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A Comparative Study on Proximate, Mineral and Fatty Acid Compositons of Deep Seawater Rose Shrimp (*Parapenaeus longirostris*, Lucas 1846) and Red Shrimp (*Plesionika martia,* A. Milne-Edwards, 1883)

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Abstract: Proximate, Fatty Acids (FA) and element compositions of two shrimp species, deep seawater rose-shrimp (*Parapenaeus longirostris*) and red shrimp (*Plesionika martia*), were determined. Amount of lipid in *P. longirostris* and *P. martia* was found as 1.1 and 2.61%. Proportion of lipid in both shrimps was lower than that of marine fish. Surprisingly, FA profile of these 2 shrimp species can be comparable with that of marine fish. The amounts of PUFA's in both shrimp species were found higher than those of SFA and MUFA. Level of DHA in *P. longirostris* was significantly ($p<0.05$) higher than that of *P. martia.* In addition, major macro elements found in both of the shrimp species were Ca, K, Na, P and Mg. Zinc and iron were the major micro elements followed by Cu and Mn. Heavy metals such as, Cd and Cr, were in below the safe limits.

Key words: Rose shrimp, *Parapenaeus longirostris*, *Plesionika martia*, red shrimp, fatty acid profile, proximate composition, minerals

INTRODUCTION

Shrimp is one of the world's most popular shellfish and is a part of almost every nation's traditional meal. Rich in protein, calcium and various extractable compounds, shrimp has been used as an important raw material for many dishes. It provides, high quality proteins and minerals for human body, while low in calorie and fat. *P. longirostris* and *P. martia* live from 20-700 m in depth and are commonly found in all over the Mediterranean Sea, maximum length in 19 cm in female and 16 cm in male.

Shrimp lipid contains mostly polyunsaturated fatty acids (essential fatty acids), which includes linoleic acid and alpha-linolenic acid that are parent compounds of omega-6 and omega-3 acid series, respectively. These essential fatty acids are available in shrimp provides health benefits for humans e.g., eye (retina) and brain development and functioning (Conner, 1992), nutrient for growth and development of human body (Simopolous, 1991).

Some elements, such as copper, zinc, manganese, iron and chromium have useful biological function and when found in shrimp at acceptable levels are very useful for human health. On the other hand, some heavy metals, such as arsenic, lead and cadmium, are toxic and even a small amount of availability of these metals in shrimp can be very harmful to human health (Khansari *et al*., 2005). Heavy metals are considered the most important form of pollution of the aquatic environment because of their toxicity and accumulation by marine organisms like shrimp (Khansari *et al*., 2005). Heavy metals are classified as: Potentially toxic (e.g., aluminum, arsenic, cadmium, lead, mercury, cadmium), probably essential (e.g., nickel, vanadium, cobalt) and essential (e.g., copper, zinc, selenium) (Olivas and Camara, 2001). Toxic elements can be very harmful, even at low concentration, when ingested over a long time. For this reason, humans have to make sure that what they eat is not toxicated with heavy metals. Few studies have considered proximate, element and lipid composition of *P. longirostris* and *P. martia* in the North-East Mediterranean Sea-Turkey. Therefore, the objective of this research is to investigate proximate compositions, fatty acid composition and macro and microelement (including heavy metals) contents of two shrimp species.

MATERIALS AND METHODS

Sampling: Deep-sea water rose shrimp (*Parapenaeus longirostris*, Lucas 1846) and red shrimp (*Plesionika martia*) caught in Northern Eastern Mediterranean Sea and samples were purchased from a local fisherman. The

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samples packed with a flake ice in polystyrene boxes were delivered to the fish-processing laboratory. A total number of randomly selected 40 rose and red shrimp were pooled and the shells were removed. Edible part of the shrimps were chopped finely with a pre-acid washed and rinsed with ultra pure water glass knife and sub-sampling were done for each analysis at least five replicates. Samples were taken in triplicates for proximate composition and values represent mean and standard deviations of the replicates.

Proximate composition: Moisture was determined according to EEC (1979) recommended oven drying method; crude lipid was determined by modified Bligh and Dyer Method and (Hanson and Olley, 1963). Crude protein (AOAC, Official Methods of Analysis 39.1.15) and ash contents were determined according to AOAC (2000) Method no 938,08. Values represent mean value of triplicate measurements.

