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Comparative Biochemical Composition of Natural and Fattened Mud Crab *Scylla serrata*

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Abstract

The biochemical composition (proteins, lipid, ash and moisture) of different parts of the body (gill, meat, egg) of fattened and natural mud crab *Scylla serrata* was determined. Twenty four samples of *S. serrata* (12 from wild & 12 from fattening farm) of different sizes and sexes (half of the sample is male) were used in this study. The mean protein and lipid contents are significantly ($p<0.05$) higher in fattened crabs than natural in natural crabs regardless of size and sexes. Moisture and ash were higher in natural crab than in fattened ones. The highest and lowest moisture content was noticed in gills and eggs in both natural and fattened crabs. Protein and lipid contents were comparatively higher in eggs than in other body parts. Female crabs contained high protein and lipid than males in both natural and fattened crabs. From the results of this study it may considered that fattened crab might be comparatively superior to natural crabs as they appear to provide higher levels of protein and fat for human nutrition.

Keywords: Biochemical composition; Natural and Fattened mud crab; *Scylla serrata*

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1. Introduction

The mud crab *scylla serrata* is one of the most popular and expensive sea food in the South East Asian countries. The crabs are increasingly realized as a potential food source for their delicacy and nutritional richness [1]. Crab meat contains essential amino acids, proteins, unsaturated fatty acids and also an excellent source of minerals [2, 3] particularly calcium, iron, zinc, potassium and phosphorus [2, 4].

In recent years, crabs have become a more popular of food item, which commands high prices in the international market [5, 6]. The crabs rank third among sea foods after shrimps and lobsters for their esteemed delicacy and also the value of fishery they support [7].

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Though increasing fishery as well as popularity as food item [8, 9], the information on the nutritive value of *S. serrata* is scanty in Bangladesh [10]. Biochemical composition and mineral content of some crabs namely *S. serrata* and *Portunus pelagicus*, were reported by Anon [11] and Das et al [12] from Bangladesh. There are some researches also available on *S. serrata* and *P. pelagicus* from coastal waters of India and Pakistan [13, 14]. However, no studies yet considered the nutrient variations among the natural and fattened source of mud crab.

Studies on the biochemical composition of edible organisms are important from the nutritional point of view. But very limited study has been done so far on the nutritional composition of crab. Hence in the present study the biochemical composition namely, moisture, protein, lipid and ash contents in different body parts (meat, gill, and egg) of male and female mud crabs from natural and fattening farm in sundarban mangrove region of Munshigonj, Bangladesh has been studied. In addition, comparison among the biochemical composition of different body parts, sexes and sizes of the species was investigated.

2. Materials and Methods

2.1. *Sample collection and preparation*

Twelve male and twelve female crabs, *Scylla serrata* of different size ranges were collected from two different sources; wild and crab fattening farm from Munshigonj, Satkhira districts of Bangladesh in live condition. The thin and small-sized crabs (<100 g) were fattened in the cages (7 ft x 5 ft x 1.7 ft) in earthen pond. Each cage consisted with 60 chambers and single crab (male or female) was reared in each chamber. Crabs were reared there about 10-15 days and supplied feed like small tilapia were feed twice daily at the rate of 5% body weight. Among the collected samples, half of the samples were from natural source and the rest half from fattening farm. Samples were categorized into two classes according to their size; large sample (>350gm) and small sample (<200gm). Collected samples were transported in live condition to the laboratory of Fisheries and Marine Resource Technology (FMRT) discipline of Khulna University and kept in deep freeze at -80˚C prior to further analysis. Samples for analysis were prepared from the preserved animals by removing the excess water from crab body with blotting paper. Then the total body weight of individual animal was measured by using an electric balance. Different body parts such as gill, meat, and ovary were dissected out. Separated and weighed body parts (gill, meat, and ovary) were taken on to aluminum foils and dried in an oven at 60˚C to constant weight. The dried samples of gill, meat and egg were preserved in airtight plastic bottles kept in a desiccators for biochemical composition analysis.

2.2. *Determination of biochemical composition*

The tissue samples were analyzed for crude protein, crude lipid, moisture and ash by standard methods described below and the analysis was carried out in triplicate following

Pearson [16], Katsutoshi and Low [17] in the fish nutrition Laboratory of FMRT Discipline Khulna University, Khulna, Bangladesh.

