UTTAR PRADESH JOURNAL OF ZOOLOGY

41(22): 24-30, 2020
ISSN: 0256-971X (P)

STUDY OF VARIATION IN NUTRIENT CONTENT OF MUDSKIPPER *Boleopthalmus dussumieri* COLLECTED FROM GUJARAT AND MAHARASHTRA STATE, INDIA

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. Authors RD, MP, NM and JT designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors RD and NM managed the analyses of the study. Author RD managed the literature searches. All authors read and approved the final manuscript.

Article Information

Editor(s):
(1) Dr. Pınar Oguzhan Yildiz, Ataturk University, Turkey.
Reviewers:
(1) Ofoego, Uzozie Chikere, Nnamdi Azikiwe University, Nigeria.
(2) Amira Saad Helal Hassenin, Zagazig University, Egypt.

Received: 28 September 2020
Accepted: 03 December 2020
Published: 16 December 2020

Original Research Article

ABSTRACT

In present study, nutritive content of *Boleopthalmus dussumieri* (mudskipper) was analysed. Samples were collected from fish markets of Gujarat state (Ghogha, Sartanpar, Bilimora, Amalsad, Onjal) and Maharashtra state (Kalyan, Bhiwandi, Mira-Bhayandar). Major biochemical components like moisture, protein, carbohydrate and total lipid content were estimated in body muscles of the male and female specimens using standard protocols. Nutritive content of studied species was variable amongst different study sites. Moisture (84.7 ± 1.21%) and protein content (36.76 ± 13.18%) were recorded maximum in male body muscle collected from Sartanpar and Mira-Bhayandar respectively, while carbohydrate (11.67 ± 6.16%) and lipid (3.21 ± 1.17%) were recorded maximum in female body muscle collected from Sartanpar and Amalsad respectively. Variation occurring in nutritive content of *B. dussumieri* collected from various sites may be due to the effect of geographical area, the environmental factors and available food resources.

Keywords: Nutritive analysis; mudskippers; protein; lipid; carbohydrate; *Boleopthalmus dussumieri*.

1. INTRODUCTION

Nutrition is a core pillar of human development as it plays vital role in physical activities and health. Besides that, it also regulates the metabolic activities which are essentials for normal cell growth, maintenance and repair [1-2]. Fish flesh is extremely rich in macronutrients (proteins, carbohydrates, lipids

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etc.,) and micronutrients (vitamins, minerals etc.,) [3], which are required as supplements in human infant and adult diets [4]. In recent years, the nutritional importance of fish food has increased because of scientifically recognized beneficial effects of diet i.e., rich in protein, carbohydrate and lipid. According to Wahengbam and Sarojnalini [5], fish consumption is higher due to its availability, flavouring and palatability. Among several commercially important indigenous fishes of India, mudskippers are common in the diet because of their availability and taste [2]. Mudskippers are small, Oxudercine fishes that are adapted to survive on land. They are rich in protein containing essential amino acids, minerals and vitamins in the right proportions [6].

Biochemical composition of body tissue reflects quality of the fish and also helps to estimate the nutritional value in terms of energy units compared to other species. Variation in nutritive quality of fish flesh depends on fishing ground, fishing season, age, sex and reproductive status of the individual [7]. Several studies have been carried out to evaluate the nutritive content of fishes in various part of India [8-11]. But very less information is available on nutritive composition of mudskippers despite of having good nutritive content [12, 2]. *Boleopthalmus dussumieri* is a common species of mudskipper distributed on the Indian coastline but the nutritive value is not studied yet. Hence the present study was designed to investigate the variation in nutritive content of *B. dussumieri* collected from coastal areas of Gujarat and Maharashtra state of India.

