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Biochemical Composition in *Scylla serrata* (Forsk.) of Chakaria Sundarban Area, Bangladesh

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Abstract: Biochemical composition (protein, fat, ash, moisture and carbohydrate) of male and female of *Scylla serrata* in Chakaria Sundarban area were studied. One factor ANOVA indicated the significant differences of protein, fat, ash and moisture concentration between male and female of *S. serrata*. The yearly mean protein content $17.69 \pm 2.14\%$ was recorded for male and $19.39 \pm 1.29\%$ in female on wet weight basis. The highest protein content in male was recorded during December (20.10%) and for female in February (20.43%) and the lowest protein content for male in May (14.00%) and for female in August (17.20%). The yearly average fat content ($0.51 \pm 0.12\%$) was recorded in male and ($0.62 \pm 0.13\%$) was recorded for female *S. serrata*. The highest fat content was recorded for male in December (0.75%) and lowest in May (0.38%). In the female *S. serrata* highest fat content 0.78% was recorded in February and lowest (0.44%) during July and August. Correlation analysis showed a positive relation between the protein and fat content of *S. serrata* ($r = 0.864$, $t = 7.67$, $df = 22$). The highest moisture content was found in male during May (83.50%) and for female in August (79.50%) and the lowest in December (76.5%) for male and female in March (74.98%). In male *S. serrata* highest ash content was recorded in December (2.22%) and for female during April (2.34%). Highest carbohydrate content was recorded in male during May (0.92%) and in female during September (1.29%). Correlation matrix showed the protein and fat content had positive correlation with pH, Dissolved Oxygen (DO), salinity and as well as water transparency in case of female *S. serrata* and male indicated a negative relation with recorded DO and salinity of the investigated area.

Key words: Biochemical composition, *Scylla serrata*, Bangladesh

INTRODUCTION

Scylla serrata is widely distributed in mangrove area of the Indo-Pacific, including the inshore waters of the Bay of Bengal. It is the most popular because of its size, meat quality, high price and export potential^[1]. *S. serrata* (mud crab) is fast growing, hardy and adapts itself to various aquatic conditions. The mud crab is consumed in Bangladesh^[2]. *S. serrata* is used as aquaculture and poultry feed and is an economical and exportable species for Bangladesh^[3]. Proximate biochemical analysis provides information on the nutritional value of a particular organism used as a source of food. There are four major types of components are found in the living organisms namely protein, fat, carbohydrate and nucleic acid^[4]. Water, protein, fat and carbohydrate are the main constituents of fish and shellfish with non-protein nitrogenous constituents and salty in small amounts^[5]. Crabs are good source of food to marine life as well as to man and also protein source^[6,7]. The nutritional quality of

the crab proteins were compare very favorable than that of muscle meat of mutton, chicken, duck and fish^[8-10]. Due to *S. serrata* food value and its various commercial and medicinal uses, it becomes an important fisheries item in many parts of the World. Work on biochemical composition of the *S. serrata* of Bangladesh is very scanty. Only a little work on proximate analyses was done by Mannan^[11] and Khan^[6]. But no published report is found on seasonal variation of biochemical composition of male and female of *S. serrata* in this country. Therefore, the present investigation is the first of its kind on biochemical composition in male and female mud crab of *S. serrata* of the Chakaria Sundarban of Bangladesh.

MATERIALS AND METHODS

Samples of *Scylla serrata* were collected from the Chakaria Sundarban area during August 1999 to July 2000. The collected samples were washed in chlorinated water and preserved in a deep freezer (-20°C); afterwards those

were taken out for performing analyses. Biochemical composition analyses were done for one year with replication.

Protein was estimated by Kjeldhal's method^[12]. Fat was determined by Soxhlet's method^[13]. The percentage of ash content was estimated by burning the materials in a Muffle Furnace at 550-600°C for 4-6 h and moisture was determined by drying the samples at 100-105°C in an oven^[13]. Carbohydrate, was analysed following standard procedure^[14]. Concurrently, water temperature was recorded by a bucket thermometer. Salinity and Dissolved Oxygen (DO) were determined by the standard procedure as following Barnes^[15]. The pH was measured by a digital pH meter. A Secchi-disk (30 cm in diameter) was used to record the transparency of water.

