

Biochemical Composition and Heavy Metal Accumulation in Tissues of the Blue Crab *Portunus pelagicus* (Linnaeus, 1766) from NW of Arabian Gulf, South Iraq

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Abstract The current study aimed determine biochemical composition (protein, fats carbohydrates) and accumulation of heavy metals (Cd, Pb, Zn, Cu and Fe) in the muscle tissues of blue crab *Portunus pelagicus* (Linnaeus, 1766). Samples of species were collected in summer and winter from NW of the Arabian Gulf, during 2017. Biochemical analysis of male and female found high rates of protein in male and carbohydrate ratios were highest in female, whereas fat was highest female. Protein was apparently high level, was reported (81.47%) in dry weight in male. High level of fat (lipid) content was reported (8.80%) in the females. Likewise higher level of carbohydrate content was noticed (6.72%) in females. The analysis showed that occurrence of metals in muscle tissue of male and female were in the order Fe>Cu>Zn>Pb>Cd. the mean of Cd, Pb, Zn, Cu and Fe concentrations in muscle for male crabs were slightly higher than the average levels of female crabs. Iron was the highest accumulated metal (68.62, 45.24 µg/g) followed by copper (45.24, 23.16 µg/g), zinc 18.98, 9.67 µg/g), lead (1.74, 0.87 µg/g) while cadmium was lowest (0.43, 0.74 µg/g) in tissues of male and female respectively. In general, the objective of this study for determines the proximate Chemical Composition of crab a good source of proteins and metabolically energy and average mineral supply.

Keywords Crab; *Portunus pelagicus*; Heavy metal; Concentrations

Background

Crabs belong to a group of animals known as decapods crustaceans. Most of the marine crabs occurring along the Persian Gulf coasts belong to the family Portunidae. The blue swimming crab, *P. pelagicus* is widely distributed throughout the coastal and estuarine areas of the tropical western Pacific and Indian oceans (Kumar et al., 2000). *P. pelagicus* is one of the important representatives of decapod crustacean and a species commonly found in Persian Gulf coasts. Crabs the capability of accumulating heavy metals (Reinecke et al., 2003). Crabs are an excellent bioindicator of metal contamination and can be used to effectively and accurately monitor metal level for several reasons.

Considerable studies have also been carried out on the biochemical composition and heavy metals accumulation in crab *P. pelagicus* of the Egyptian and Iranian coasts (Ghazaly, 1988; Zaghoul, 2003; Sallam et al., 2006; Hosseini et al., 2012; Khoei and Abdi Bastami, 2013).

Environmental pollution has increased substantially in the last decades due to a great number of industrial, agricultural, commercial and domestic waste, effluents and emissions as well as hazardous substances. Some heavy metals such as Hg, Cr, Cd, Ni, Cu, Pb etc. introduced into environmental water system may pose high toxicities on the aquatic organisms (Wu and Zhao, 2006; Ambreen et al., 2015). In order to evaluate the environmental impact of these pollutants on the marine ecosystem it has become important for a rapid assessment of their toxic effects on the marine organisms.

The aim of this work is therefore to determine biochemical composition (protein, fats carbohydrates) and the concentration of five metals, namely cadmium (Cd), lead (Pb), copper (Cu), zinc (Zn), and iron (Fe) in muscle tissue of male and female crab *P. pelagicus* and their possible health effect on man.

1 Materials and Methods

Fresh samples of *P. pelagic* were collected from the catches of the trawling net at the landing site of Al-faw city (Al-najaa region on bank of the shatt Al-Arab river) (Figure 1), during summer and winter seasons in 2017. Specimens were measured for carapace width (CWmm) by means of vernier calipers. A total of 20 crabs, 10 male and 10 female were chosen for analysis (three replicates of each sex from each size range).