2. 2.1. *Determination of moisture*

Moisture was determined by keeping weighed quantity of tissue in a thermostat controlled oven at 105˚ C for 6 hours. There after samples were kept in dessicator for about 1 hour. The dry weight of each sample was taken in an electric balance. The percentage of the moisture content was then calculated by the following formula:

Percentage (%) of moisture = (Weight loses/Original weight of sample) × 100

2.2.2. *Determination of crude protein*

Total nitrogen was estimated by following the standard Kjeldahl method [16]. Crude protein content was obtained by multiplying the total nitrogen value by the conventional factor 6.25 [16]. The percentage of protein in the sample was calculated by the following equation : % Crude protein = % N×6.25

2.2.3. *Determination of lipid*

Crude lipid was determined by extracting the sample with methanol and chloroform solution (1:2).The clear extracted solution was kept at 70^0 C until the evaporation of chloroform and methanol. The percentage of Crude lipid content was calculated by the following equation.

Percentage (%) of fat = (Weight of extract/Weight of sample) × 100

2.2.4. *Determination of ash*

Ash content was determined by igniting previously dried tissue sample in a muffle furnace at 550˚c for 6 hours. The ash content was calculated by the following equation.

Percentage (%) of ash = (Weight of ash / Weight of Sample) × 100

2.3. *Data analysis*

All the measured data were arranged and analyzed by wet weight method. Data were subjected to statistical analysis by the SPSS 12.0 statistical software and Microsoft Office Excel 2007. The one way ANOVA was done for testing the difference among the three body tissues and the pooled t for comparing sex as well as two sources of crab. Significance level was considered as 5% for the tests.

3. Results

The moisture, protein, lipid and ash content in different organs of crab samples are given in Table 1.

Table 1. Moisture, protein, lipid and ash content in different organs of crab *S. serrata* samples.

Organ	Source	Size	Sex	Moisture	Protein (%)	Lipid (%)	Ash (%)
Gill	Fattened	Small	Male	83.59±1.13	8.62±0.76	0.34±0.09	6.36±0.36
			Female	82.3±2.50	10.86±1.75	0.36±0.03	5.94±0.34
		Large	Male	79.25± 1.22	11.83±1.51	0.50±0.05	7.65±0.52
			Female	78.87±2.10	13.51±1.47	0.52± 0.08	6.23±0.49
	Natural	Small	Male	85.68±1.58	8.10±0.61	0.20±0.06	5.58±0.54
			Female	83.66±1.36	9.29±0.77	0.27±0.05	5.81±0.61
		Large	Male	84.54± 0.84	9.43± 0.29	0.28±0.02	5.60±0.32
			Female	80.66± 0.70	11.81±0.26	0.37± 0.04	6.77±0.51
Meat	Fattened	Small	Male	81.3±1.25	14.44±1.41	1.25±0.13	2.02±0.75
			Female	75.3±1.43	19.85±1.77	2.05±0.62	2.11±0.95
		Large	Male	76.39±0.61	18.78±0.22	1.75±0.42	2.40±0.64
			Female	70.68±1.55	24.54±1.32	2.62±0.12	1.83±0.61
	Natural	Small	Male	78.02±1.53	16.60±.94	1.32±0.17	3.63±0.32
			Female	76.90±1.80	17.65±1.0	1.17±0.04	3.87±0.12
		Large	Male	75.41±1.01	18.95±1.21	1.45±0.08	3.20±0.39
			Female	75.31±1.25	19.38±0.66	1.47±0.22	3.47±0.07
Egg	Fattened	Small	Female	49.77±1.07	40.77±1.43	6.78±0.41	1.47±0.28
		Large	Female	47.35±2.08	43.38±2.91	7.51±0.34	1.09±0.17
	Natural	Small	Female	56.73±1.65	34.67±2.19	5.45±0.41	1.70±0.54
		Large	Female	53.31±0.92	37.87±0.66	6.73±0.37	1.50±0.48

[1]Small crab: < 200g [2]Large crab: > 350g

As dissection of male gonad (testes) was difficult, biochemical composition of gonad was restricted to the female crabs only. The highest (85.68±1.58%) and the lowest (47.35±2.08%) moisture content were recorded in the small natural male crabs gill and large fattened females egg tissue, respectively. Moisture content was found comparatively higher in females than in the males in both sources and the small crabs contain higher moisture than large crabs (Fig. 1). A significant variation in moisture content was found between sexes regardless of sources ($p<0.05$).