Determination of Fatty Acids Methyl Ester (FAME): Fatty acids methyl esters of shrimp lipids were prepared by saponifying 20-25 mg of lipid with 2 mL of 0.5 M methanolic KOH by heating at 100°C for 7 min. Further 1.5 mL of 14% BF_3-CH_3OH were added and heated for further 5 min. The FAMEs were recovered in 2 mL of iso-octane and analyzed using a GC-MS gas chromatograph (HP 6890 Agillent) equipped with MS detector. Separation of FAME was carried out by using HP-INNOWAX Polyethylene Glycol Capillary Column, model number: HP 19091N-133, 30 m length, 250 μm diameter and 0.25 μm film thickness and operated in a split mode with split ratio 50:1. The injector and detector temperature were 250 and 260°C, respectively. The column and the temperature was held at 70°C for 1 min then programmed to 180°C at 20°C per min. Ramp rate and finally reached to 220°C with a 3°C per min Ramp rate, hold at this temperature for 10 min. Complete separations of FAMEs were achieved in 31 min run time.

Identification of individual fatty acid was made by comparing those retention time of FAME standard (Supelco 47085U PUFA No:3) and Supelco 37 component Fame mix (47885-U). Confirmation of fatty acid methyl esters were also done by using MS database library (FAMEDBWAX). The values of fatty acids are presented as area percentage of total fatty acids.

Extraction and determination of elements: Organic matters were digested according to Wet ashing method (AOAC Method 975.03) with a minor modification. Known amount of shrimp flesh (2 g) were weighted into polypropylene screw capped tube and 10 mL of concentrated HNO_3 (65%, Merck) were added on to sample then 3 mL of 60% perchloric acid were added. Samples were left overnight to complete digestion. Then further heating was carried out in hot water bath at 90°C for 7 h. Digests were filtered into a 25 mL volumetric flash, using ash free filter paper and made up to the volume with ultra pure water.

Determination and quantification of elements were done by ICP-AES (Varian Model-Liberty series II). Calibration curve of each individual elements were prepared from ICP Multi element stocks (High purity standards) and phosphorus standard solution were prepared from KH_2PO_4 by dissolving in ultra pure water to obtain 1000 ppm stock phosphorus standard. The Standard stock solution was acidified (100 μL/100 mL) with 65% HNO_3.

RESULTS

Proximate composition: The mean value of each component of proximate composition of *P. longirostris* and *P. martia* was reported in Table 1. Moisture, crude protein, crude lipid and ash level were found as 78.66, 20, 1.1 and 1.55% in muscle of *P. longirostris* and as 82.21, 14.2, 2.6 and 1.01% in that of *P. martia*.

Fatty acid composition: Total fatty acid composition of the *P. longirostris* and *P. martia* are shown in Table 2. As it can be observed from Table 2, total Polyunsaturated Fatty Acids (PUFA) has the highest percentage, compared with total Saturated Fatty Acid (SFA) and total Monounsaturated Fatty Acids (MUFA) in edible part of these two shrimp species. In addition, the ratio of docosahexaenoic DHA: EPA, PUFA: SFA and n-6: n-3 were found as 1.37, 1.32, 0.22 in *P. longirostris* and 1.21, 1.27 and 0, 19 in *P. martia*, respectively.

Total SFA level of the *P. longirostris* was found as 31.8±3.3%, whereas the level of total saturated fatty acid composition was 27.5±0.27% in *P. martia*. Among the saturated fatty acid, palmitic (C16:0) and stearic (C18:0) acid of *P. longirostris* have the highest percentages ($p>0.01$) with the value of 19.2 and 6.91, respectively. Significant differences ($p<0.01$) were observed only in C:15 and C:17 in SFA. As it seen in the table, those of red shrimp had the similar results.