RESULTS AND DISCUSSION

Physico-chemical parameters: The hydrological parameters of the study area showed seasonality (Table 1). Air temperature varied from 25.70 to 33.10°C, the minimum temperature was recorded in January and maximum in May. Water temperature ranged from 24.4 to 30.90°C, the maximum temperature was recorded in May and minimum in January. The pH varied from 6.99 to 8.20, the lowest occurrence was in August and the highest in March. The concentration of dissolved oxygen varied through a range of 3.70 to 5.60 ml L⁻¹, the minimum was recorded in August and maximum in April. Salinity ranged from 0.81 to 31.12‰, with the maximum in May and minimum in August. Secchi-disc visibility varied between 10.80 and 40.10 cm and highest value was found in January and minimum in August.

Biochemical composition

Protein: The highest protein in male *S. serrata* was found in the month of December (20.10%) and lowest was found in May (14.00%). In female *S. serrata*, higher protein was found in January to April during pre-monsoon period and lowest was found during June to October, where monsoon was prevailed (Table 2 and 3). Protein content of female *S. serrata* was high in pre-breeding and breeding period during pre-monsoon (January to April) and lower in post breeding period in monsoon from (June to October). The yearly mean protein content 17.69±2.14% was recorded in male *S. serrata* and 19.39±1.29% for female *S. serrata* on wet weight basis. Khan^[6] found 11.60% protein in body meat of male *S. serrata* and 19.92% protein in female body meat of *S. serrata*. Zaitsev *et al.*^[10] found 17 to 20% protein in crab meat. George and Gopakumar^[16] found 16.80 and 16.28% protein in body meat and claw meat of crab.

One factor ANOVA showed significant differences of protein concentration between male and female *S. serrata* ($p = 0.028$, $F = 5.558$, $df = 22$).

Fat: The yearly average fat content 0.51±0.12% was found in male *S. serrata* and 0.62±0.13% was in female *S. serrata*. One factor ANOVA analysis indicated the concentration of fat difference between male and female *S. serrata* ($p = 0.046$, $F = 4.477$, $df = 22$) of Chakaria Sundarban area. The fat content of male *S. serrata* was high in December (0.75%) and lowest in May (0.38%). The amount of fat increased gradually from July to December and decreased from January to May (Table 2). In female the highest fat content found in February (0.78%) and lowest in July and August (0.44%). The fat content increased gradually from September to February and decreased May to August (Table 3). Fat content in female was high during pre-breeding period and lowest contribution was in post breeding period. The fat content of *S. serrata* (male and female) was positively related with protein ($r = 0.856$, $t = 5.247$, $df = 10$, $p = 0.0001$ and $r = 0.909$, $t = 6.907$, $df = 10$, $p = 0.0005$ accordingly). Fat deposits varied from species to species^[17] and also from light to dark muscles^[18]. Lovern^[19] reported the variation of fat content was influenced by the variation of species, diet, temperature, salinity, selective mobilization and distribution. During present investigation, high fat content was found during February in female, when pre-monsoon was prevailed and in male high fat content was in December. Farooqui and Nagabushanam^[20] found the lipid content of *S. serrata* decrease during the peak spawning period. The present finding of fat content was harmonious variation with the result of Farooqui and Nagabushanam^[20].

Moisture: The nutritive substances existed in a dissolved condition. All the important chemical reactions in cells also occurred in aqueous medium. In male *Scylla serrata* higher moisture content was found in May (83.50%) and lowest in December (76.50%). In female higher moisture content was recorded in August (79.50%) and lowest in March (74.98%) and moisture content was high during post breeding period (June to October) (Table 3). The yearly average concentration of moisture in male was 79.53±3.42% and in female moisture content was 77.29±4.93%. One factor of ANOVA showed the moisture difference between male and female *Scylla serrata* in the Chakaria Sundarban area ($p = 0.012$, $F = 7.432$, $df = 22$).

