SEASONAL VARIATIONS IN BIOCHEMICAL COMPOSITION OF EDIBLE CRAB (PROTUNUS PELAGICUS LINNEAUS).

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SUMMARY: Seasonal changes in biochemical composition such as water, total nitrogen, non-protein nitrogen, protein, glycogen, lipid and ash have been followed throughout the year in both male and female crabs. The analysis were done on three parts body meat, claw meat and trash. The water content of the entire body (edible and non-edible) showed no seasonal fluctuations. However significant seasonal variations were noted in other component of edible parts nitrogen (total) washiger in edible parts than in trash. The percentage of protein was found to be high in edible parts for most of the time during the year (54 to 75%) while the reserved polysaccharides (glycogen) were ranged from 1.53 to 2.44%. The total lipid of edible tissue was ranged from 3.8 to 4.7 % and total inorganic contents were varied from 8.4 to 11.3 % but they were high in non-edible portion (33.0 %). The calorific value (ash inclusive) was ranged from 3.5 to 3.8 Kcal/g.

Key Words: Edible Crab, Biochemical Organic constituents, Body meat, Claw meat, Trash.

INTRODUCTION

About one hundred species of crab have been identified from the Karachi coast (9). The common edible crabs of the family portunidae, occur in great abundance along the entire coast. Among them, Charybdis (Goniosoma) callianassa (Herbest); Charybdis (Goniosoma) cruciate (Herbest); Portunus (Neptunus) pelagicus (Linneaus); Portunus (Neptunus) sanguinolentus (Herbest) and Scylla serrata (Forskall) are of special importance. Studies on seasonal variations in biochemical composition of crabs tissue reflect the season and the type of meat suited best for the commerical processing and also help in the assessment of nutritional quality.

Data pertaining to the biochemical composition of swim crab Portunus pelagicus L. is very rare (1,8,19,20, 22). A number of reports are available on the composition of other species, such as blue crab Callinectes sapidus (6,13,24) dungeness crab Cancer magister (7); king crab Paralithodes camtschatica Til. (13), mud crab scylla serrate (17); Atlantic queen crab Chionoecetes oplio, (14) shore crab Carcinus meanas (11), cocconut crab Birgus latro L. (15); sand crab Platyonichus ocellatus (25); Jonah crab Cancer boreallis and red crab Geryon quinquedens Latereille (14).

Owing to the fact that crab is one of the most important invertebrate group having high value in commerce and trade and that its fishery in Pakistan is almost at stand still, studies on the abundant crab species from Pakistan should be a great help for boosting up the crab fishery on the commercial scale. The present study reports the data on the seasonal variation in the organic constituents of blue crab Portunus pelagicus L., from back waters of Karachi. Among many edible species, P. pelagicus was chosen for the present study, partly due to its comparatively high nutritional value than Portunus sanguinolantus and Scylla serrata (i.e. low C: N ratio) (22) and partly for its abundance in the Karachi coastal waters (9).

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MATERIAL AND METHODS

Carbs were fished from back waters of Karachi every month during December, 1984 to December, 1985 from Mannora channel using baited hook. Soon after catching crabs were brought to the laboratory and divided in to three components, i.e., body meat, claw meat and the remaining shell and offal portion known as trash. The organic constituents of each component were determined by standard methods, such as water (12) total nitrogen and non-protein nitrogen (10), protein (16), glycogen (5), lipid (2) and ash or total inorganic content (12). The calorific values were calculated by multiplying the metabolites with caloric constant, i.e. protein 5.65, glycogen, 4.2, and lipid 9.45 (3,26).