MUFA content of rose shrimp was calculated as 26.09 %, whereas that of *P. martia* was found as 34,47%. The highest value in total MUFA of *P. longirostris* and *P. martia* was oleic acid (C18:1 n-9) with levels of 14.24 and 19.92%, consecutively. The value of C16:1 n-7 in flesh of *P. longirostris* and *P. martia* were almost the same ($p>0.01$). In addition, a significant difference ($p<0.01$)

Table 1: Proximate composition of *P. longirostris* (rose shrimp) and *P. martia* (red shrimp)

Components (%)	*P. longirostris*	*P. martia*
Moisture	78.7±0.17	82.2±0.6
Crude protein	20±0.3	14.2±1.3
Crude lipid	1.1±0.24	2.6±0.9
Ash	1.6±0.03	1.01±0.1

Table 2: Fatty acid compositions (%) of *P. longirostris and P. martia*

Carbon chain	*P. longirostris*	*P. martia*	p-value
C14:0	1.14±0.40	1.04±0.08	0.686
C15:0	1.01±0.13	0.48±0.02	0.002
C16:0	20.27±1.66	20.14±0.15	0.629
C17:0	2.21±0.54	0.74±0.02	0.010
C18:0	7.14±0.57	5.09±0.01	0.005
C16:1 ω7	5.69±1.10	5.68±0.27	0.812
C17:1	1.25±0.14	0.71±0.02	0.003
C18:1 ω9	14.24±1.11	19.92±0.28	0.001
C18:1 ω7	4.21±0.07	7.35±0.29	0.000
C20:1 ω9	0.70±0.14	0.82±0.03	0.172
C18:2 ω6	1.60±0.07	1.66±0.09	0.216
C20:2 ω6	0.77±0.06	0.28±0.02	0.000
C20:3 ω6	0.12±0.02	0.21±0.01	0.001
C20:4 ω6	4.98±1.29	3.34±0.10	0.109
C18:3 ω3	1.10±0.38	0.49±0.16	0.069
C20:5 ω3	13.84±2.08	12.84±0.38	0.650
C22:5 ω3	0.75±0.05	0.61±0.01	0.010
C22:6 ω3	18.98±1.65	15.59±0.71	0.046
Total SAFA	31.78±3.29	27.46±0.27	
Total MUFA	26.09±2.56	34.47±0.89	
Total PUFA	42.13±5.58	35.01±1.45	
EPA/DHA	0.73	0.82	
Total ω3	34.66	29.53	
Total ω6	7.47	5.48	
ω6:ω3	0.21	0.19	
ω3:ω6	4.5	5.2	
PUFA/SFA	1.32	1.27	

Table 3: Elements concentrations (mg kg^{-1}) of rose shrimp (*P. longirostris*) and red shrimp (*P. martia*)

Elements	*P. longirostris*	*P. martia*	p-value
Cr	0.098±0.046	0.099±0.05	0.962
Mn	0.729±0453	0.145±0.04	0.000
Cd	0.784±0.081	1.56±0.184	0.000
Cu	2.2±0.672	2.83±0.3	0.014
Zn	6.1±0.472	5.87±0.57	0.382
Fe	18±2.7	2.0±0.96	0.000
Mg	382±21.5	579±84.8	0.000
Ca	495±94.1	322.5±111.9	0.002
Na	876±79.1	574.8±149.8	0.000
P	933±57.1	1344.6±182.4	0.000
K	996±106.3	644.9±88.35	0.000

(n = 9), values are mean ± standard deviation

was noted between shrimp species in terms of C18:1 n-7 with percentages of 5.54 and 4.05.

Three major PUFA were DHA, EPA and C20:4 n-6, with percentages of 18.98, 13.84 and 4.98 in edible part of the *P. longirostris* and 15.59, 12.84, 3.34 *P. martia*, respectively. In addition, the levels of C18:3 n-3 C22:5 n-3, C20:2 n-6 and C20:3 n-6 were detected in very low concentrations comparing with other PUFA contents in both shrimp species.

Seafood lipids generally contain even carbon chain fatty acids. Although, odd carbon chain fatty acid is rarely found in seafood lipids, surprisingly, we ascertained some odd chain fatty acids such as C15:0 and C17:0 in both *P. martia* and *P. longirostris*, in this study.

Element composition of shrimp: *P. martia* samples were analyzed and mean values are shown in Table 3, which also provides the values of macro element (Mg, Ca, Na, P and K) and microelement (Cr, Mn, Cd, Cu, Zn and Fe) contents of rose shrimp as well as some of the heavy metals, which were additionally measured to check safety of eating edible part of rose shrimp. The values of the heavy metals contents were not high to constitute a major risk for consumers of these two shrimp species.

In Table 3, the highest amount of macro elements content of *P. longirostris* were K, P, Na and Ca with the values of the 996, 993, 876 and 495 mg kg^{-1}, while those of *P. martia* were P, K, Mg and Na with the values of 1344, 644.96, 578.8 and 574.8 mg kg^{-1}, respectively.

