. Chemical and proximate composition properties of different fish species obtained from Iran.

World journal of fish and marine science, 2(3): 237-239.
Barua, P. and Chakraborty, S. 2011. Proximate composition of egg, stomach content and body composition of Pacu (*Piaractus brachypomus*) collected from aquatic environment of Bangladesh. Current Biotica, 5(3): 330-343.
CSIR, 1962. The wealth of India, Raw materials, Supplements fish and fisheries, CSIR, IV, New Delhi, 50pp.
Deradoss, P. 1983. Nutritive values of sharks, Skates and Rays caught from Protonova coast. Indian Journal of Fisheries, 30: 156-161.
Dyer, W.J., Fraser, D. and Mannan, A. 1961. Proximate composition of Canadian Atlantic Fish II, Mackerel, Tuna, and Sword fish. Journal of Fisheries Research Canada, 18: 495-499.
Das, 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 Fisheries, 48: 297-302.
DoF, 2011. Fishery Statistical Yearbook of Bangladesh 2010-2011. Fisheries Resources Survey System, Department of Fisheries (DOF), Dhaka, Bangladesh, 65pp.
Foran, J.A., Carpenter, D.O., Hamilton, M.C., Knuth, B.A. and Schwager, S.J. 2005. Risk-based consumption advice for farmed Atlantic and wild pacific salmon contaminated with dioxins and dioxin-like compounds. Environmental Health Perspectives, 113: 552-556.
Gatlin, D.M. 2010. Principles of fish nutrition. Southern Regional Aquaculture Center. Publication No. 5003.
Hossain, A.C. 1990. Study on the biochemical analysis of different types of Hilsa fish. M.Sc. Thesis, Department of Chemistry, University of Dhaka, 80pp.
Halver, J.E. and Hardy R.W. 2002. Fish Nutrition, 3rd edition. Academic Press, San Diego, CA, USA.
Jacobs, M.B. 1973. The Chemical Analysis of Food Products. 3ed. New York: Robert Krieger, Publishing Co., 80pp.
Jeong, B.Y., Choi, B.D., Moon, S.K. and Lee, J.S. 1998. Fatty Acid Composition of 72 species of Korean Fish. Journal of Fisheries Science Technology, 1: 129-146.
Lagler, K.F., Bardach, J.E., Miller, R.R. and May Passino, D.R. 1977. Ichthyology. New York: John Wiley and Sons, 267pp.
Love, R.M. 1980. The chemical biology of fishes. Academic Press. New York and London, 11th edition, 467pp.
Maynard, J. 1970. Methods of Food Analysis, Academic Press, New York, NY, 163pp.
Oyelese, O.A. 2006. Implication of organ and tissue weight to the processing of some selected fresh water fish families. Journal of fisheries International, 1(2-4): 136-140.
Patra, A.P., Patra, J.K., Mohapatra, N.K., Das, S. and Swain, G.C. 2010. Seasonal variation in physiochemical parameters of Chilika lake after opening of new mouth near Gabakunda, Orissa, India. World Journal of Fisheries and Marine Sciences, 2: 109-117.
Qasim, S.Z. 1972. The dynamics of food and feeding habits of some marine fishes. Indian Journal of Fisheries, 19: 11-28

Stirling, H.P. 1972. The proximate composition of the European Bass (*Dicentrarchus labrax* L.) from the Bay of Naples. Journal of International Councils of Exploration of Marine Reources, 34: 357-364.

Sinha, G.M. and Pal, P.C. 1990. Seasonal variation in protein, lipid and carbohydrate contents of ovary, liver and body muscle in relation to gonado-somatic index and oogenesis of *Clarias batrachus* (Linn.). Impacts of Environment on Animal and Aquaculture, 45: 107-112.

Schmidt, E.B., Rasmussen, L.H., Rasmussen, J.G., Joensen, A.M., Madsen, M.B. and Christensen, J.H. 2006. Fish, marine n-3 polyunsaturated fatty acids and coronary heart disease: A minireview with focus on clinical trial data. Prostaglandin, Leukotrienes and Essential Fatty Acids. Journal of Fisheries Research, 75(3):191-195.

Wilson, R.P. 1986. Protein and amino acid requirements of fishes. Annual Review of Nutrition, 6: 225-230.

Watanabe, T., Kiron, V. and Satoh, S. 1997. Trace minerals in fish nutrition. Aquaculture, 151: 187-207.

التركيب الكيميائي الحياتي لبعض الأسماك الإقتصادية البحرية من خليج البنغال، بنغلاديش

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المستخلص - تعد الأسماك واحدة من أرخص مصادر البروتين الحيواني والمغذيات الأساسية الأخرى التي تتطلبها أغذية الإنسان. ومعلومات التركيب الكيمياء الحياتي للأنواع المصادة من الأهمية بمكان: تطبيق عمليات تقنية مختلفة، وصفات الأنواع بعد الموت، من حيث نوعية المواد الخام وإعطائها فكرة عن الطور الجنسي. لقد أجريت هذه الدراسة لتحديد التركيب الكيميائي الحياتي لأربعة أنواع من الأسماك البحرية من خليج البنغال، في بنغلاديش. كانت الأسماك قيد الدراسة هي *Dasyatis americana, Dasyatis pastinaca, Dasyatis zugei , Gymnothorax favagineus*. لقد لوحظ من خلال الدراسة أن *D. americana* تحوي أكثر كمية من البروتين والدهون والرماد، بينما *D. pastinaca* تحوي أعلى تركيز من الرطوبة وأقلها كمية من البروتين والدهون. من جهة أخرى، تمتلك *D. zugei* أقل تراكيز من الرطوبة والرماد. إتضح من خلال التركيب الكيميائي الحياتي لجميع الأنواع أن النسبة المئوية للبروتين والدهون جيدة بحيث يمكن أن تكون غذاءاً يوازي الأسماك العظمية.