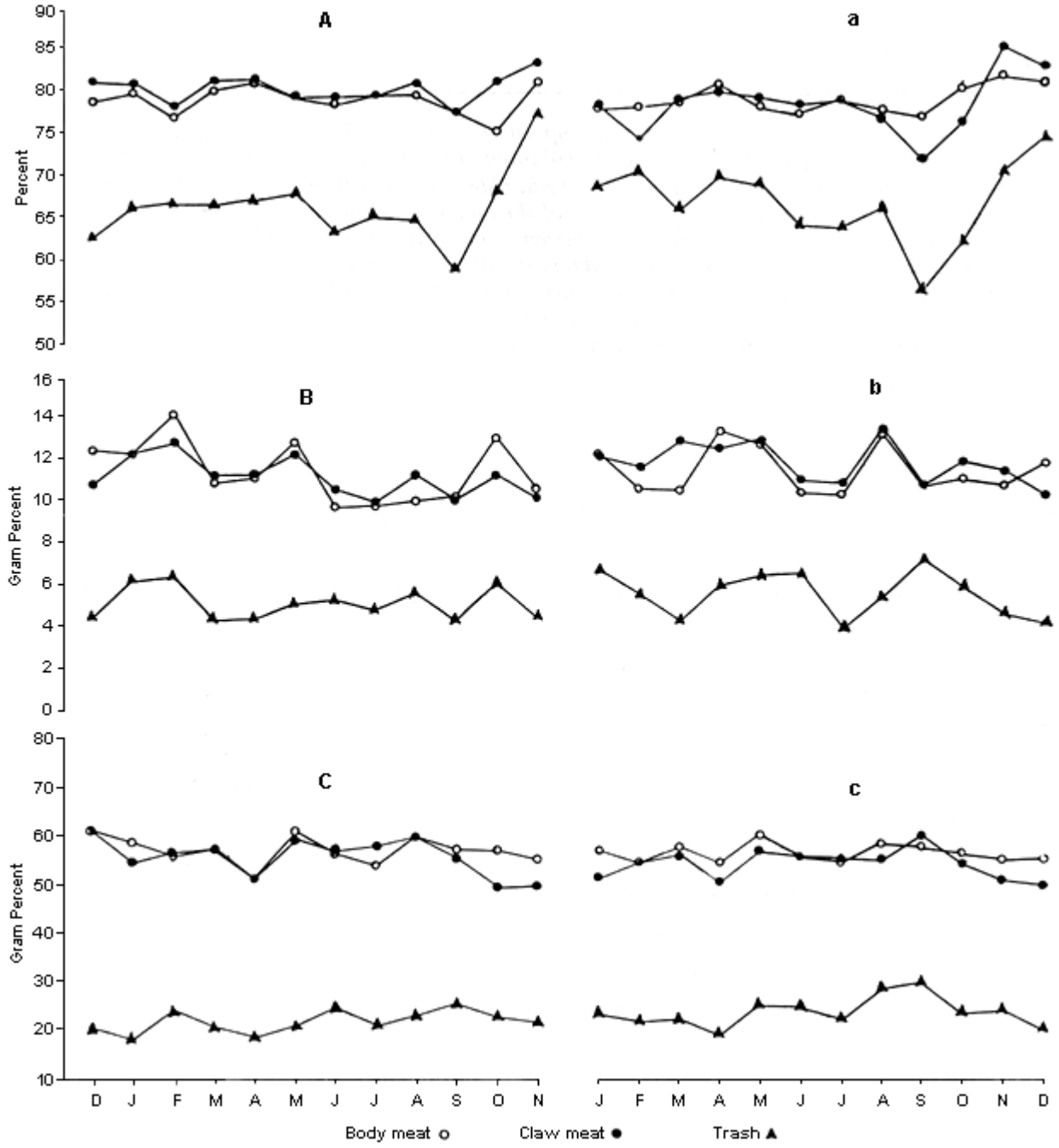

Figure 1: Changes in water (A, a) total nitrogen (B, b) and protein (C,c) content of body meat, claw meat and trash of male (A, B, C, Dec. 84 to Nov. 85) and female (a,b,c, Jan 85 to Dec. 85) crab Portunus pelagicus L.

Table 1: Biochemical composition of edible and non-edible components of male crab during different months of the year (Dec. 84 to Nov. 85). The results are expressed on dry tissue weight basis. (Values represent Mean ± Standard error).