The highest concentrations of microelements in *P. longirostris* were iron, zinc and copper with values of 18, 6.1 and 2.2 mg kg^{-1} as presented in Table 3, respectively. In addition, very small amount of Cd, Mn and Cr were also detected in *P. longirostris* with values of 0.784, 0.729 and 0.098 mg kg^{-1}, correspondingly. On the other hand, similar results were observed for *P. martia.*

DISCUSSION

Proximate composition: The proximate composition varies depending upon season, age, maturity, sex and availability of food (Karakoltsidis *et al*., 1995; Sikorski *et al*., 1990). During long starvation periods, fish and shellfish may utilize the protein in its body to survive. However, the main changes in the body composition occur in moisture and lipid content, which may show an inverse correlation. These two shrimp species-spawning season is in the summer when the water temperature is above the 25°C. The samples used for this research were caught in March when shrimps were out of spawning season thus, proximate composition of shrimps may not be affected from the spawning.

Shrimp is considered as a high-range protein-containing nutrient like fish, which contain 8-20% protein. It has been reported that protein content of shrimp ranged between 17-21% depending on shrimp species (Sriket *et al*., 2007; Yanar and Celik, 2006). According to the study, of Silva and Chamul (2000), the protein content of crustaceans and mollusks were indicated around 20%. Comparing these previous studies with the results of protein content of *P. longirostris* and *P. martia*, findings were in a good agreement.

Moisture of fresh shrimp is generally reported as 75-80% (Sriket *et al*., 2007; Yanar and Celik, 2006). The moisture of these two shrimp species are in parallel with previously reported findings. Lipid content of shellfish generally ranges between 0.3 and 3.2%. In our study, in edible part of lipid content of deep seawater rose shrimp and red shrimp contained about 1.1 and 2.61%. Cadun *et al.* (2005) and Huidobro *et al.* (2002) found that the lipid content of frozen shrimp and shrimp covered with liquid ice were 0.35 and 0.31%, respectively. These finding are lower than rose shrimp used in study. However, lipid value of *P. martia* was calculated higher than both that of *P. longirostris* and previously reported findings.

Even if the fat level of rose shrimp and red shrimp was calculated higher than that of others mentioned above, the amount of lipid level may not be provide enough fat for human diet. When all these values considered, the lipid content of shrimp may not be quantitatively a good source of human diet. However, based on results of this present study, the quality of lipid content of shrimp species used in this study is as good as lipid content of fish. In addition, the crude lipid in edible part of rose shrimp in this study contained some chloroform soluble pigments, which were seen in orange color in *P. longirostris* and red color in *P. martia*. The intensity of the colour was much higher in *P. martia*.

The ash content of the *P. longirostris* and *P. martia* was calculated as 1.55 and 1.01%, respectively, in this study. The amount of ash shows the richness of the food in terms of element composition. Ash content of shrimp is generally 1-1.5%. Sriket *et al.* (2007) calculated the amount of ash of black tiger and white shrimp 0.95 and 1.47%, respectively. These previously reported findings are very close to the findings in this study.

Fatty acid compositions: Palmitic acid was dominant fatty acid in total SFA in both shrimp species in this study. The amout of palmitic acid of *P. longirostris* (20.27%) was almost the same as in *P. martia* (20.14%) ($p>0.01$). This finding is slightly lower than the one reported for black tiger shrimp (22.2%) and white tiger shrimp (21.8%) (Sriket *et al.*, 2007), while it is slightly higher than the one reported averagely for red shrimp as 17.3%, pink shrimp as 18.0% and Norway shrimp as 17.6% (Rosa and Nunes, 2003).

Findings of C18:1 n-9 and C18:1 n-7 of two shrimp species in this study were similar to previously reported findings of white and black tiger shrimp (Lin *et al.*, 2003; Sriket *et al.*, 2007). In addition, DHA and EPA, belonging to n-3 fatty acids family, are considered as essential (Feliz *et al.*, 2002). DHA and EPA, two of the major PUFA were found as 18.98 and 13.84% in the *P. longirostris*'s total fatty acids and 15.59 and 12.84 in *P. martia's* total fatty acids, respectively. The amount of DHA of *P. longirostris* was significantly ($p<0.01$) higher than that of *P. martia*, while no significant differences ($p>0.01$) were observed in EPA. Results of this present study also showed that the value of EPA was lower than that of DHA in rose shrimp although Ackman (1989), reported that, the shellfish tend to have EPA greater than DHA. These previous findings show disagreement with our findings for *P. longirostris*. It can be stated that the percentage of DHA was greater than EPA in both species.

