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Investigation on mineral composition of freshwater crab (*Paratelphusa lamellifrons*) of Padma River near Rajshahi City, Bangladesh

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Abstract
Present study deals with investigation of mineral composition of the freshwater crab *Paratelphusa lamellifrons* from the river Padma near Rajshahi city of Bangladesh. Amount of mineral in the different body parts were found to be in the range between (6.63-7729.15) mg/kg. Mineral components like K, Ca, Fe, Cu and P among the different body parts of the freshwater crab were recorded in the ranges of (1037.03-1192.79) mg/kg, (5385.87-5640.81) mg/kg, (423.22-487.03) mg/kg, (6.63-64.78) mg/kg and (6539.21-7729.15) mg/kg respectively. From the present study it is evident that the different body parts contents higher amount of P, Ca and K than Fe and Cu. Among the different body parts of crab presence of minerals in cephalothorax were found to higher compared to cheliped and legs.

Keywords: *Paratelphusa lamellifrons,* freshwater crab, mineral composition, Padma River, different body parts

1. Introduction
Minerals are naturally occurring inorganic solid substances in the biosphere (including all foods) found following the degradation of plant and animal tissues [1] are formed by geological processes [2], some of which are essential from nutritional point of view. Essential minerals make up an important component of our diet. These nutrients, though required only in small amounts, but these play an important role in our body. They play very important role in the living body in the regulation of major metabolic pathways [3]. On the basis of body requirements minerals are divided into three groups: (1) major elements, (2) trace elements, and (3) ultra-trace elements. Deficiencies of these minerals can lead to metabolic disorders and organ damage, leading to acute and chronic disease and ultimately death [4]. Thus, they must be obtained from food. Mineral components such as sodium, potassium, magnesium, calcium, iron, phosphorus and iodine are important for human nutrition [5]. Crabs are the prominent sources of essential macro and micro elements like potassium, phosphorus, calcium, magnesium copper, iron manganese and zinc [6-10]. The Shellfish are nutritionally precious sources of various minerals and high quality of protein concentrations to human [11-15]. Crabs are the basic components of the ecosystem and they are consumed as food in many countries. Edible crustaceans such as crabs, prawns, shrimps, crayfishes and lobsters comprise major sources of nutritious food for humans. The nutritive value of crustaceans depends on their biological constituents such as proteins, carbohydrates, lipids, vitamins and minerals. Crabs have exceptional and scrumptious taste as compared to fish and mollusks and rank third after shrimps and lobsters for their revered delicacy and value of fishery they support [16]. They are distributed in seas, backwaters, estuaries, lakes and freshwaters. More than 6,700 known species of Brachyuran crabs and over 1,300 true freshwater crabs were identified along in the world [17]. The fresh water crabs is significantly an important for biological role in the food webs. The freshwater crabs are good source of food and medicinal values and play an important role in the food chain of aquatic ecosystems [18, 19] as well as the fishery wealth of many nations [20]. Freshwater crabs are also consumed for purported medicinal and tonic properties, including treatment of stomach ailments and physical injuries [21] and as food [22].

In various parts of the world mineral values of different crab species have been previously investigated by many researchers [23-26].

Although the presence of essential mineral in any food item is the reflection of the quality of that food, no work has been done on the mineral contents of different body parts of freshwater crabs of the river Padma. So, the aim of the present study was to determine the mineral (potassium, calcium, iron, and copper and phosphorus) contents of crab of the river Padma.

2. Materials and Methods

Mineral contents of crab sample were determined by atomic absorption spectrometry according to the methods of AOAC [27].

2.1 Wet digestion of sample

For wet digestion of sample, exactly (0.5 g) of the representative powdered sample were taken in Kjeldhal digestion tube. Six milliliters (6 ml) of HNO_3 was added to the samples and mixture was kept for overnight at room temperature. Then 4.0 ml perchloric acid ($HClO_4$) was added to this mixture and was heated in a block digester gradual in creased of temperature starting from 50 ºC and increasing up to (200-250) ^{0}C. Appearance of white fumes indicate the completion of digestion in about 70-85min. The mixture was left to cool down, filtered and the contents of the tubes were transferred to 100 ml volumetric flasks and made up to the mark with distilled water. The wet digested solution was transferred to plastic bottles, stored and used for mineral estimation by Atomic Absorption Spectrophotometer (Hitachi model 170-10) in the Central Science Lab, University of Rajshahi. The amount of minerals was calculated from standard graph of each mineral.