Months	Body Tissue	Water %	Total Nitrogen ga %	Non Protein Nitrogen ga %	Protein Nitrogen ga %	Protein ga%	Glycogen ga%	Lipid ga %	Ash %	Calorific Value Kcal/ga	
										Ash inclusive	- Ash free
DEC.	*BM	78.55±0.78	12.36±0.14	2.55	9.81	61.33±0.54	0.95±0.08	5.49±0.27	5.58±0.29	4.02	4.26
	**CM	81.09±0.58	10.76±0.00	0.92	9.84	61.50±0.81	0.81±0.05	5.04±0.30	8.50±0.07	3.98	4.35
	***T	62.55±2.55	4.40±0.32	1.20	3.20	20.00±0.47	0.01±0.01	6.11±0.3	33.45±0.08	1.74	2.61
JAN.	BM	79.50±0.56	12.22±0.14	2.78	9.44	58.97±0.54	1.17±0.06	3.17±0.14	11.53±0.05	3.68	4.16
	CM	80.79±0.63	12.37±0.30	3.66	8.71	54.46±0.44	1.09±0.03	2.90±0.24	11.22±0.33	3.65	4.11
	T	66.15±0.84	6.12±0.0	3.30	2.82	17.60±0.50	0.82±0.04	2.80±0.39	35.80±0.13	1.29	2.01
FEB.	BM	76.76±0.54	14.04±0.16	5.07	8.97	15.06±0.71	2.10±0.05	3.20±2.15	7.82±0.35	3.55	3.85
	CM	77.92±0.63	12.69±0.01	3.60	9.09	56.80±0.49	1.29±0.0	2.63±0.14	8.92±0.18	3.51	3.85
	T	66.51±0.96	6.31±0.37	2.49	3.82	23.89±0.27	0.70±0.03	2.51±0.10	31.15±0.44	1.61	2.34
MAR	BM	79.83±0.74	10.80±0.41	1.62	9.18	57.37±1.18	1.93±0.11	4.01±0.31	9.02±0.40	3.70	4.07
	CM	81.08±0.93	11.10±0.01	2.03	9.07	56.66±1.22	1.44±0.08	3.23±0.14	7.96±0.70	3.56	3.87
	T	66.35±1.2	4.28±0.00	1.06	3.22	20.13±0.11	0.89±0.03	2.79±0.10	34.66±0.08	1.44	2.20
APR.	BM	80.70±0.58	11.06±0.28	2.84	8.22	51.40±0.82	2.35±0.06	4.54±0.19	12.06±0.04	3.43	3.90
	CM	81.21±0.93	11.12±0.02	2.89	8.23	51.46±0.70	1.92±0.08	3.16±0.12	8.47±0.25	3.28	3.58
	T	67.05±1.13	4.31±0.05	1.43	2.88	18.00±0.47	1.10±0.03	4.17±0.34	33.83±0.09	1.45	2.19
MAY.	BM	79.24±0.84	12.73±0.49	2.97	9.76	60.99±0.71	3.58±0.00	5.03±0.11	7.89±0.39	4.07	4.42
	CM	78.68±1.74	12.18±0.70	2.66	9.52	59.51±0.94	2.83±0.04	3.81±0.30	10.62±0.25	3.84	4.30
	T	67.87±1.15	5.00±0.17	1.73	3.27	20.46±0.33	1.97±0.05	2.89±0.07	38.28±2.52	1.51	2.45
JUNE	BM	78.15±0.48	9.61±0.00	0.59	9.02	56.40±0.71	2.99±0.08	5.52±0.16	6.46±0.23	3.84	4.11
	CM	79.05±0.57	10.40±0.70	1.30	9.10	56.88±1.25	2.64±0.21	5.63±0.18	7.12±0.29	3.85	4.13
	T	63.16±0.68	5.20±0.03	1.31	3.89	24.30±0.06	1.40±0.08	2.56±0.10	28.69±0.25	1.67	2.34
JULY	BM	79.40±0.54	9.67±0.46	1.01	8.66	54.13±0.00	2.44±0.11	4.99±0.14	8.48±0.38	3.63	3.97
	CM	78.85±1.81	9.80±0.06	0.55	9.25	57.80±1.02	1.91±0.09	4.20±0.11	9.46±0.44	3.74	4.13
	T	65.00±2.00	4.71±0.0	1.44	3.27	20.43±0.16	1.92±0.04	3.18±0.15	34.65±0.28	1.53	2.34
AUS.	BM	79.21±0.40	9.90±0.26	0.30	9.60	59.98±0.71	1.31±0.05	3.29±3.51	9.37±0.10	3.76	4.15
	CM	80.74±0.41	11.19±0.0	1.64	9.55	59.66±0.53	1.11±0.11	3.26±0.11	10.00±0.19	3.73	4.14
	T	64.63±0.59	5.53±0.30	1.91	3.62	22.60±0.16	0.79±0.05	2.78±0.41	30.89±1.44	1.57	2.27
SEP.	BM	77.16±1.13	10.19±0.0	1.04	9.15	57.16±0.49	1.58±0.13	6.16±0.15	7.81±0.26	3.88	4.21
	CM	77.18±1.46	9.91±0.03	0.99	8.92	55.72±0.70	0.86±0.13	4.71±0.18	13.92±0.09	3.62	4.21
	T	58.56±1.69	4.21±0.08	0.20	4.01	25.06±0.00	2.30±0.07	5.85±0.13	28.92±0.56	2.07	2.19
OCT.	BM	75.00±3.26	12.92±0.34	3.81	9.11	56.92±0.88	1.55±0.13	5.77±0.46	7.98±0.08	3.82	4.16
	CM	80.91±1.52	11.11±0.44	3.22	7.89	49.30±1.03	1.51±0.09	4.09±0.58	9.56±0.21	3.23	3.57
	T	67.98±2.81	5.95±0.0	2.42	3.53	22.08±0.38	0.98±0.06	3.79±0.22	31.41±0.16	1.64	2.40
NOV.	BM	80.75±0.89	10.50±0.36	1.7	8.80	55.00±0.32	1.34±0.10	4.99±0.10	8.79±0.28	3.63	3.98
	CM	83.03±0.89	10.01±0.0	2.08	7.93	49.57±0.38	0.93±0.00	4.44±0.23	12.95±0.46	3.25	3.73
	T	77.02±4.66	4.35±0.0	0.99	3.36	20.97±0.11	1.08±0.01	3.33±0.18	29.84±0.36	1.54	2.20
Annual Average	BM	78.68±0.46	11.33±0.41	2.14	9.19	57.14±0.80	1.94±0.22	4.68±0.28	8.56±0.50	3.75±0.05	4.10±0.05
	CM	80.04±0.46	11.05±0.27	2.13	8.92	55.77±1.08	1.53±0.19	3.92±0.25	9.89±0.55	3.60±0.06	4.02±0.08
	T	66.06±1.20	5.03±0.22	1.62	3.41	21.29±0.65	1.25±0.15	3.56±0.34	32.63±0.81	1.58±0.05	2.36±0.06