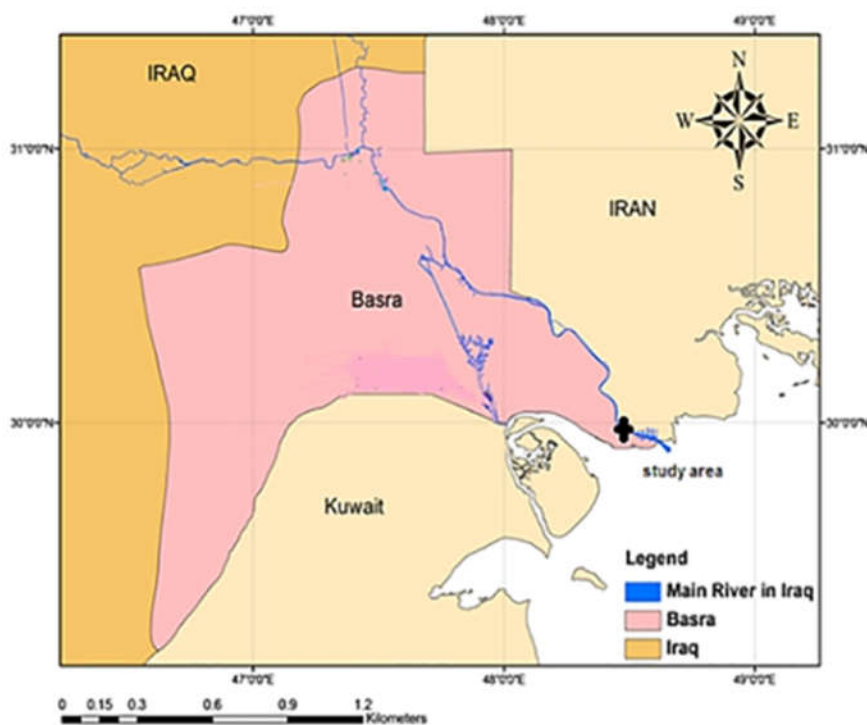


Figure 1 Map of study area at Al-Faw city

The meat from the abdomen was extracted, a heavy pestle was used to crack the chelipeds and the meat was removed by means of a spatula.

Muscle tissue of crab was subjected to analysis the biochemical composition such as, crude protein, carbohydrate and lipid (fat) of the males and female on basis of the dry weight. All analysis was carried out in triplicates.

Three biochemical compositions such as protein, fat and, carbohydrate content were measured using the method of Association of Official Analytical Chemists (AOAC, 2000). Nitrogen was estimated by the micro-Kjeldahl method and the percentage nitrogen was converted to crude protein by multiplying by 6.25. Carbohydrate was determined by difference. All determinations were performed in triplicates. Concentrations of iron (Fe), zinc (Zn), copper (Cu), cadmium (Cd) and lead (Pb) in muscle tissue samples of each crab specimen were determined using the atomic absorption spectroscopy technique in marine biology department, marine science center, Basrah university.

The statistical interpretation of the tabulated data was performed by using SPSS (21.0 version) for the mean standard deviation at 5% level of significance.

2 Results and Discussion

Table 1 shows mean carapace width (CW) of female and male species of crab *P. pelagic* in both summer and winter seasons. The mean carapace width (CW) for male crab were found to be higher than mean carapace width (CW) for female crab during both seasons. Similar results were reported for the crab *P. pelagic* in other researches (Kangas, 2000; Abdul-Saheb, 2012). These results are consistent with the above-reported for same species.

Table 1 The mean carapace width (mm) of male (M) and male (F) crab in summer and winter

Seasons	Mean carapace width in males(mm)	Mean carapace width in females(mm)
Summer	105	88
Winter	122	96

The mean percentages of the three biochemical compositions in the muscle tissue of *P. pelagic* are presented in Table 2. Protein was apparently high level of protein, was reported (81.47%) in the males of current study. High level of fat (lipid) content was reported (8.80%) in the females. Likewise higher level of carbohydrate content was noticed (6.72%) in females.

Table 2 Mean percentages of the three biochemical compositions determined in the muscle tissues of *P. pelagic*

Sex	Protein%	Fats%	Carbohydrates%
Male	81.47	7.26	4.45
Female	76.98	8.80	6.72

Figure 2 and Figure 3 showed the mean percentages of the three biochemical contents in relation to the crab's body size (CWmm). The largest males, with carapace width between 90-135mm, had the highest protein percentage (79.45%), the highest lipids (9.36%) and carbohydrates (7.3%) respectively (Figure 2) while largest females, with carapace between 80-120mm, had the highest protein percentage.

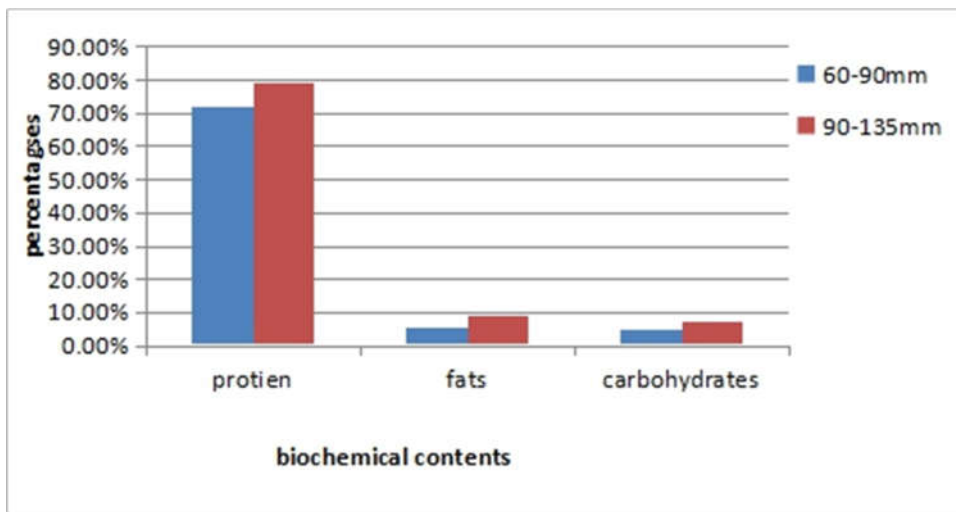


Figure 2 The mean percentages of the three biochemical contents in the muscle tissue of male in relation to the crab's body size (CWmm)