2.2 Estimation of phosphorous

Determination of Phosphorus of crab powder samples were done by following the method Vanadomolybdate yellow colour method [28]. The acid digested solution was used for phosphorus content of samples. 10 ml aliquot of digested crab extract was pipetted out into 50 ml volumetric flask. Then 10ml vanadomolybdate reagent was added, dilute to 50 ml with DW, mix well and the intensity of the yellow colour was read at 470 nm on GENESYS 20 spectrophotometer. The amount of phosphorus was calculated from standard graph of phosphorous.

3. Results

The results of mineral composition of different body parts (cephalothorax, cheliped and legs) of the collected freshwater crab are listed in Table 1 and their graphical presentation are shown in Figure 1 to 6. From Table 1 it is observed that the amount of minerals is high in cephalothorax when compared to cheliped and legs (walking & swimming). The results showed that the amount of mineral in the different body parts of the crab ranges from (6.63-7729.15) mg/kg as dry weight basis. Mineral components like K, Ca, Fe, Cu and P among the different body parts of the collected freshwater crab were observed in the ranges of (1037.03-1192.79) mg/kg, (5385.87-5640.81) mg/kg, (423.22-487.03) mg/kg, (6.63-64.78) mg/kg and (6539.21-7729.15) mg/kg respectively. Phosphorous was observed as the dominant and copper as the least mineral matter among all the body of crab followed by calcium (Ca) potassium (K) and Iron (Fe). The levels of phosphorus, calcium potassium, iron and copper were found to be higher in cephalothorax as compared to cheliped and legs. From the present study it is evident that the collected freshwater crab contents highest amount of P, Ca and K than Fe and Cu and were present in the different body parts of crab following the order cephalothorax > cheliped > legs.

Table 1: Mineral composition of different parts of *P. lamellifrons* (Values are expressed as dry weight basis)

Parameters	P (mg/kg)	Ca (mg/kg)	K (mg/kg)	Fe (mg/kg)	Cu (mg/kg)
Cephalothorax	7729.15 ± 1.94	5640.81 ± 1.33	1192.79 ± 1.34	487.03 ± 1.26	64.78 ± 1.72
Cheliped	7320.87± 1.45	5448.06 ± 1.24	1090.09±2.17	448.73 ± 1.26	9.77 ± 0.90
Legs	6539.21 ± 1.46	5385.87 ± 2.33	1037.03 ± 1.41	423.22 ± 1.61	6.63 ± 0.81

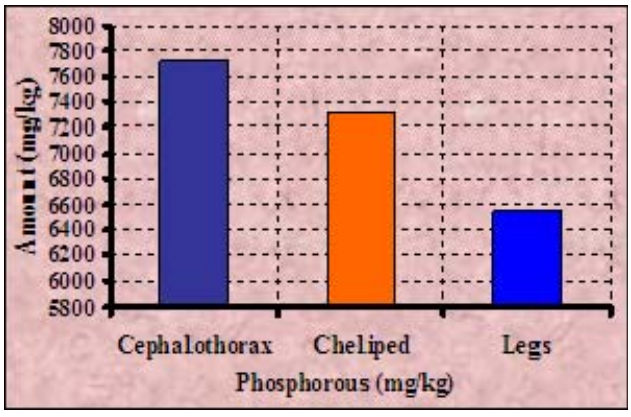

Fig 1: Graphical presentation of amount of Phosphorus in cephalothorax, chelipeds and legs.