* Body eta ** Claw eat *** Trash.

RESULTS AND DISCUSSION

The seasonal variations in biochemical composition of body meat, claw meat and trash of the whole crab is represented in Tables 1, 2 and Figures 1-3. The results are expressed on dry tissue weight basis.

Figure 1 (A, a) shows water content in different body components which do not seem to vary greatly in both males and females. However, comparatively high values can be seen in the winter months, which may be due to the breeding period of the animal. Pillay and Nair (18) and Farragut (7), have also reported high water in breeding season. It can be presumed that Portunus pelagicus developed gonades at this time of the year. The water content in both male and female crabs, tissues, we noted is closely related to the other species of crabs (23) which ranged between 68.64 percent (whole crab) in Portunus pelagicus (8) to 86 percent in king crab Paralithodes camtshatica (21) and Portunus pelagicus (1).

Nitrogen content of crab tissue reflects its nutritive condition. Food technologists generally assess quality of food through their nitrogen content. High nitrogen level in crabs render them highly nutritive. Present data reveals that in both male and female crabs average nitrogen content is higher in body meat and claw meat. However, pat-

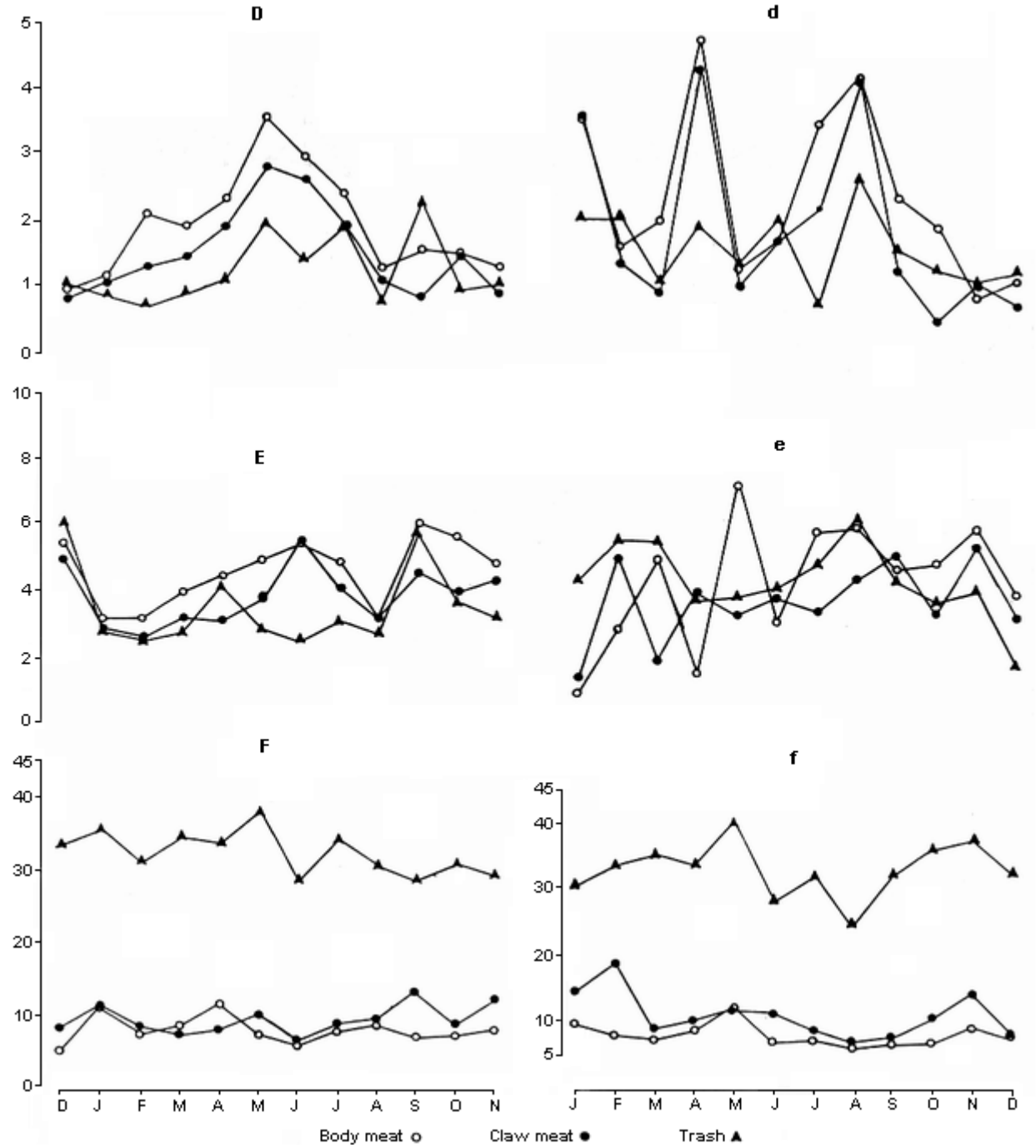

Figure 2: Changes in glycogen (D, d) lipid (E, e) and ash (F, f) content of body meat, claw meat and trash of male (D, E, F, Dec. 84 to Nov. 85) and female (d, e, f, Jan 85 to Dec. 85) crab Portunus pelogicus L.

tern of seasonal variations in trash, body meat and claw meat is some what identical (Figure 1, B, b). On the basis of annual average it may be deduced that male crabs have high nitrogen in edible portion as compared to female crabs. Nitrogen values tends to exhibit some correlation with protein as they vary with season. Thought the nitrogen values fluctuate widely in the crab tissues, the values for protein do not. Hence the highly fluctuating nitrogen is the function of non-protein nitrogen and not of protein nitrogen. Non-protein nitrogen constitutes about more than 20 percent of the total nitrogen in both male and female edible parts but non-edible part constitute

Table 2: Biochemical composition of edible and non-edible components of female crab during different months of the year (Jan. 85 to Dec. 85). The results are expressed on dry tissue weight basis. (Values represent Mean ± Standard error).