Moisture showed negative correlation with protein concentration both male and female *S. serrata* ($r = -0.998$, $df = 10$, $t = 50.13$, $p = 0.0001$ and $r = -0.847$, $df = 10$, $t = 5.03$, $p = 0.0005$).

Table 1: Physico-chemical parameters of the Chakaria Sundarban area during August 1999 to July 2000

Months	Air temperature (°C)	Water temperature (°C)	Water pH	Dissolved oxygen (mg L ⁻¹)	Salinity (‰)	Water transparency (cm)
August	28.30	27.50	6.99	3.70	0.81	10.80
September	30.10	29.00	7.20	4.68	7.02	30.10
October	29.50	27.00	7.40	4.68	7.02	30.10
November	28.40	26.80	7.59	4.30	6.51	34.30
December	26.30	25.20	8.03	3.90	13.56	38.50
January	25.70	24.40	7.85	4.51	22.27	40.10
February	26.80	25.60	7.45	4.12	20.08	29.30
March	30.90	29.40	8.20	5.02	28.39	34.10
April	31.30	30.10	7.75	5.60	28.69	30.20
May	33.10	30.90	7.56	4.91	31.12	16.00
June	29.70	28.60	7.20	4.00	18.00	15.40
July	29.10	26.90	7.10	4.25	5.10	14.10

Table 2: Biochemical composition in male *Scylla serrata* (g/100 g) on wet weight basis during August 1999 to July 2000

Months	Protein (%)	Fat (%)	Moisture (%)	Ash (%)	Carbohydrate (%)
August	18.20	0.49	79.00	1.80	0.51
September	19.00	0.50	78.00	2.10	0.40
October	19.44	0.52	77.50	2.12	0.42
November	19.63	0.61	77.30	2.14	0.32
December	20.10	0.75	76.50	2.22	0.31
January	20.00	0.67	77.00	2.10	0.33
February	18.30	0.50	79.00	1.70	0.50
March	16.50	0.41	81.00	1.30	0.79
April	14.50	0.40	83.00	1.25	0.85
May	14.00	0.38	83.50	1.20	0.92
June	15.60	0.42	82.00	1.23	0.85
July	17.00	0.47	80.50	1.60	0.43

Table 3: Biochemical composition in female *Scylla serrata* (g/100 g) on wet weight basis during August 1999 to July 2000

Months	Protein (%)	Fat (%)	Moisture (%)	Ash (%)	Carbohydrate (%)
August	17.20	0.44	79.50	1.62	1.24
September	18.84	0.51	79.00	1.80	1.29
October	18.60	0.60	78.20	1.98	0.80
November	20.10	0.73	76.50	2.22	0.45
December	19.50	0.67	77.00	2.00	0.60
January	20.22	0.74	76.50	2.20	0.34
February	20.43	0.78	76.20	2.30	0.29
March	21.10	0.74	74.98	2.33	0.39
April	21.22	0.77	75.34	2.34	0.33
May	19.33	0.52	77.00	2.22	0.93
June	18.65	0.48	78.00	1.82	1.05
July	17.50	0.44	79.20	1.75	1.11

Table 4: Correlation matrix between hydrological parameters and biochemical composition of male *S. serrata*

	Water temperature (°C)	pH	DO (mg L ⁻¹)	Salinity (‰)	Water transparency (cm)	Protein (%)	Fat (%)	Moisture (%)	Ash (%)	Carbohydrate (%)
Water temperature (°C)	1									
pH	-0.273	1								
DO (mg L ⁻¹)	-0.207	0.473	1							
Salinity (‰)	0.074	0.565	0.705	1						
Water transparency (cm)	-0.583	0.831	0.358	0.294	1					
Protein (%)	-0.332	0.114	-0.555	-0.607	0.457	1				
Fat (%)	-0.264	0.353	-0.446	-0.330	0.584	0.856	1			
Moisture (%)	0.343	-0.135	0.543	0.598	-0.472	-0.998	-0.873	1		
Ash (%)	-0.399	0.068	-0.494	-0.649	0.423	0.960	0.852	-0.971	1	
Carbohydrate (%)	0.425	0.006	0.554	0.692	-0.387	-0.946	-0.832	0.943	-0.948	1