2. MATERIALS AND METHODS

2.1 Study Site

Specimens of *Boleopthalmus dussumieri* were collected from total 8 local fish markets of Gujarat and Maharashtra states of India. From Gujarat the samples were collected from the fish markets of Ghogha (21°41'05" N 72°16'29" E), Sartanpar (21°18'05" N 72°05'47" E), Bilimora (20°46'00" N 72°57'30" E), Amalsad (20°48'44" N 72°57'25" E) and Onjal (20°49'21" N 72°50'39" E) while from Maharashtra the fish specimens were collected from Kalyan (19°13'47" N 73°09'41" E), Bhiwandi (19°16'51" N 73°00'09" E) and Mira-Bhayandar (19°17'42" N 72°51'15" E). A total of 10 individuals (5 males and 5 females) were collected from each site and stored in ice box for further biochemical analysis.

2.2 Laboratory Methodology

Specimens of *B. dussumieri* were dissected to extract the edible muscle and stored at -20°C for further analysis. All biochemical parameters were analysed from extracted body muscle using standard protocol. For moisture content determination, a known amount of muscle tissue was kept in oven at 75°C for 24 hours. Then, the variation in the tissue weight was considered as the total quantity of moisture present in the muscle tissue. Protein was determined by the method proposed by Lowry et al. [13], using Bovine Serum Albumin (BSA) as standard. Carbohydrate content was estimated by Anthrone method [14]. Total lipid content was estimated by Barnes and Blackstock [15] method. The values of protein, carbohydrate and lipid content have been converted into percentage dry weight basis. Mean variation in biochemical content was checked using one way-ANOVA (Analysis of Variance) with significance level of α=1%.

3. RESULTS AND DISCUSSION

Seafood has a major position in their composition that can potentially increase the quality of health in humans. In past few decades, there has been great awareness among the people about the affinity shared between health and nutrition. According to that, increasing of comprehend and interpret the nutrient profile of the food we eat [16]. Present study was carried out to estimate nutritive content in body muscle of *B. dussumieri*. In the present study, moisture content was recorded maximum in body muscle of male and female collected from Sartanpar (84.7 ± 1.21%; 84.6 ± 1.11% respectively) and minimum in individuals collected from Ghogha (69.66 ± 3.26%; 68 ± 5.25% respectively) (Fig. 1A, B). Significant variation was recorded in moisture content of male (ANOVA; $F = 10.73$, $p < 0.001$) and female (ANOVA; $F = 10.93$, $p < 0.001$) body muscle collected from different study site. Similar trend in moisture content was recorded in muscle tissue of *Harpadon nehereus* and *Labeo rohita* [17]. Moisture content of an organism is involved in maintaining the balance of the organism during its movement [18]. Moisture content of fish can vary greatly mainly due to species, season, age, feeding and environmental condition [19]. In addition to, high moisture content may cause decrease lipid level [20]. This inverse relation might be due to unavailability of food, low food intake, low atmospheric temperature and high energy demands to maintain homeostasis of the body [21].

In male body muscle tissue, protein content was showed maximum in individual collected from Mira-Bhayandar (36.76 ± 13.18%) and minimum in individuals collected from Ghogha (19.33 ± 5.86%) (Fig. 2A). Protein content was recorded maximum in body muscle of female collected from Onjal (34.81 ±

7.2%) and minimum in body muscle of female collected Bhiwandi (15.98 ± 2.48%) (Fig. 2B). Significant variation was not recorded in protein content (ANOVA; F = 2.82, p = 0.02) of body muscle of male collected from different study site. While significant variation was recorded in protein content (ANOVA; F = 4.78, p < 0.001) of female body muscle collected from different study site. Similar trend in protein content was recorded in several studies conducted on nutrition analysis of marine fishes [22, 2, 23]. According to Reddy [24] and Sivani [25], concentration of protein corresponds to the maturing stage of the fishes. The fall in protein content is mainly due to depletion of feeding activity, scarcity of food material, turbidity and other ecological factors [24].