Months	Body Tissue	Water %	Total Nitrogen ga %	Non Protein Nitrogen ga %	Protein Nitrogen ga %	Protein ga%	Glycogen ga%	Lipid ga %	Ash %	Calorific Value Kcal/ga	
										Ash inclusive	- Ash free
JAN.	*BM	77.62±1.01	11.33±0.21	2.25	9.08	56.73±0.72	3.59±0.22	1.06±0.09	9.84±1.04	3.45	3.83
	**CM	78.06±1.38	11.19±0.40	3.04	8.15	50.93±0.44	3.65±2.06	1.55±0.09	14.70±0.23	3.18	3.73
	***T	68.62±1.48	6.22±0.15	2.55	3.67	22.93±0.24	2.06±0.05	4.44±0.33	30.73±0.32	1.80	2.60
FEB.	BM	77.73±2.55	10.21±0.42	1.51	8.70	54.35±0.44	1.65±0.05	2.99±0.27	8.21±0.30	3.42	3.73
	CM	74.03±4.2	10.70±0.18	2.03	8.70	54.19±0.43	1.40±0.11	5.10±0.26	19.01±0.25	3.60	4.40
	T	70.25±3.1	5.12±0.05	1.69	3.43	21.46±0.34	2.07±0.00	5.66±0.17	33.87±0.05	1.83	2.77
MAR	BM	78.34±0.75	9.17±0.19	0.53	9.17	57.34±0.49	2.04±0.03	5.10±0.10	7.60±0.63	3.80	4.11
	CM	78.88±0.89	11.87±0.34	2.94	8.93	55.80±0.33	0.94±0.02	2.07±0.02	9.05±0.46	3.38	3.72
	T	65.66±1.06	3.95±0.0	0.46	3.49	21.80±0.50	1.11±0.04	5.64±0.45	35.48±0.23	1.63	2.53
APR.	BM	80.58±0.71	12.32±0.29	3.62	8.70	54.36±0.32	4.80±0.08	1.70±0.31	9.28±0.10	3.43	3.78
	CM	79.65±0.95	11.53±0.11	3.49	8.04	50.22±0.43	4.34±0.09	4.12±0.14	10.44±0.34	3.40	3.80
	T	69.57±0.67	5.52±0.02	2.54	2.98	18.62±0.46	1.95±0.03	3.88±0.56	33.88±0.17	1.50	2.27
MAY.	BM	77.83±2.04	11.76±0.74	2.18	9.58	59.87±0.94	1.33±0.00	7.34±0.41	12.45±0.16	4.13	4.72
	CM	78.78±2.84	11.94±0.06	2.89	9.05	56.56±0.49	1.06±0.08	3.40±0.18	12.36±0.49	3.55	4.05
	T	68.56±4.87	5.59±0.03	2.02	3.93	24.55±0.43	1.42±0.04	3.97±0.56	40.48±1.74	1.82	3.06
JUNE	BM	77.03±0.61	9.61±0.00	0.71	8.90	55.63±0.33	1.74±0.07	3.21±0.17	7.33±0.13	3.51	3.79
	CM	78.01±1.07	10.12±0.71	1.19	8.93	55.80±0.33	1.72±0.02	3.99±0.27	11.57±0.11	3.60	4.07
	T	63.82±1.00	5.98±0.00	2.09	3.89	24.35±0.00	2.06±0.06	4.28±0.02	28.46±0.27	1.70	2.38
JULY	BM	78.53±0.88	9.50±0.16	0.81	8.69	54.34±0.00	3.53±0.11	5.92±0.18	7.75±0.02	3.78	4.10