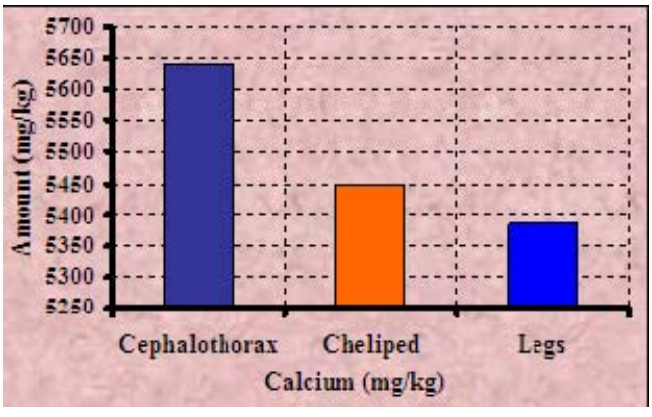

Fig 2: Graphical presentation of amount of Calcium in cephalothorax, chelipeds and legs.

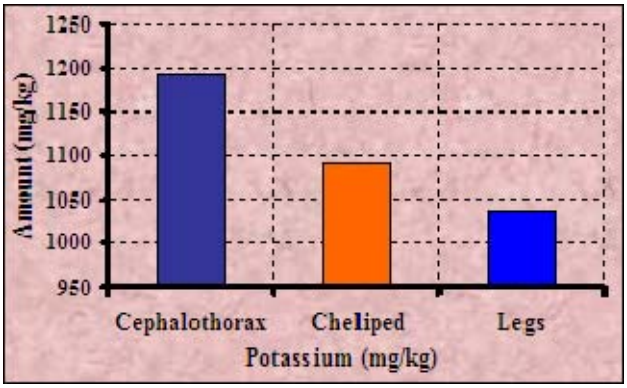

Fig 3: Graphical presentation of amount of Potassium in cephalothorax, chelipeds and legs.

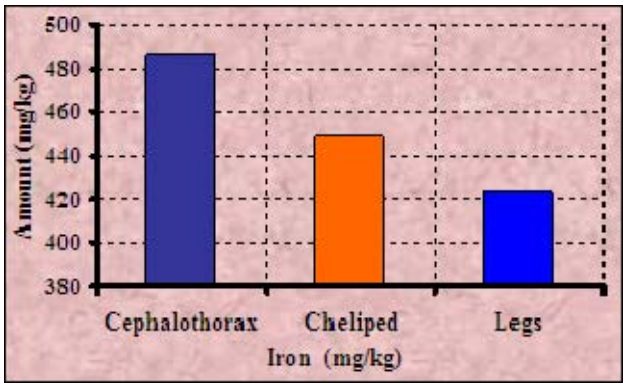

Fig 4: Graphical presentation of amount of Iron in cephalothorax, chelipeds and legs.

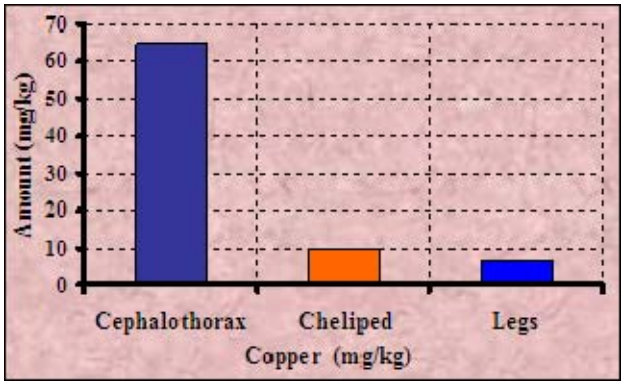

Fig 5: Graphical presentation of amount of Copper in cephalothorax, chelipeds and legs.

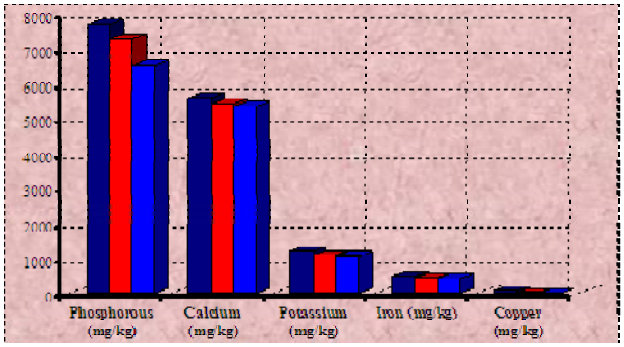

Fig 6: Comparative graphical presentation of mineral composition in cephalothorax, chelipeds and legs.

