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SEASONAL VARIATIONS IN INORGANIC COMPOSITION OF EDIBLE CRAB (*PORTUNUS PELAGICUS* LINNAEUS)

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Present communication reports the variations in the accumulation of macro and micro- elements throughout the year, in edible and non-edible components of crab (*Portunus pelagicus* Linnaeus). Among macro-elements sodium was found in highest quantity in all the three parts (body meat, claw meat and inedible or trash), followed by potassium, phosphorus, calcium and magnesium in descending order in body meat while in claw meat magnesium was found in excess of calcium. On the other hand the distribution of calcium, phosphorus, magnesium and potassium come next to sodium in trash portion. Maximum quantity of iron was found in both edible and non-edible fractions, among the micro-elements, while concentration of manganese was minimum in edible part contrasting the lowest value of copper in trash.

Key words: Crab, Inorganic elements, Body meat.

Introduction

Portunus pelagicus L., the blue crab, is one of the abundant edible species inhabiting Karachi coast. Few reports on its organic constitutents [1-2]; condition index [3] and macro and micro elements in comparasion with other crabs and invertebrate species [4] have been emerged. Changes in nutrition condition in response to reproductive cycle in *P. pelagicus* is also known [5-7]. A little is known of reproduction, spawning and moulting cycle in blue crabs from Karachi coast.

Inorganic elements in crabs have been studied with a variety of approaches, some researchers have estimated proximate composition of a number of metals [8-12], while others have compared a particular metal in different species [13-17], and reported the metal concentration in preparations made out of crab tissues [18]. The interaction of metal with organic moieties [19-22] has also been investigated in crabs. Elemental composition of the edible species of crab has not been reported so far from Pakistan, except for Siddiqui *et al.* [4] who have studied the proximate composition in three species of crabs and other invertebrates. Such data is also available for green mussels [23] and oyster species [24] from our waters.

Baseline environmental surveys in creeks and near-shore waters of Karachi [25-27] have conferred an increasing trend in the metal pollution in water and sediments. This seems to be threatening not only to the general survival of juveniles and adult species, but also to the human health. The present work was undertaken to detect the level of metal sequesteration in body meat (BM), claw meat (CM) and trash portion (shell and offal) of male and female crabs; and to measure the seasonal variation in metal composition and the differences between male and female crabs.

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Materials and Methods

The crabs (*Portunus pelagicus* L.) were fished using baited nylon line at low tides during the day time. Collection was made from Dec. 1984 through Dec. 1985. Six to ten crabs of "standard size" [3] were kept in wooden ice box and transferred to the laboratory, crabs were washed carefully to remove excesses dirt and salt. Claws were detached and carapace was pulled off the rest of the body. Meat from the body (BM) and claws (CM) was removed using a spatula. BM, CM and remaining offal (trash) was pooled into two samples. Duplicate samples of each components were dired in a hot air oven at 70° for 48 hr. Dired samples were ground, sieved and stored over silica gel in a desicator.

Inorganic elements were determined by the techniques of spectrophotometery, flame photometery and atomic absorption spectrophotometery on the wet ashed samples [28]. In organic phosphorus was measured by the method of lowery *et al.* [29]. Sodium, potassium and calcium were estimated on flame photometer (Corning 400) using prescribed mannual method. Magnassium, manganese, iron and copper were measured on Atomic Absorption Flame Emission Spectrophotometer (Jarrel Ash AA 782). Student's t-test was performed according to Ipsen and Feigl [30] to check the level of significance in the difference between the mean values recorded for BM and CM of male and female crabs.

Results and Discussion

Annual averages of macro and micro elements are given in Table 1. Among macro elements (Na, K, Ca, Mg and P) average value for Na was highest in all elements measured in edible and trash parts. In edible portion Na, concentration was followed in decreasing order by K, P, Ca and Mg. The next lower concentration to Na in trash part was recorded for Ca following which were the levels of K, P and Mg in descending order.