The presence of carbohydrate in human diet maintains immunity, health of brain cells and acts as energy packets [18, 21]. The current study showed, maximum carbohydrate was recorded in individuals collected from Kalyan (10.74 ± 5.31%) and minimum carbohydrate was recorded in individuals of Ghogha (2.02 ± 0.48%) (Fig. 3A). Whereas, carbohydrate content was recorded maximum in body muscle of female collected from Sartanpar (11.67 ± 6.16%) and minimum in female collected from Ghogha (2.66 ± 0.98%) (Fig. 3B). Significant variation was not recorded in carbohydrate content (ANOVA; F = 3.14, p = 0.012) of body muscle of male collected from different study site. While significant variation was recorded in carbohydrate content (ANOVA; F = 4.31, p < 0.001) of female body muscle collected from different study site. Other researchers also recorded similar carbohydrate content in various marine fishes [26-28]. According to Lockwood [29] variation in the of muscle carbohydrates levels can be due to the habitat difference and also due to the dietary material they consume.

In male body muscle tissue, lipid content was recorded maximum in individuals collected from Sartanpar (1.52 ± 0.63%) and minimum in individuals collected form Mira-Bhayandar (0.47 ± 0.1%) (Fig. 4A). While lipid content was recorded maximum in body muscle of female collected from Amalsad (3.21 ± 1.17%) and minimum in females of Mira-Bhayandar (0.64 ± 0.38%) (Fig. 4B). Significant variation was not recoded in lipid content of male (ANOVA; F = 2.70, p = 0.047) and female (ANOVA; F = 3.87, p = 0.011) body muscle collected from different study site. Similar data have been recorded for lipid content in marine fishes by several scientist [30, 2]. However, the results of present study are contrasting (conducting) from other previous studies where researcher observed that lipid content is higher in body muscle of marine fishes [31,23]. Das [32] has reported that different species shows distinct lipid level at diverse conditions like variable temperature, freezing time, location and size. This variation may be due to availability of food, fasting especially during spawning and migration [30]. In this study, variation was observed in nutrient content of *B. dussumieri* among the various study site. Such kind of variation we recorded may be due to geographical variation, food availability and environmental condition of the study site [33]. Great variation between chemical composition in edible food generally reflects their physiological functions, metabolic needs and available diet [34-35].

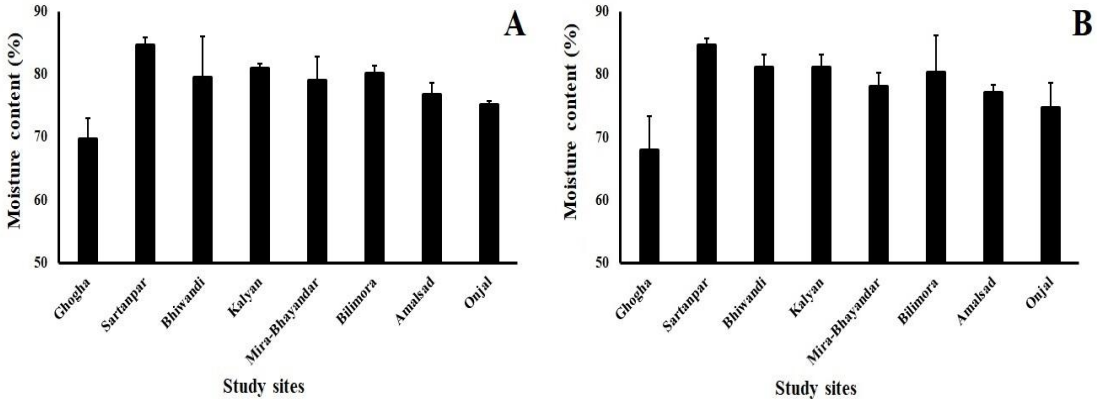

Fig. 1. Moisture content in muscle tissue of across study sites. A. Moisture content in body muscle of male; B. Moisture content in body muscle of female