The highest (43.38±2.91%) and the lowest (8.10±0.61%) protein content were recorded in egg tissue of large fattened female and gill of small natural male crab respectively (Table 1). Protein content varied between 8.10% to 18.95% and 9.29% to 43.38% in male and female respectively regardless of size and sources. Protein content

was found comparatively higher in females than the males and the large crabs contain higher protein than small crabs (Fig. 1). The significant variation ($p<0.05$) in protein content showed between sexes except gill of small fattened crab and meat of small natural crabs.

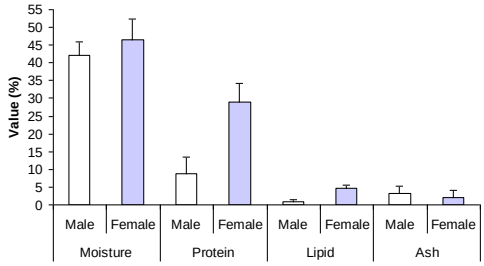

Fig. 1. Moisture, protein, lipid and ash content in different body parts of *S. serrata* from Munshigonj, Satkhira regardless of sources and sizes.

The maximum (7.51±0.34%) lipid recorded from large fattened female and the minimum (0.20±0.06%) from natural small female (Table 1). Female mud crabs showed higher fat content than the male regardless of size and sources (Fig. 1). In terms of size variation, large crabs showed higher fat content than the small crabs. Lipid content of large natural meat and small fattened meat showed significant variation between sexes ($p<0.05$).

Ash content varied between 2.02% to 7.65% and 1.09% to 6.77% in male and female respectively regardless of size and sources. The highest (7.65±0.52%) and the lowest (1.09±0.17%) ash content were recorded in fattened large male gill and fattened female's egg respectively. Among the nutrient contents examined only male showed higher ash content than the female regardless of size and sexes (Fig. 1). The large crab showed higher ash content than the small crab without considering sexes and sources. However, neither the gill of natural crab nor the gill of fattened crab showed significant variation between sexes ($p<0.05$).

3. 2. *Source variation in biochemical composition*

Variation in moisture content of gill, meat and egg tissue for male and female mud crab depends upon their sources have been shown in Fig. 2. The average moisture content was higher in natural crabs than fattened crabs, irrespective of sex and size,. The highest and lowest moisture content from fattened crab were in small male gill (83.59±1.13%) and large crab egg (47.35±2.08%) whereas the highest and lowest moisture content from natural crab were in small male gill (85.68±1.58%) and large crab egg (53.31±0.92%) respectively (Fig. 1). The source variation of moisture content in egg was statistically significant for both sizes ($p<0.05$) whereas the source variation for gill of small male and large female were not significant. In case of meat, the small male, large female and large

male showed significant variation (p<0.05) but the meat of small female was not significantly different (Fig. 2).

Protein content in all tested body parts was higher in fattened crabs than natural ones (Fig. 2). The highest and lowest protein content from fattened crabs were in large female egg (43.38±2.91%) and small male gill (8.62±0.76%) whereas the highest and lowest protein content from natural crab were in female egg (37.87±0.66%) and small male gill (8.10±0.61%) respectively. Protein content of all the female eggs and meat of male in both size crabs showed significant variation between the two sources (p<0.05).

Lipid content of fattened crab showed comparatively higher value than that of natural crab except that of small male meat (Fig. 2). The maximum lipid content of 7.51±0.34% and 6.73±0.37% was in eggs of *S. serrata* from fattened and natural sources, respectively (Table 1). However, mean lipid content varied significantly (p<0.05) in egg between two sources.

The maximum ash content from fattened and natural source was 7.65±0.52% and 6.77±0.51% in large male gill and large female gill respectively (Table 1). Male in fattened crabs showed higher ash values than the natural source. Ash content in egg was statistically significant for both size and sources (p<0.05) except gill of small male and small and large female. In case of meat, the ash content for small male and large female showed a significant source variation but no significant (p<0.05) variation was found in meat of large male (Fig. 1).