TABLE 1. ANNUAL AVERAGE OF INORGANIC CONTENTS OF EDIBLE AND NON- EDIBLE COMPONENTS OF MALE AND FEMALE CRABS (DEC. 84 TO DEC. 85). VALUES REPRESENT MEAN ± STANDARD ERROR.

Parameters	Male crab			Female crab		
	Edible part		Non-edible part	Edible part		Non-edible part
	Body meat	Claw meat	Trash	Body meat	Claw meat	Trash
Na gm %	3.02 ± 0.11	4.53 ± 0.23	2.45 ± 0.11	3.30 ± 0.15	3.98 ± 0.25	2.62 ± 0.15
K gm %	1.51 ± 0.07	1.45 ± 0.02	0.60 ± 0.02	1.58 ± 0.03	1.43 ± 0.04	0.64 ± 0.02
Ca gm%	0.135 ± 0.003	0.138 ± 0.004	1.614 ± 0.043	0.131 ± 0.003	0.155 ± 0.009	1.54 ± 0.064
Mg mg/100gm	118.79 ± 9.41	196.10 ±12.86	597.16 ±12.23	128.77 ± 10.54	182.63 ± 12.36	566.23 ±11.14
P gm%	0.672 ± 0.041	0.532 ± 0.039	0.867 ± 0.070	0.615 ± 0.051	0.452 ± 0.043	0.727 ± 0.066
Mn mg/100gm	3.56 ± 0.99	4.79 ± 0.28	9.60 ± 1.47	6.44 ± 1.65	6.62 ± 1.95	13.24 ± 2.63
Fe mg/100gm	11.60 ± 2.01	12.94 ± 1.70	22.56 ± 1.80	15.69 ± 2.66	14.26 ± 1.70	29.70 ± 3.46
Cu mg/100gm	9.16 ± 1.41	10.55 ± 1.29	8.53 ± 1.13	9.01 ± 0.86	10.89 ± 1.23	10.46 ± 1.25

Seasonal variations in metal concentration is shown in Figs. 1 and 2. Results indicate that Na was high in all three components during winter (October - December). Pattern of fluctuation in Na concentration in CM and trash corresponds to that of female crabs. Whereas Na level in BM of both the sexes showed a reverse pattern. Lower concentration of K was found in the trash part. Its values in both BM and CM are almost equal in the two sexes. A little fluctuation was observed through a year (Fig. 1) Ca, concentration is also high in the trash and low in the edible tissues (BM and CM) a little or no seasonal variation in Ca was found in BM and CM of both the sexes. On the other hand, a monthly pattern was noted in the trash, i.e. high values were recorded during December - April in male and female crabs. Lowest values in Sept. for male and in Oct. for female were recorded. Mg was higher in trash compared to the edible tissues. BM showed lower values in March, May and June in the two sexes, and the higher values remained fairly constant through out the year (Fig. 1). The pattern of variation in Mg content in CM and trash of both sexes is identicle. Phosphorus was observed at a higher concentration in the trash part and it was found in lowest concentration in CM. In all three components low values occured during Sept. – Dec. in females and in Oct. – Nov. in