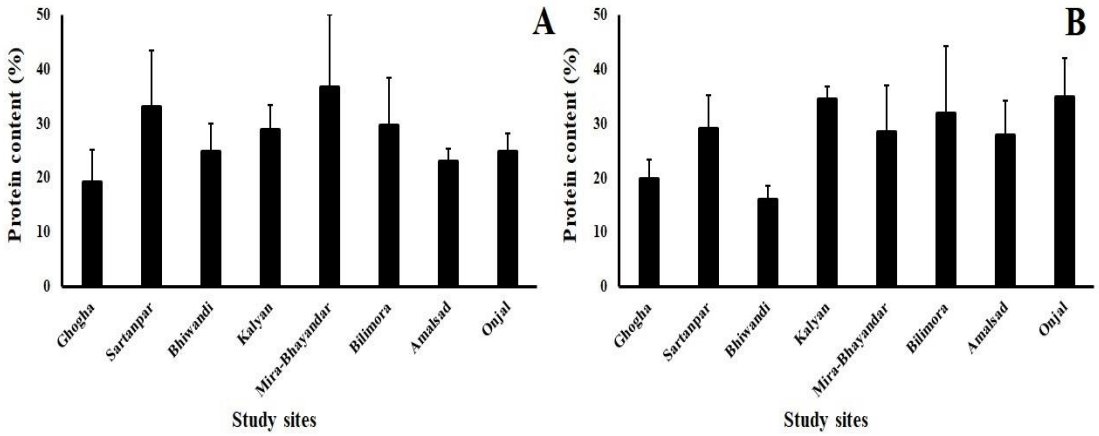

Fig. 2. Protein content in muscle tissue of across study sites. A. Protein content in body muscle of male; B. Protein content in body muscle of female

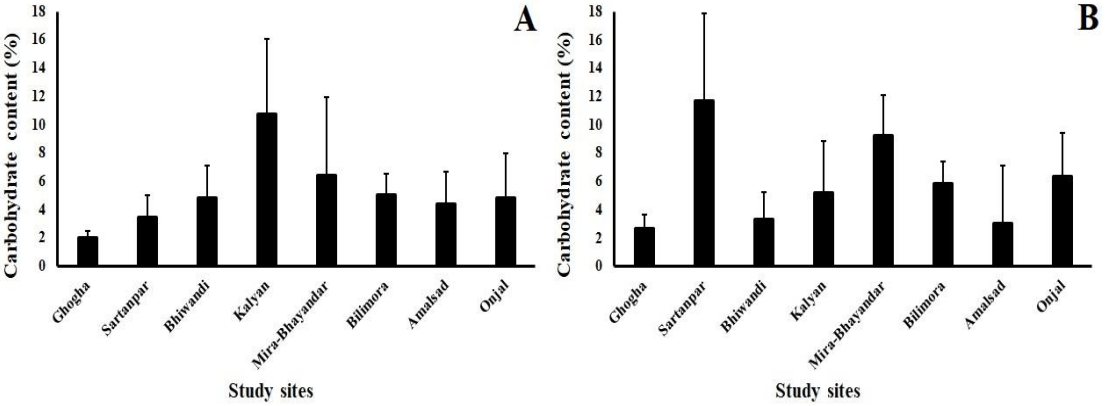

Fig. 3. Carbohydrate content in muscle tissue of across study sites. A. Carbohydrate content in body muscle of male; B. Carbohydrate content in body muscle of female

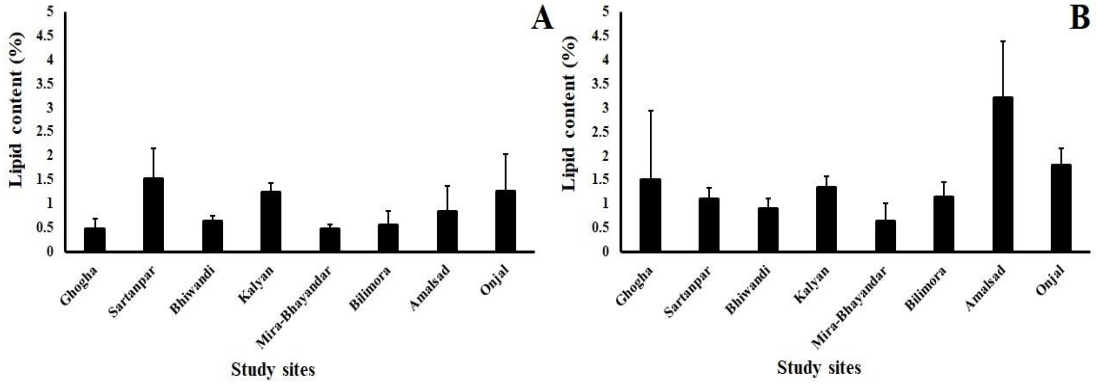

Fig. 4. Lipid content in muscle tissue of across study sites. A. Lipid content in body muscle of male; B. Lipid content in body muscle of female