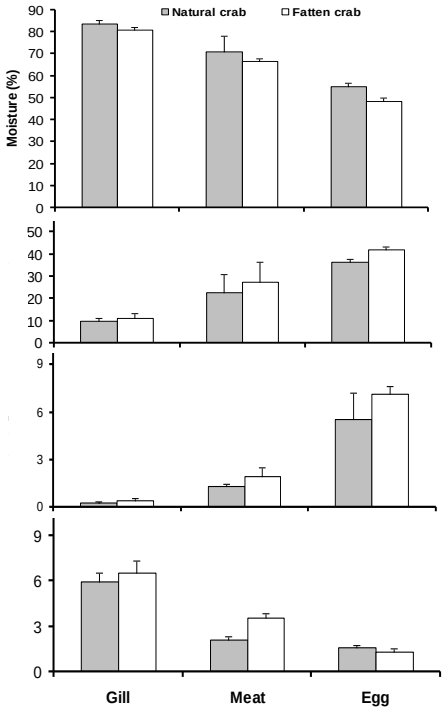

Fig. 2. Source variation in Moisture, Protein, Lipid and Ash content in different body parts of *S. serrata* regardless of sexes and sizes from natural and fattened farm of Munshigonj, Satkhira.

4. Discussion

The results of present showed that the biochemical composition of mud crab varies significantly between sexes and sources. Particularly, females' posses a higher fat content than the males and that may be the reason why the demand and price of female mud crab is much higher than the males. Moreover, composition also varied within different size groups. However, the findings of biochemical composition of *Scylla serrata* particularly the body meat is more or less similar to the results provided by the previous workers (Table 2) regardless of sexes and sizes.

Table 2. A comparative table of biochemical composition of body meat in *S. serrata* from different published reports with the present findings.

Source		Moisture (%)	Protein (%)	Lipid (%)	Ash (%)
Srinivasagam (13)		78.38	16.65	F>M	--
George and Gopakumar (15)		80.19 M	20.92F	F>M	5.09
Das et al. (12)		77.45 F	19.98 F	0.48 F	1.23 F
Mannan (10)		--	7.3	0.5	0.14
INFS (18)		83	8.9	--	--
Present study	Natural	83.64	22.77	1.35	2.09
	Fattened	81.00	27.43	1.92	3.54

M= Male, F= Female, INFS = Institute of Nutrition and Food Science.

Moisture was found to be the major component as it varied from 70.63% to 83.64% in body meat. The results are supported by other such studies as 83% moisture reported by the Institute of Nutrition and Food Science [18] and 80.19% by George and Gopakumar [15]. The percentage of protein (16.60 % to 24.54 %) in the body meat also showed close to the study of George and Gopakumar [15] who reported 20.92% protein in meat of *S. serrata* from India. The level of protein in mud crabs from all sources is higher than molluscs (8-13%) reported in Bangladesh [19]. In aspect of lipid%, present result showed a slightly higher value (1.35% to 1.92%) than other studies (0.5%, Mannan [10]; 0.48%, Das *et al.* [12]. However, ash% was more or less similar to other such studies. George and Gopakumar [15] reported 5.09% ash content in crab body meat whereas Das et al [12] recorded 1.23%. The present study also focused on the different body parts of the mud crab for biochemical composition which are limited in other such studies.

The gill of crabs contained higher moisture in both sources. Regarding moisture in meat, males contain higher moisture than females. In addition, moisture in meat of fattened crabs showed significant variation between sexes whereas it did not vary in natural crabs ($p<0.05$) (Fig. 2). The small size crab showed higher moisture content than

the larger crabs which was in contrast with the findings of Srinivasagam [13] who found that larger crabs possessed higher moisture than small ones.

Protein and lipid contents in all the examined body parts of *S. serrrata* showed higher levels in fattened crabs than of the natural sources irrespective of size and sexes (Fig. 2). The results could be supported by Hossain [14] who reported that the mud crab meat (male and female combined) from low saline zone contains comparatively higher protein value than the crab from high saline zone. Females possessed a higher fat content than males. Srinivasagam [13] and George and Gopakumar [15] observed that the lipid content of female is higher than the male which also agrees with the present findings.

5. Conclusion

In the present study, it has been shown that the protein, lipid, ash and moisture contents vary in different body parts of *S. serrata*. The composition also varies with the sexes, sizes as well as sources of the crabs. The most important finding is that fattened crabs showed higher protein values than the natural ones. Thus, fattened are nutritionally more superior than the natural crabs.

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