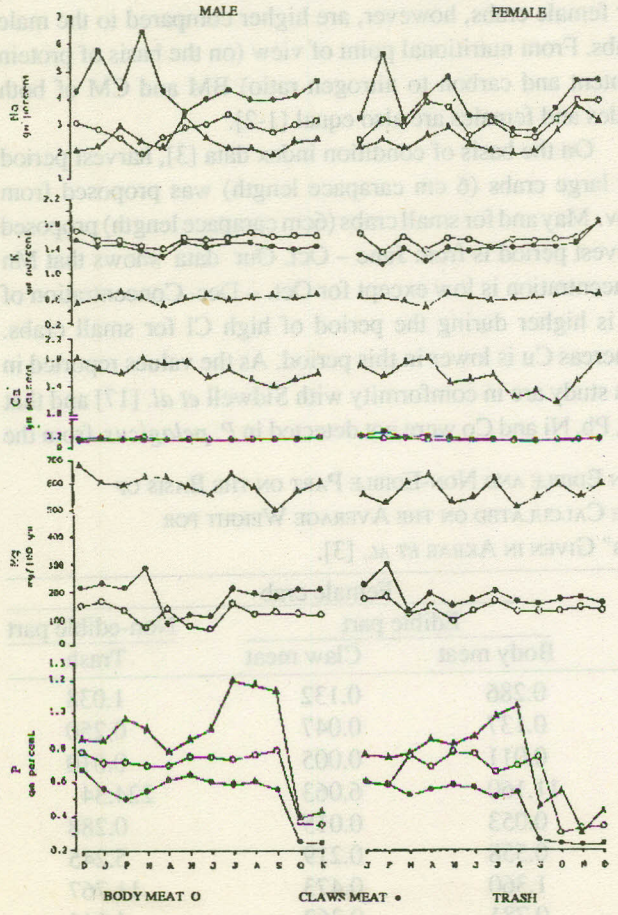

Fig. 1. Variations in Na, K, Ca, Mg and P contents in the edible and non-edible parts of male and female crabs.

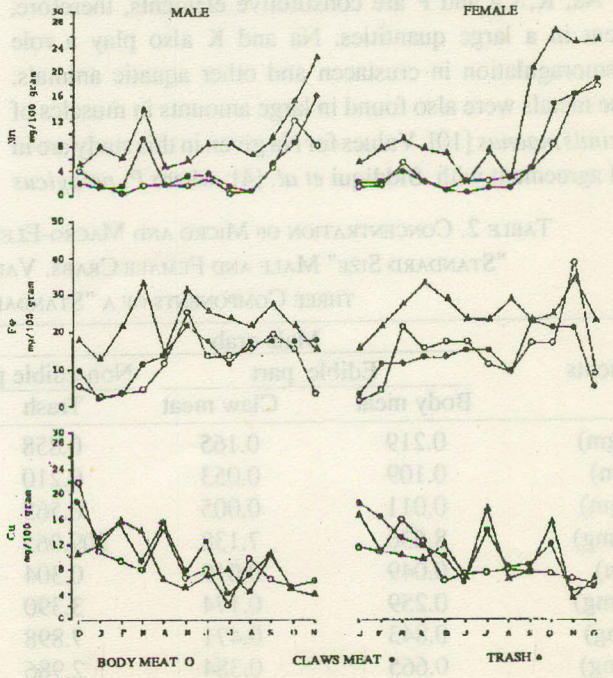

Fig. 2. Variations in Mn, Fe and Cu contents in the edible and non-edible parts of male and female crabs.

male (Fig. 1). Values for female crab fluctuate at higher magnitude.

Manganese occurs in a low concentration in crab tissues. Mn increased from Aug. and remain high until Nov. in males and Dec. in females (Fig. 2). Fe constitutes the highest proportion of the micro elements measured. Trash showed more Fe compared to edible part. Seasonal pattern of Fe in BM and CM showed low values during Dec. – Feb. in females and Nov. – March in males. Copper was found in equal amount in both BM and CM. It was higher in trash. Seasonal pattern of variation in Cu content is identicle in BM and CM in male and CM and trash in female.

Concentration of metals in different components of crab were also calculated on the basis of average weights reported for BM, CM and trash [3] (Table 2). All the elements are present twice as much in BM as in CM in both sexes except for Mg which is only slightly higher in BM of male crab.

Student's t-test was performed to evaluate level of significance in the differences in mean values for BM and CM of male and female crabs. Among micro elements a significant difference ($P<0,05$) was found between male body meat (MBM) and female body meat (FBM) and in male CM and female CM for Ca. Na and P did not show a difference at a significant level in BM and CM within each sex and in the two sexes. Mg showed a significant difference between MBM and MCM and FBM and FCM. Fe and Cu values did not show any difference at a significant level in BM and CM of male and female crabs. However, a difference in MBM and FBM and MCM and FCM in Mn mean values was noted.