Table 1. Comparison of nutrient content among commercially important seafood

Seafood type	Species	Moisture content	Protein content	Lipid content	Source
Fish	*B. dussumieri*	84.7 ± 1.21%	28.22 ± 8.63%	3.21± 1.17%	Present study
	Catla catla	76.2 ± 0.3%	16.2 ± 0.5%	2.8 ± 0.3%	[17]
	Sillago sihama	56.8 ± 0.77%	17.47 ± 0.89%	3.453 ± 0.99%	[36]
	Sardinella longiceps	71.3 ± 7.1%	17.1 ± 1.4%	9.2 ± 5.8%	[17]
	Pampus argentius	71.38 ± 0.66%	22.22 ± 0.66%	2.35 ± 0.46%	[31]
	Chitala chitala	74.2 ± 1.2%	22.2 ± 0.7%	4.0 ± 0.7%	[17]
	Euthynnus affinis	75.7 ± 0.1%	20.9± 0.1%	1.9 ± 0.0%	[17]
	Auxis rochei	74.3%	21.0%	3.1%	[37]
	Tor tor	76.43 ± 0.15 %	26.24 ± 0.62%	4.70 ± 0.36%	[38]
	Mugil cephalus	79.1%	15.3%	2.2%	[39]
Prawns	*Penaeus monodon*	72.56 ± 1.09%	23.60 ± 1.63%	0.91± 0.13%	[40]
	Fenneropenaeus indicus	64.16 ± 1.1%	22.87 ± 1.63%	0.71 ± 0.13%	[40]
	Litopenaeus vannamei	75.43± 0.40%	19.8 ± 0.04%	0.76 ± 0.03%	[40]
Bivalves	*Crassostrea madrasensis*	80.1 ± 0.7%	16.8 ± 0.1%	2.7 ± 0.2%	[17]

On comparing the nutrient profile of *B. dussumieri* with commercially available fishes sold and consumed in India, the concentration of essential nutrients like proteins and lipid was observed to be higher (Table. 1).

4. CONCLUSION

The consumption of mudskipper is not well known among majority of seafood consumers along the northwest coast because of its unavailability in all the markets and mostly because of public's perception on its consumption. This may be due to the organism's habitat being muddy and physical appearance is not so appealing. The data in the current study might trigger the consumption of *B. dussumieri* among the people by changing their perception. However further investigations regarding variation in biochemical composition during breeding, non-breeding, in berried females and more importantly the required intake for optimum benefits is required.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Andem AB, Ekpo PB. Proximate and mineral composition of mudskipper fish (Periopthalmus barbarous) in the mangrove swamp of calabar river, south Nigeria. The International Journal of Science and Technology. 2014;2(2):72-76.
2. Kanejiya J, Solanki D, Gohil B. Nutrient content of three species of mudskipper (Gobiidae; Oxudercinae) in Bhavnagar coast, Gujarat, India. The Journal of Zoology Studies. 2017;4(3):48-51.
3. Flowra AF, Tumpa SA. Chemical composition of five selected dry fish species in Chalan beel, Bangladesh. DAV International Journal of Science. 2012;1(2):157-160.
4. Botta JR, Noonan PB, Lauder JT. Chemical and sensory analysis of ungutted offshore capelin (Mallotus villosus) stored in ice. Journal of Fish Biology. 1978;35:971-980.
5. Wahengbam S, Sarojnalini C. Estimation of protein contents of chocolate mahseer (Neolissochilus hexagonolepis, McClelland) of Iyei River of Manipur. International Journal of Science and Research. 2003;2(2):257-259.
6. Tremblay LA. Vitamins and Minerals in fish. F:/vitamins and minerals in fish Livestrong, Com; 2011.
7. Love WG, Nakayama K, Franey MA. Isovector couplings for nucleon charge-exchange reactions at intermediate energies. Journal of Physical Review Letters. 1980;59(13):1401-1404.
8. Gopakumar K. Biochemical composition of Indian food fish. Central Institute of Fisheries Technology, Cochin; 1997.
9. Ravichandran S, Kumaravel K, Florence PE. Nutritive Composition of some Edible Fin