	CM	78.13±0.88	9.93±0.00	1.13	8.80	5.01±0.70	2.22±0.16	3.53±0.19	9.14±0.13	3.52	3.87
	T	63.43±1.74	3.52±0.28	0.05	3.47	21.71±0.27	0.77±0.01	4.93±0.29	32.40±0.39	1.71	2.53
AUG.	BM	77.31±0.23	12.10±0.69	2.79	9.30	58.16±0.53	4.24±0.04	6.04±0.12	6.63±0.31	4.03	4.32
	CM	76.40±0.27	12.40±0.78	3.64	8.76	54.72±0.00	4.13±0.03	4.55±0.28	7.39±0.15	3.69	3.98
	T	65.58±2.07	4.95±0.17	0.43	4.51	28.23±0.16	2.68±0.07	6.33±0.03	24.75±0.09	2.30	3.06
SEP.	BM	76.40±0.50	9.91±0.61	0.70	9.21	57.56±0.54	2.38±0.03	4.83±0.04	7.07±0.49	3.76	4.05
	CM	71.24±3.19	9.84±0.13	0.30	9.54	59.64±0.54	1.30±0.02	5.22±0.24	7.89±0.27	3.92	4.26
	T	55.83±0.62	6.55±0.13	1.85	4.70	29.38±0.53	1.60±0.05	4.44±0.26	32.47±0.40	2.13	3.15
OCT.	BM	79.59±0.63	10.12±0.27	1.13	8.99	56.19±0.52	1.95±0.29	5.01±0.02	7.37±0.29	3.72	4.01
	CM	75.73±4.98	10.91±0.08	2.26	8.65	54.08±0.43	0.52±0.02	3.44±0.33	10.94±0.16	3.40	3.82
	T	61.83±4.67	5.35±0.00	1.67	3.68	23.03±0.11	1.30±0.00	3.81±0.48	36.37±0.45	1.71	2.70
NOV.	BM	81.26±0.96	9.83±0.47	1.05	8.78	54.89±0.32	0.89±0.00	6.00±0.05	9.54±0.19	3.70	4.10
	CM	84.62±2.08	10.55±0.00	2.47	8.08	50.50±1.04	1.10±0.04	5.47±0.20	14.68±0.14	3.40	4.00
	T	69.83±1.97	4.15±0.08	0.38	3.77	23.55±0.34	1.15±0.04	4.16±0.43	37.83±1.45	1.78	2.86
DEC.	BM	80.38±0.51	10.80±0.25	2.01	8.79	54.95±0.32	1.14±0.00	4.08±0.09	8.32±0.16	3.53	3.85
	CM	82.29±0.66	9.36±0.37	1.44	7.92	49.50±0.00	0.76±0.04	3.35±0.15	8.86±0.05	3.14	3.45
	T	73.85±1.64	3.72±0.04	0.59	3.13	19.54±0.38	1.28±0.03	1.94±0.14	34.87±0.21	1.33	2.00
Annual Average	BM	78.55±0.28	10.60±0.28	1.61	8.99	56.19±0.49	2.44±0.29	4.44±0.52	8.44±0.44	3.68±0.06	4.03±0.08
	CM	77.98±0.97	10.86±0.26	2.23	8.63	53.91±0.84	1.93±0.37	3.81±0.33	11.33±0.93	3.43±0.06	3.93±0.07
	T	66.40±1.32	5.08±0.29	1.36	3.72	23.26±0.86	1.62±0.15	4.45±0.31	33.29±1.15	1.77±0.07	2.66±0.10