Na, K, Ca and P are constitutive elements, therefore, present in a large quantities. Na and K also play a role in osmoragulation in crustacen and other aquatic animals. These metals were also found in large amounts in muscles of *Carcinus maenas* [10]. Values for Na given in this study are in good agreement with Siddiqui *et al.* [4], where *P. pelagicus* was reported to have higher values compared to *P. sanguinolantus* and *Scylla serrata* from the same waters. Ca and Mg are the chief constitutent of exoskeleton in decapods [16] and reported to occur in high amounts in *C. irroratus* [12]. The occurance of high Ca and Mg in trash recorded in this study is thus justified. As low Ca corresponds to the soft shells of newly moulted crabs, the moulting period of *P. pelagicus* could be during these months in our waters. No report on moulting period for this crab in our waters is available. In addition seasonal variation in Mn may reflect a inter moult cycle [12] in this crab during same months. Values for macro elements reported conforms the earlier study [17]. High Fe concentration in this study may be attributed to the high level of this metal in water and sediments close to this area [25-27]. However, high . values for Fe have also been reported for *C. maenas* and *C. irroratus*[12].

High levels of metal concentration in BM may be an effect of high ash content (Table 2), values calculated from the annual average values for ash content [2] and the average weight of crab components [3]. The amount of BM is also two times more than CM in a crab [3]., Hence , one gram of either BM or CM would contain equal amount of metal. Ash values for female crabs, however, are higher compared to the male crabs. From nutritional point of view (on the basis of protein content and carbon to nitrogen ratio) BM and CM of both males and females are also equal [1-2].

On the basis of condition index data [3], harvest period for large crabs (6 cm carapace length) was proposed from Nov. May and for small crabs (6cm carapace length) proposed harvest period is from June – Oct. Our data shows that Mn concentration is low except for Oct. – Dec. Concentration of Fe is higher during the period of high Cl for small crabs. Whereas Cu is lower in this period. As the values reported in this study are in comformity with Sidwell *et al.* [17] and that Cd, Pb, Ni and Co were not detected in *P. pelagicus* from the

TABLE 2. CONCENTRATION OF MICRO AND MACRO-ELEMENTS IN EDIBLE AND NON-EDIBLE PART ON THE BASIS OF "STANDARD SIZE" MALE AND FEMALE CRABS. VALUES ARE CALCULATED ON THE AVERAGE WEIGHT FOR THREE COMPONENTS OF A "STANDARD CRAB" GIVEN IN AKBAR *ET AL.* [3].

Elements	Male crab			Female crab		
	Edible part		Non-edible part	Edible part		Non-edible part
	Body meat	Claw meat	Trash	Body meat	Claw meat	Trash
Na (gm)	0.219	0.165	0.858	0.286	0.132	1.038
K (gm)	0.109	0.053	0.210	0.137	0.047	0.250
Ca (gm)	0.011	0.005	0.565	0.011	0.005	0.610
Mg (mg)	8.636	7.138	209.065	11.160	6.063	224.34
P (gm)	0.049	0.019	0.304	0.053	0.015	0.288
Mn (mg)	0.259	0.174	3.390	0.558	0.219	5.245
Fe (mg)	0.843	0.471	7.898	1.360	0.473	11.767
Cu (mg)	0.665	0.384	2.986	0.781	0.362	4.144
Total Ash	0.622	0.359	11.423	0.732	0.376	13.189

same waters [4], we thus arrived at a conclusion that metal pollution is not a direct threat in terms of crab consumption so far. However, increasing trend in the metal concentration in coastal water and sediments [25–27] demands a close vigilance in the tissues of various fishery commodities on a regular basis.