4. Discussion

The freshwater crabs constitute a great food potential for human. A large part of these shellfish species are cultivated forms. So there is growing need for information about the biochemical composition of these shell fishes. For the cultivation of these shellfishes some important characteristics, such as nutritional properties, biochemical structure and growth conditions need to be known. Biochemical studies are very important from the nutritional point of view. The biochemical constituents in the animals are known to vary with season, size of the animal, stage of maturity, temperature and availability of food etc. Crabs are a good source of protein, carbohydrates and various minerals. Therefore, determining of the proximate and mineral elements of crabs species has a great importance due to the good effect on human health. Determination of the mineral elements of crab species has a great importance since Crab meat is an excellent source of minerals, particularly calcium, Iron, zinc, potassium and phosphorus [7-10] and which have very much good effect on human health. In present study the mineral contents of *P. lamellifrons* species were observed in following the order P>Ca>K>Fe>Cu.

Phosphorus is an important mineral to maintain the pH, storage and transfer of energy and nucleotide synthesis. Phosphorus is necessary to maintain an optimal bone development which is required during childhood and growing stages to prevent rickets and osteomalacia. Human body also needs phosphorus to make new DNA, and it relies on phosphorus for cell communication and energy production. In present study, phosphorus content was found to be higher than other minerals (Fe, Ca, K, Cu). Maximum amount of phosphorus was observed in cephalothorax (7729.15±1.94 mg/kg) and whereas cheliped (7320.87± 1.45 mg/kg) and legs (6539.21 ±1.46 mg/kg) content least amount of phosphorus compared to cephalothorax. Omatayo *et al.* (2013) [29] have reported 237.03 ± 0.20 mg/l00g phosphorous in male and 182.00 ±0.10 mg/l00g phosphorous in female exoskeleton, 170.11 ± 0.10 mg/l00g phosphorous in male flesh and 158.20 ± 0.10 mg/l00g phosphorous in female flesh, 250.12 ±0.12 mg/l00g phosphorous in male whole body and 265.21 ± 0.11 mg/l00g phosphorous in female whole body of *Sudanonautes africanus*. Sudhakar *et al.* (2011) [30] have recorded 4.560 mg/g phosphorous in body of *Podophthalmus vigil*. The amount of phosphorous found in this study varied from the reported one due to the difference in selection of organ for analysis.

Calcium has an essential role in blood clotting, muscle contraction and nerve transmission. Calcium is nutritionally very important (up to 1.9% Ca is available in human body) and provides rigidity to the skeleton and plays a role in many metabolic processes (FAO/WHO, 2002) [31]. It is also essential for hard tissue structure, osmoregulation and as a co-factor for enzymes procession [31]. In present study calcium content was recorded 5640.81±1.33, 5448.06±1.24 and 5385.87±2.33 mg/kg in cephalothorax, cheliped and legs of *P. lamellifrons* respectively. Calcium was observed second highest mineral matter in the study crab and were present in cephalothorax (5640.81±1.33 mg/kg) as the highest and in cheliped and legs as the lowest amount 5448.06±1.24 and 5385.87±2.33 mg/kg. Elegbede *et al.* (2013) [32] have recorded the calcium content 3849.95 ± 0.89 mg/kg in meat of *Callinectes pallidus* and 18901.51 ± 0.50 mg/kg in meat of *Cardisoma armatum*. Another study recorded 2157.86 ±1.01 mg/100 g of calcium in land crab *Cardisoma armatum*

(Omotoso, 2005) [34], and 15.670 mg/g in *Podophthalmus vigil* (Sudhakar *et al.,* 2011) [29] and Chinese mitten crab (*Eriocheir sinensis)* 0.67 mg/g (Chen *et al.* 2007) [35]. Soundarapandian *et al*. were observed mineral quantity on *Podophthalmus vigil* was shows 14.58 mg of Ca on female crab [36].