Fishes. International Journal of Zoological Research. 2011;7:241-251.
10. Mathana P, Raj TS, Nair RKC, Selvamohan T. Seasonal changes in the biochemical composition of four different tissues of red spotted emperor Lethrinus lentjan (Family: Lethrinidae). Annals Biological Research. 2012;3:5078-5082.
11. Kumaran R, Ravi V, Gunalan B, Murugan S, Sundramanickam A. Estimation of proximate, amino acids, fatty acids and mineral composition of mullet (Mugil cephalus) of Parangipettai, Southeast Coast of India. Advances in Applied Science Research. 2012;3(4):2015-2019.
12. Manal A. Gobiidae. Eagle wood Cleff Press, New Jersey. 2009;142.
13. Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Protein measurement with the Folin-Phenol reagents. Journal of Biological Chemistry. 1951;193:265-275.
14. Hedge JE, Hofreiter BT. Carbohydrate chemistry 17 (Eds., Whistler, R. L. and Be Miller, J. N). Academic press New York; 1962.
15. Barnes H, Blackstock J. Estimation of lipids in marine animals and tissues. Detail investigation of the Sulpho-Phosphovanilin method for total lipids. Journal of Experimental Marine Biology and Ecology. 1973;12:103-118.
16. Van Dillen SM, Hiddink GJ, Koelen MA, de Graff C, van Woerkum CM. Understanding nutrition communications between health professionals and consumers: development of a model for nutrition awareness based on qualitative consumer research. The American Journal of Clinical Nutrition. 2003;77(4):1065S-1072S.
17. Mohanty BP, Ganguly S, Mahanty A, Mitra T, Patra S, Karunakaran D, Mathew S, Chakraborty K, Paul BN, Sarma D, Dayal S, Singh S, Ayyappan S. Fish in human health and nutrition. Advances in Fish Research. 2019;7:189-218.
18. Eddy RL, Eddy PF, Gilliland JD, Ibarra JF, Mc Murry JQ. Thompson human growth hormone release: comparisons of provocative test procedures. American Journal of Medicine. 1974;56:179-185.
19. Shearer KD. Factors affecting the proximate composition of cultured fishes with emphasis on salmonids. Aquaculture. 1994;119:63-88.
20. El Oudiani S, Chetoui I, Darej C, Moujahed N. Sex and seasonal variation in proximate composition and fatty acid profiles in Scomber scombrus (L. 1758) fillets from the Middle East Coast of Tunisia. Grasas Aceites. 2019;70(1):285.
21. Varghese T, Mathew S. Seasonal variations in the proximate composition of Asian stinging catfish Heteropneustes fossilis (bloch, 1794) and banded snakehead (Channa striata) (bloch, 1793) collected from paddy field of Kerala. Trends in Fisheries Resserach. 2016;5(3):2319-4758.
22. Minar MH, Adhikary RK, Begum MM, Islam MR, Akter T. Proximate composition of Hilsha (Tenualosa ilisha) in laboratory condition. Bangladesh Journal of Progressive Science and Technology. 2012;10(1):057-060.
23. Sonavane AE, Koli JM, Patange SB, Naik SD, Mohite AS. Proximate composition and fatty acid profiling of Indian mackerel (Rastrelliger kanagurta) off Ratnagiri, west coast of India. International Journal of Pure and Applied Bioscience. 2017;5(4):920-924.
24. Reddy SK. Comparative studies on the ecology and biology of Mystus species (Telecostei: Bagriolae) from Mehadrigedda stream of Visakhapatnam. Ph.D. Thesis submitted to the Andhra University, Waltair, India; 1992.
25. Sivani G. Studies on biology, nutritive value and fishery of some commercially important fishes of Gostani estuary near Visakhapatnam. Ph.D. thesis submitted to Andhra University, Waltair, India; 1994.
26. Sankar, T. V. & Ramachandran, A. (2001). Changes in biochemical composition in Indian major carps in relation to size. Fishery Technology, 38(1), 22-27.
27. Prasad SK, Prasad NV, Venkateswarlu C. Seasonal variations in the biochemical composition of muscle and liver of marine fishes, Gazza achlamys and Ariomma indica from Visakhapatnam coast, South India. International Journal of Bioassays. 2017;6(6):5407-5414.
28. Ghribi F, Boussoufa D, Aouini F, Bejaoui S, Chetoui I, Rabeh I, Cafsi ME. Seasonal variation of biochemical composition of Noah's ark shells (Arca noae L. 1758) in a Tunisian coastal lagoon in relation to its reproductive cycle and environmental conditions. Aquatic Living Resources. 2018;31:14.
29. Lockwood APM. Aspects of the physiology of crustacean. Oliver Boyn. Edinburg. London. 1968;9-15.
30. Viswanathan PGN, Mathew S. Biochemical composition of fish and shellfish. Central Institute of Fisheries Technology, Cochin. CIFT Technology Advisory Series. 2000;4-7.