Osborn and Akoh (2002) mentioned in their review article that n-9 fatty acids, found as oleic acids (C18:1 n-9) play moderate role in the body. Moreover, n-6 fatty acids cannot be synthesized by humans and are therefore considered essential fatty acids. *P. longirostris* and *P. martia* contained considerable amounts of Arachidonic acid (20:4 n-6), which is the precursor of eicosanoids. Among the n6 series 20:4 n6 fatty acid were found in highest level in both species. Furthermore, n-3 fatty acids are essential in growth and development throughnd out the human life cycle and should be included in diet. As it is stated in Table 2, n-9, n- 6 and n-3 are available in both *P. longirostris* and *P. martia*. Based on these given useful knowledge, these two shrimp species can be considered as a good source of fatty acid as well as protein.

On the other hand, it is also important levels of n-6, n-3 and ratio of their relations between them. Fatty acids profile of *P. longirostris* and *P. martia* in this present study showed that ratio of n-6:n-3 was very close to each other with the value of 0.21 and 019. Due to high levels of n3 fatty acid in both shrimp ratio of n6: to n3 was much lover than set by Health Department. According to Health Department, maximum n-6:n-3 ratio was set 4. Therefore, both shrimp species provides balanced n-6:n-3 ratio (Annon, 1994).

Element composition of shrimp: Determination of element composition of shrimp is important for both checking raw material quality and labeling requirement in nutritional point of view. That kind of information gives the idea of choosing the best product for health. It is pointed out that the main functions of essential minerals are to maintenance of colloidal system and regulation of acid-base equilibrium. Minerals also constitute important components of enzymes, hormones and enzyme activators (Belitz and Grosch, 2001). Fish and shellfish contain considerable amounts of minerals such as, calcium, magnesium, phosphorus, potassium and sodium (Attar *et al.*, 1992). Due to fact that their importance, the mineral content, including Ca, Na, P, Mn, Fe, of edible part of *P. longirostris* and *P. martia* were investigated and levels of their content were given below.

The amount of phosphorus in flesh *P. martia* was found significantly ($p<0.01$) higher than that of *P.*

longirostris, while the level of calcium in *P. longirostris* was significantly ($p<0.01$) higher than that of *P. martia*. Calcium and phosphorus is the most abundant mineral in fish, human and other living organisms. Approximately, 99% of calcium and 80-85% of the phosphorus are present in bones as calcium phosphate and hydroxyapatite.

In this present study, Ca levels of *P. longirostris* and *P. martia* were found to be 495 and 322 mg kg^{-1}, respectively, which is lover than green tiger shrimp (59.5 mg/100 g) (Yanar and Celik, 2006), sea bass (63.6 mg/100 g) and sea bream (19.2 mg/100 g) (Erkan and Ozden, 2007). Ca is essential for hard tissue structure, blood clotting, muscle contraction, nerve transmission, osmoregulation and as a cofactor for enzymatic procession (Lovell, 1989). Calcium recommendation is (RDA) 800 mg/day. In addition, many Ca supplement contain lead, which impairs health in numerous ways. Fortunately, Ca interferes with the absorbsion and action of lead in the body system (Whithney and Rolfes, 2008).

Sodium is the principal cation of the extracellular fluid and regulator of its volume. Sodium also helps maintain acid-base balance and is essential for nerve system (Whithney and Rolfes, 2008). The level of Na in flesh of *P. longirostris* and *P. martia* was found as 876 and 574 mg kg^{-1}, respectively.

Potassium plays a major role in maintaining fluid and electrolyte balance and cell integrity. During the nerve transmission and muscle contraction, potassium and calcium briefly exchange places across the cell membrane. Potassium requirement for human is about 2 g day^{-1}. The average K contents of *P. longirostris* and *P. martia* were found to be 996 and 644 mg/100 g ($p<0.01$), respectively, which is less than that reported by Yanar and Celik (2006) for green tiger shrimp, Erkan and Ozden (2007) for sea bass and sea bream.