* Body eat ** Claw eat *** Trash.

about 32 percent in male and 27 percent in female. Similar high non-protein nitrogen content was observed in king crab paralithodes camtschatica (21) and in Portunus pelagicus (1). From the annual average values, it is apparent that protein is slightly higher in edible portion of male crabs, but identical in non-edible part of both the sexes. Our average values for protein are in good agreement with Badawi (1), Pillay and Nair (19), Sidwell *et al.*, (23), Hamsa (8), Nagabhushanam and Farooqui (17) and Siddiqui *et al.*, (22). Seasonal variations in protein content of edible and non-edible parts of body meat and claw meat vary almost in a similar pattern (Figure 1, Cc.).

The glycogen in Portunus pelagicus varies from 0.52 to 4.8 gram percent in dry edible tissue. Trash portion have also comparatively high glycogen; its average value is higher in female which is even higher than the claw meat of male crabs, this may be due to the presence of gonades, hepatopancrease and other offal portion in trash. We observed a higher content of glycogen in body than the claw meat of both in males and females. Average values, of edible and non-edible part, recorded in our experiments were found lower than those estimated by Watson and Fellers (25); Butler, (4) and Farragut (6). However, our values correspond with Sidwell *et al.*, (23);

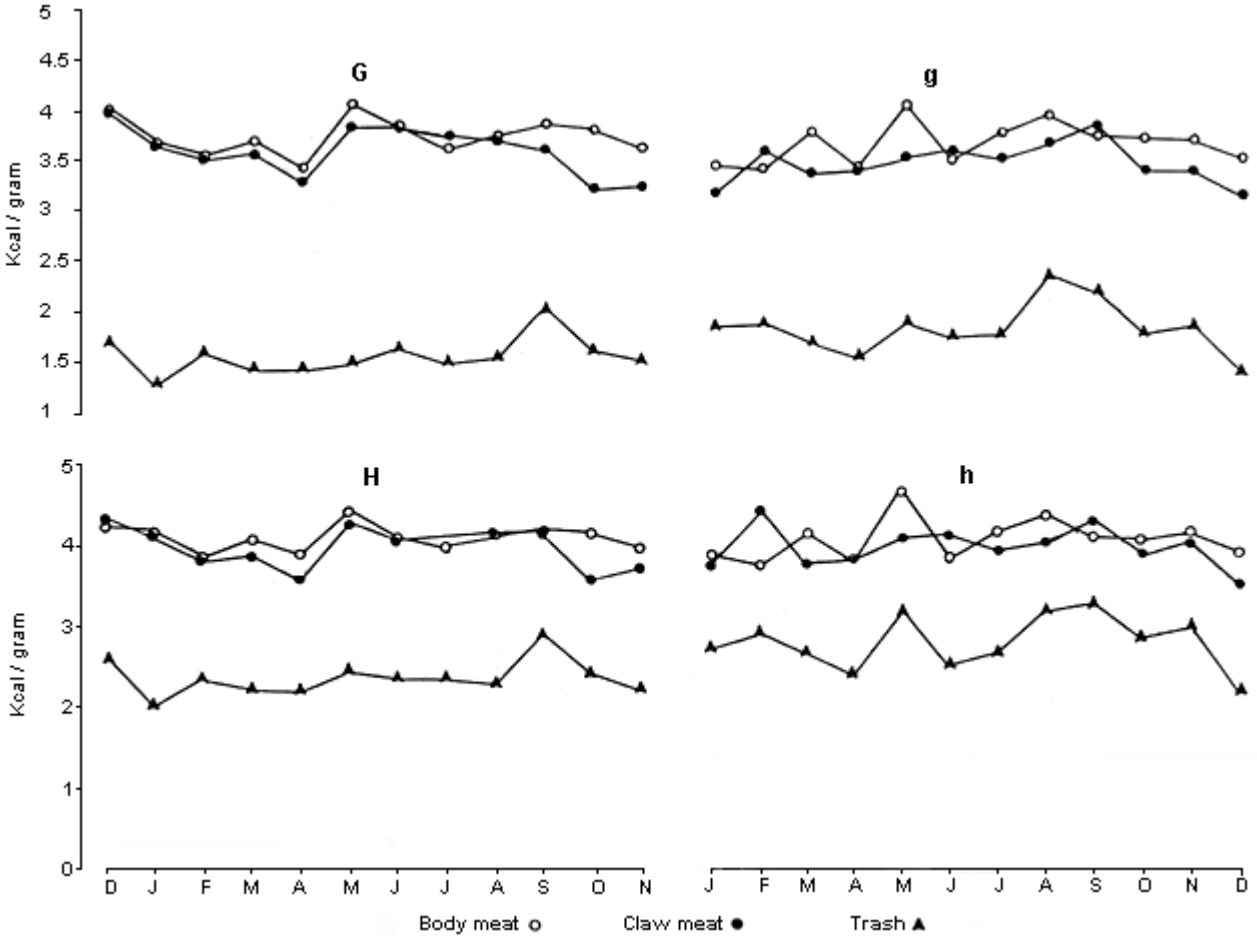

Figure 3: Changes in calorific content of body meat, claw meat and trash of male (G, H; ash inclusive and ash free, Dec. 84 to Nov. 85) and female (g, h; ash inclusive and ash free, Jan 85 to Dec. 85) crab Portunus pelagicus L.

Pillay and Nair (19) and Siddiqui *et al.*, (22). Seasonal fluctuations in glycogen vary in all the three components of female than the male crabs (Figure 2, D,d), from September to December, while at this period water and ash contents were high and lipoidal material moderately low.