One of potassium's major functions in your body is to facilitate nerve transmission where potassium is needed to send the electrical signals required for communication between our brain and body, as well as within our brain. Crab meat also is a modest source of potassium. The potassium contents were higher in cephalothorax (1192.79±1.34 mg/kg) and minimum in legs (1037.03±1.41mg/kg) cheliped contents higher amount of potassium (1090.09±2.17 mg/kg) than legs (1037.03±1.41mg/kg) but lower than cephalothorax (1192.79±1.34 mg/kg). In earlier studies, 367.19 ± 0.01 mg/100 g of Patassium was recorded in land crab *C. armatum* [34], 4.780 mg/gm in P. vigil [30] and 2.73 mg/gm in Chinese mitten crab E. sinesis [35]. Elegbede *et al.* (2013) [33] recorded the potassium content 1489.02 ± 2.02 mg/kg in meat of *Callinectes pallidus* and 5720.01 ± 0.96 mg/kg in meat of *Cardisoma armatum.*

Iron content in the present observation was 487.03±1.26 mg/kg, 448.73±1.26 mg/kg and 423.22±1.61 mg/kg in cephalothorax, cheliped and legs of *P. lamellifrons* respectively where, cephalothorax content higher amount of Iron than cheliped and legs. Amount of Iron in the study crab was found to lower than phosphorous and calcium but higher compared to copper among the different body parts of the crab (Table 1). In earlier studies, 27 ± 95.10 mg/100 g of iron (Fe) was recorded in land crab *C. armatum* [34], 3.3570 mg/gm in *P. vigil* [30], 0.039 mg/gm in Chinese mitten crab *E. sinensis* [34]. Iron is one of the very important essential trace elements since it has several vital functions in the human system and hence adequate Fe in the diet is very important for avoiding some major health problems such as anemia, especially in young children [37].

Even though iron usually gets the spotlight, copper is involved in the absorption, storage and metabolism of iron to keeps bones, blood vessels, nerves and the immune system healthy. In present study amount of copper was also reported in various body parts of *P. lamellifrons* and found maximum in cephalothoraxes 64.78 ± 1.72 mg/kg and minimum in legs 6.63 ± 0.81 mg/kg. Among the different body parts of crab amount of copper were found to be lower than other investigated mineral and were present in cephalothorax, cheliped and legs following the same trend (cephalothorax > cheliped > legs) as P, Ca, K and Fe. In earlier studies, 57.83 ± 0.10 mg/100g of copper (Cu) was recorded in land crab *C. armatum* [34], 0.450 mg/gm in *P. vigil* [30], 0.16 mg/gm in Chinese mitten crab *E. sinensis* [35]. Copper is an essential trace element (i.e., micronutrient) that is required for plant, animal, and human health [38]. It is also required for the normal functioning of aerobic (oxygen-requiring) microorganisms. Foods contribute virtually all of the copper consumed by humans. The best dietary sources include seafood (especially shellfish like oysters, squid, lobster, mussels, crab, and clams).

Although minerals in various crab species has been investigated by many researcher all over the world the amount of mineral hardly matched to each other since, the concentration of minerals in the meat of crab species can be influenced by a number of factors such as seasonal and biological differences (species, size, age, sex and sexual maturity), food source and environment (water chemistry, salinity, temperature and contaminants) [39]. The present investigated results also varied from the reported results due the above mentioned reasons and also due the variation in choice of selection of different body organ such as whole body, body meat, claw meat, gill, hepatopancreas, meat with and without shell etc. for the estimation of minerals and in expressing the results as dry weight or wet weight basis.

5. Conclusions

The results obtained in this study showed that crab species *P. lamellifrons* are nutritious and rich in the essential elements such as Fe, K, Ca, Cu and P. Nutrients are required in order to build and repair cells and body tissues, maintain the organs and bones in optimum working condition and to provide energy, fuel and warmth. Ca and P are necessary to maintain an optimal bone development with more of both minerals being required during childhood and growing stages to prevent rickets and osteomalacia. Iron has several vital functions in the body. Adequate Iron in the diet is very important for decreasing the incidence of anaemia. Good nutrition is essential for good health and eating nutritious food can help prevent common ailments, as well as more life threatening illnesses and diseases. The present study revealed that all the body parts of the investigated crab are very much rich with essential mineral components which could be used as an excellent source of vital nutrients for human consumption and could also be used in the formulation of well-balanced animals feed.

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