31. Huque R, Munshi MK, Khatun A, Islam M, Hossain A, Hossain A, Akter S, Kabir J, Jolly YN, Islam A. Comparative study of raw and boiled silver pomfret fish from coastal area and retail market in relation to trace metals and proximate composition. International Journal of Food Science. 2014;7.
32. Das KP. Effect of ambient temperature, icing and freezing on nutrient composition of Rohu (Labeo rohita), Grass carp (Ctenopharyngodon idella) and Tilapia (Oreochromis mossambica). B.Sc. Thesis, Fisheries and Marine Resources Technology Discipline, Khulna University, Khulna, Bangladesh. 2009;20-30.
33. Jelin V, Panju A. Comparative biochemical study of the crab Charybdis feriatus from marine and estuarine water. International Journal of Novel Trends in Pharmaceutical Science. 2017;7(1):2277-2782.
34. Rosa R, Nunes ML. Biochemical composition of deep-sea decapod crustaceans with two different benthic life strategies off the Portuguese south coast. Deep-Sea Research I. 2013;50:119-130.
35. Vinagre AS, Amaral APN, Ribarcki FP, Silveira EF, Perico E. Seasonal variation of energy metabolism in ghost crab Ocypode quadrata at Siriu´ Beach (Brazil). Comparative Biochemistry and Physiology. 2007;146(A): 514-519.
36. Mohanty SS, Dash BP, Pramanik DS. Proximate composition of three marine fishes of Chandipur, Bay of Bengal, India. International Journal of Fisheries and Aquatic Studies. 2015;2(4):354-358.
37. Kumar VM, Farejiya MK, Dikshit AK, Siva A, Rao RA, Mali KS. Proximate composition, nutritive value and share of protein to the diet of coastal population from four neritic tunas occurring along north western Indian EEZ. International Journal of Educational Research and Technology. 2017;8(3):34-40.
38. Romharsha H, Sarojnalini C. Proximate composition, total amino acids and essential mineral elements of some Cyprinid fishes of Manipur, India. Current Research in Nutrition and Food Science. 2018;6(1):157-164.
39. Chandrashekar K, Deosthale YG. Proximate composition, amino acid, mineral and trace element content of the edible muscle of 20 Indian fish species. Journal of Food Consumption and Analysis. 1993;6:195-200.
40. Raffic Ali SS, Ramchandran M, Chakma SK, Sheriff MA. Proximate composition of commercially important marine fishes and shrimps from the Chennai coast, India. International Journal of Fisheries and Aquatic Studies. 2017;5(5):113-119.