The annual average values of total lipid in edible and non-edible tissue of crab was almost equal. Its values throughout the year varied from 2.5 to 6.16 gm percent in males and 1.06 to 7.34 gm percent in females. Present results are in accordance with the findings of Hamsa (8). Badawi (1), Siddiqu *et al.*, (22), and Pillay and Nair (18) in the same species. Seasonal variations in male crab was less contrasting than the variations in female (Figure 2, E,e).

Ash or total inorganic content in present study, varies on the average from 8.44 to 33.29 percent dry weight in both male and female crabs; the higher values being recorded for non-edible components. Average values observed in our studies are higher than those reported earlier, on wetweiht basis, by Sidwell *et al.*, (23); Badawi (1); Hamsa (8), and Farragut (6). Comparison of annual averages for male and female reveals that values are almost similar for edible and non-edible components but the range of fluctuation throughout the year is some what higher in claw meat and highest in trash in female than male crabs (Figure 2, F, f).

In the present study, the energy content was also calculated using the caloric equivalent for major metabolites, such as, protein, lipid and glycogen. Average values in edible tissue varied from 3.23 to 4.07 Kcal./gm in males and 3.14 to 4.13 Kcal./gm in females, on ash inclusive basis, while on the ash free basis the values fluctuated between 3.57 and 4.4 Kcal./gm in male and 3.45 and 4.72 Kcal./gm in females. Fluctuation pattern of ash free and ash inclusive values are corresponding in all the body components (Figure 3, G,g, H,h). Variation in energy content can be correlated with monthly fluctuations of protein, lipid and glycogen, of crab tissue.

Energy values recorded in the present study are only slightly higher than those recorded for other sicies of rab (22,23).

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