Magnesium content of *P. longirostris* and *P. martia* was about 382 and 578 mg kg^{-1}, respectively, Magnesium toxicity is rare, but it can be fatal. It has some useful roles in body. Magnesium is important for human nutrition and it is required for body's enzyme system. In addition to maintain bone health, magnesium acts in all cells of soft tissues, where it forms part of the protein-making machinery and necessary for energy metabolism (Whithney and Rolfes, 2008).

Iron is one of the very important essential trace elements since it has several vital functions in human system. It serves as a carrier of oxygen to tissues from the lungs by red blood cell. Adequate Fe in diet is very important for avoiding some major health problems (Belitz and Grosch, 2001; Camara *et al*., 2005). However, according to Institute of Turkish Standard (ITS, 2000), exceeding level of 10 mg kg^{-1} for iron is not permitted. Iron content of shrimps used for this study was significantly ($p<0.01$) higher in *P. longirostris* than *P. martia*. However, the value stated for *P. longirostris* was higher than those stated by Gokoglu *et al*. (2008), green tiger shrimp (1.48 mg/100 g) and speckled shrimp (1.55 mg/100 g) (Yanar and Celik, 2006), *Aristeus antennatus* (0.9 mg/100 g) (Karakolsidis *et al*., 1995).

High amounts of copper are present in crustaceans, decapods, gastropods and cephalopods that use copper (White and Rainbow, 1985) in their haemocyanins to carry oxygen to their tissues. Despite the high copper concentrations in some molluscan and crustacean shellfish, copper concentrations in aquatic food present no problem for human health (Oehlenschlager, 2002). Copper has been known one of the major catalysts for oxidation (Thanonkaew *et al*., 2006). In addition, like many other essential elements such as copper, zinc and manganese are valuable for a healthy life not only for humans but also for animals. That's because they play important roles in many physiological functions in living organisms. According to Agency for Toxic Substances and Disease Registry (Annon, 2004), a very high intake can cause some health problems, such as liver and kidney damage. Cu, Cd and Zn were found as 2.2, 0.7 and 6.1 mg kg^{-1} for *P. longirostris* and 2.8, 0.14 and 5.8 for *P. martia* in this present study, respectively. Except Zinc and Chromium, all the elements were significantly different in both shrimp species. According to ITS (2000), tolerance level of Cu, Cd and Zn in food should not exceed 5, 0.1 and 50 mg kg^{-1}(500 mg/100 g), respectively. The levels of Zn in *P. longirostris* and *P. martia* was not exceed the limit, moreover, it was approximately 8 times lower than legislated toxic level. Additionally, Gokoglu *et al*. (2008) reported levels of Cu, Cd and Zn for *P. longirostris* as 1.33, 0.23 and 14, 57 mg kg^{-1}. Comparing these results with the present study, Zn level of previously reported value was higher than that of this study.

Shellfish are usually high in minerals such as iodine, iron and copper than fish. Heavy metals, for instance, Pb, Mn, Zn and Cr, may be present at toxic level in seafood depending on how they feed and where they live. Those who are living in polluted water may accumulate some toxic elements and may harm to the people who consume them. This toxic effect may show its consequences either long term or short term, depending on the concentration and how much they are consumed. Moreover, shellfish that harvested from clean water may not contain any heavy metals or much below the toxic level.

CONCLUSION

The findings for *P. longirostris* and *P. martia* showed some differences in proximate compositions, fatty acid profile and element compositions. Protein and ash contents were much higher in *P. longirostris* than *P. martia* and lipid and moisture contents were higher in *P. martia.* Quality of fatty acid profile of both shrimp species was similar to most of the marine fish species in terms of EPA and DHA contents. However, the quantity of these fatty acids from shrimp may be limited due their lipid content.

Both shrimp species contained adequate amounts of macro elements in different quantities. Among the macro elements; Ca, Na and K were in high level in *P. longirostris*, whereas Mg and phosphorus were abundant in *P. martia.* Some heavy metals such as Cr, Mn and Zn were not at toxic levels in both species. Therefore, it can be concluded that these shrimp species could be considered safe for the heavy metal mentioned above consumption that caught in Samandag Coast (Northern Eastern Mediterranean Sea, Turkey). In addition, element content of rose shrimp showed that this shrimp species has some essential minerals, such as copper, zinc and iron at required levels. Furthermore, the shrimp may be considered as a good source of K, P, Mg, Ca, Fe, which are nutritionally important elements.

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