Table 5: Correlation matrix between hydrological parameters and biochemical composition of female *S. serrata*

	Water temperature (°C)	pH	DO (mg L ⁻¹)	Salinity (‰)	Water transparency (cm)	Protein (%)	Fat (%)	Moisture (%)	Ash (%)	Carbohydrate (%)
Water temperature (°C)	1									
pH	-0.273	1								
DO (mg L ⁻¹)	-0.207	0.473	1							
Salinity (‰)	0.074	0.565	0.705	1						
Water transparency (cm)	-0.583	0.831	0.358	0.294	1					
Protein (%)	-0.405	0.844	0.377	0.492	0.812	1				
Fat (%)	-0.359	0.796	0.469	0.511	0.859	0.909	1			
Moisture (%)	0.166	-0.855	-0.663	-0.802	-0.684	-0.847	-0.888	1		
Ash (%)	-0.305	0.779	0.704	0.777	0.692	0.847	0.875	-0.951	1	
Carbohydrate (%)	0.297	-0.798	-0.502	-0.599	-0.846	-0.850	-0.970	0.908	-0.890	1

(d.f = 10)

At 5% level significant tabulated value = 0.576.

At 1% level significant tabulated value = 0.708

Zaitsev *et al.*^[10] found 77 to 79% moisture in crab meat. Srinivasagam^[21] reported 77.20% moisture content in male and 73.64% in female *Scylla serrata*. George and Gopakumar^[16] found 77.20% moisture in female *S. serrata*.

Ash: In male *S. serrata* highest ash content recorded during December (2.22%) and lowest in May (1.20%) and the ash content was gradually increased from July to December and decreased from January to June (Table 2). In female highest ash content was recorded during April (2.34%) and lowest in August (1.62%) and the ash content gradually increased from October to April and decreased from May to August (Table 3). The yearly average ash content $1.73 \pm 0.41\%$ was recorded for male and $2.05 \pm 0.25\%$ in female on wet weight basis. Ash content showed negative correlation with moisture and carbohydrate both male and female *S. serrata* (Table 4 and 5).

One factor ANOVA showed significant differences of ash concentration between male and female *S. serrata* ($p = 0.031$, $F = 5.338$, $df = 22$).

Carbohydrate: Carbohydrate content varied from 0.31-0.92% in male and 0.29-1.29% in female. In male highest carbohydrate content was recorded in May (0.92%) and lowest in December (0.31%) and carbohydrate content increased gradually from January to May and decreased June to December (Table 2).

In female higher carbohydrate was recorded in September (1.29%) and lowest in February (0.29%) and carbohydrate content gradually increased from May to September and decreased from October to March (Table 3). Zaitsev *et al.*^[10] found 0.30 to 1.10% glycogen in crab meat. Khan^[6] reported 0.13% carbohydrate in male and 0.86% in female body meat in hydrate condition of *S. serrata*. Srinivasagam^[21] reported 0.15 to 0.17% carbohydrate in *S. serrata*. Carbohydrate content showed negative correlation with protein both male and female *S. serrata* ($r = -0.946$, $t = 9.183$, $df = 10$, $p = 0.0001$ and $r = -0.850$, $t = 5.092$, $df = 10$, $p = 0.0005$) in the investigated area of Chakaria Sundarban.

One factor ANOVA showed significant differences of protein concentration between male and female *S. serrata* ($p = 0.168$, $F = 2.023$, $df = 22$).

Changes in biochemical composition of *S. serrata* in the Chakaria Sundarban area showed seasonality. Protein, fat, ash and moisture contents in male and female *S. serrata* indicated the significant differences. High protein and fat content were recorded in female *S. serrata* during prebreeding and breeding period, when pre-monsoon was prevailed. During monsoon time (May to August) after the peak breeding time protein and fat contents gradually decreased.

Correlation matrix showed that protein and fat concentration were positively correlated with pH, DO, salinity and water transparency in case of female *S. serrata* and male showed a negative relation with DO and as well as salinity (Table 4 and 5).