References

1. P.J.A. Siddiqui, Z. Akbar and R. Qasim, Pak. j. sci. ind. res., **30** , 119 (1987).
2. Z. Akbar, R. Qasim and P.J.A. Siddiqui, J . Islamic Acad. Sci. , **1**, 127 (1988).
3. Z. Akbar, R. Qasim and P.J.A. Siddiqui, Pak. j. sci. ind. res., **31**, 656 (1988).
4. P.J.A. Siddiqui, Z. Akbar and R. Qasim, Pak. j. sci. ind. resi, **31**,326 (1988).
5. K.K. Pillay and N.B. Nair, Mar. Biol., **11**, 152 (1971).
6. K.K. Pillay and N.B. Nair, Mar. Biol., **18**, 167 (1973).
7. A.A. Rahman, Proceeding of Indian Academy of Science , (Section B), **65**, 76 (1967).
8 S.V. Gengal and N.G. Magar, Indian J. Appl. Chem., **25**, 133 (1962).
9. R.W. Nelson and C.E. Thurston, J. Am. Diet. Assoc., **45**, 41 (1962).
10. H. Huddart, Comp. Biochem. Physiol., **38 A**, 715 (1971).
11. B.H. Lauer, M.C. Murray, W.E. Anderson and E.B. Guptill, J. Fd. Sci., **39**, 383 (1974).
12. J.L.M. Martin, Mar. Biol., **28**, 245 (1974).
13. M. Cancio, J. Am. Diet. Assoc., **38**, 341 (1961).
14. W.W. Leung, R.R. Butrum and F.H. Chang, Natl. Inst. of Arthiritis Metabolism and Digestive Diseases, Bethesda, MD 20014 (1961).
15. J. Mauchline and W.F. Templeton, J. Cons. Perm. Inst. Explor. Mar., **30** , 161 (1966).
16. P.E.Gibbs and G.W. Bryan, J. Expt. Mar. Biol. Ecol., **9**, 97 (1972).
17. V.D. Sidwell, D.H. Buzzel, P.R. Foncannon and A.L. Smith, Mar. Fish, Rev., **39**,1 (1977).
18. J.K. Babbitt, D.K. Law and D.L. Crawford, J. Fd. Sci., **38**, 1089 (1973).
19. R.W. Olafson, A. Kearns and R.G. Sim, Comp. Biochem. Physiol. (B), **62B**, 417 (1979).
20. M. Brouwer, C. Bonaventura and J. Bonaventura, Biochemistry (WASH), **21**, 2529 (1982).
21. K. Lerch, D. Ammer and R.W. Olafson, J. Biol. Chem., **257**, 2420 (1982).
22. J.D. Otvos, R.W. Olafson and I.M. Armitage, J. Biol. Chem., **257**, 2427 (1982).
23. M. Fatima, M. Phill. Thesis, Centre of Excellence in Marine Biology, University of Karachi (1983).
24. R. Qasim , N. Aftab and S. Barkati, Pak. j. sci. ind. res., **28**,126 (1985).
25. S.H.N. Rizvi, M. Saleem and J. Baquar, In. M.F. Thompson and N.M. Tirmizi (ed.), *Marine Sciences of the Arabian Sea* (1988).
26. M. Ahmed, Base Line Chemical and Biological Survey of the Gharo-Phitti Creek System with a View to Monitor Pollution, Final report 1981-82, Port Qasim Pollution Study Research Project, CEMB, Univ. of Karachi, Karachi, Pakistan (1982).
27. R. Qasim, P.J.A. Siddiqui and Z. Akbar, Environmental Investigation for Karachi Fisheries Harbour Project, Dept. of Biochemistry, Univ. of Karchi, Karachi, Pakistan (1986), pp. 1-21.
28. FAO, Mannual of Methods in Aquatic Environment Research, Part I, FAO Fisheries, Techical Paper NO. 137 (1975).
29. O.H. Lowry, N.R. Roberts, K.Y. Leiner, M.L. Wu and A.L. Farr, J. Biol. Chem., **207**, 1 (1954).
30. J. Ipsen and P. Feigl, *Bancorft's Introduction to Biostatistics* (Harper and Row Publishers, N.Y., USA), 2nd ed., Ch. 6.