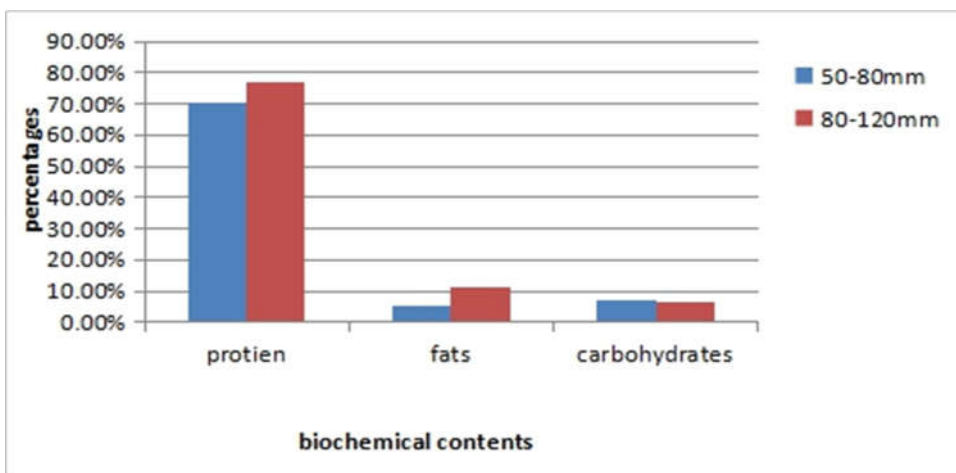


Figure 3 The mean percentages of the three biochemical contents in the muscle tissue of female in relation to the crab's body size (CWmm)

Furthermore, values recorded in this study were higher than those reported for other edible crab species including *Podophthalmus vigil* (Radhakrishnan and Natarajan, 1979), *Chaceon Affinis* (Vasconcelos and Braz, 2001), while for the same species *P. pelagicus* in particular (Sallam et al., 2006). Akbar et al. (1988) reported a range of 54-75% for protein and 3.2-6.2% for lipids for *P. pelagicus* in Pakistan, while Pillay and Nair (1978) reported 40.1-60.7% for protein and 1.3-6.15% for lipids for the same species in India.

Mean concentrations ($\mu\text{g/g}$) of the heavy metals Cd, Pb, Zn, Cu, and Fe in the muscle tissues of both sexes (Table 3) indicated that iron was the highest accumulated metal (68.62, 45.24 $\mu\text{g/g}$) followed by copper (45.24, 23.16 $\mu\text{g/g}$), zinc 18.98, 9.67 $\mu\text{g/g}$), lead (1.74, 0.87 $\mu\text{g/g}$) while cadmium was lowest (0.43, 0.74 $\mu\text{g/g}$) in tissues of male and female respectively.

Table 3 Concentrations of heavy metal in muscle tissues of male and female of crab *P. pelagicus* ($\mu\text{g/g}$)

Sexes	Cd	Pb	Cu	Zn	Fe
Male	0.43	1.74	45.24	18.98	68.62
Female	0.74	0.78	23.16	9.67	45.24

The average Cu, Zn, and Fe muscle tissues concentrations in males were slightly higher than the average levels for females. Significant differences were observed only for Fe and Cu ($p < 0.05$) when compared with each other. The order of average heavy metal concentrations found in muscle tissues samples in both male and female species was: Fe>Cu>Zn>Pb>Cd.

It was reported that the relationship between metal accumulation and sex may be due to the difference in metabolic activities between the males and the females, and the faster-growing sex (usually the female) can be expected to contain lower concentrations of metals (Pourang et al., 2004; Yilmaz and Yilmaz, 2007; Sallam and Gab-Alla, 2009; Umunnakwe and Ogamba, 2013). Thus, the mean concentrations of these metals in males were found to be slightly higher than the females.

Cd concentrations in *P. pelagicus* were the lowest heavy metal concentrations followed by Pb, while Fe, Cu, Zn concentrations were highest level observed in both two sexes.

Results showed that Fe had the higher concentrations in the tissues of crab and Pb element had concentrations least. This observation may be due to the major functional differences in their body. The research same, the comparison on heavy metal accumulation between all tissues crustaceans show that bioaccumulation of heavy metals was more in gills than other tissues (Pourang et al., 2005; El Gendy et al., 2015).

Authors' contributions

All authors in this paper have contributed equally toward the publication of this paper.

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