REFERENCES

1. Raj, M.M., 1991. A Review of the Mud Crab (*Scylla serrata*) Fishery on the East Coast of India and in Kerala State. In: The Mud Crab-A Report on the Seminar Convened in Surat Thani, Thailand, Angel, C.A. (Ed.), BOBP/REP/51, pp: 103-125.
2. Ahmed, M.K., 1991. Mud Crab-a Potential Aquar-resource of Bangladesh. In: the Mud Crab-A Report on the Seminar Convened in Surat Thani, Thailand, Angel, C.A. (Ed.), BOBP/REP/51, pp: 95-102.
3. Zafar, M. and M.Z.H. Siddiqui, 2000. Occurrence and abundance of four Brachyuran crabs in the Chakaria Sundarban of Bangladesh. The Chittagong Univ. J. Sci., 24: 105-110.
4. Cuningham, E.B., 1978. Biochemistry Mechanism of Metabolism in Animal Nutrition. Maynard, L.A. *et al.* (Eds.), 7th Edn, 1979, Academic Press, London, pp: 10-20.
5. Zafar, M., 2000. Study on sergestid shrimp acetes in the vicinity of Mathamuhuri river confluence, Bangladesh. Ph.D. Thesis, University of Chittagong, Bangladesh, pp: 222.
6. Khan, P.A., 1992. Biochemical composition, minerals (Calcium and iron) and chitin content of two Portunid crabs *Scylla serrata* Forskal and *Portunus pelagicus* Linnaeus available in and around the coastal region of Bangladesh. M.Sc. Thesis, Institute Marine Sciences, Chittagong University, pp: 112.
7. Siddiqui, M.Z.H. and M. Zafar, 2002. Crabs in the Chakaria Sundarban area of Bangladesh. J. NOAMI., 19: 61-77.
8. Derosier, N.W., 1963. The Technology of Food Preservation. The Avi Publishing Company, Inc., pp: 20.
9. Newcombe, C.L., 1944. The nutritional value of seafoods. Virginia Fisheries Laboratory of the College of William and Mary and Commission of Fisheries as the Series, No. 2.
10. Zaitsev, V., I. Kizevette, L. Lagunoy and T. Makarov, 1969. Fish Curing and Processing. Mir publishers, Moscow, pp: 280.
11. Mannan, A., 1977. Nutritional aspects of marine fishes and fisheries products. In: Marine fisheries Seminar, Chittagong, Bangladesh, Chittagong University, pp: 8-19.

12. Bradstreet, R.B., 1965. The Kjeldhal Method for Organic Nitrogen. New York Academic Press.
13. Pearson, D., 1976. The Chemical Analysis of Foods. Churchill Livingstone, Edinburgh, London and New York, 7th Edn., pp: 575.
14. Rangana, S., 1986. Hand Book of Analysis and Quality Control for Fruit and Vegetable Products, Tata Mc Graw Hill Publishing Company Ltd, New Delhi, India, pp: 1-30.
15. Barnes, H., 1954. Apparatus and Methods of Oceanography Part-1, (Chemical), Acad. Press London, pp: 178-183.
16. George, C. and K. Gopakumar, 1987. Biochemical studies on crab *Scylla serrata* (Forsk.) Fish Tech., 24: 57-61.
17. Devadoss, P., 1984. Nutritive value of shark and skates and ray from Porto Novo Coast. Indian J. Fish, 31: 156-161.
18. Watabe, A.S., K. Kanna and J. Suzuki, 1977. A comparison white and dark muscle proteins of sardine. Bull Japanese Soc. Sci. Fish, 43: 1353.
19. Lovern, J.A., 1950. Some causes of variation in the composition of fish oils. J. So. Leath Trades Chem., 34: 7-21.
20. Farooqui, U.M. and R. Nagabushanam, 1983. Biochemical composition variations during testis maturation in the marine crab *Scylla serrata* Forskal (Crustacea: Decapoda, Portunidae). Rev. Bras. Biol., 43: 257-260.
21. Srinivasagam, S., 1979. On the nutritive values of the meat of Portunid crabs. J. Inland Fish Soc. India, 11: 128-131.