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RESEARCH ARTICLE

A study on fatty acid profile and some mineral contents of mantis shrimp (*Erugosquilla massavensis* Kossmann, 1880) from Northeastern Mediterranean Sea (Turkey).

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ABSTRACT

This study was carried out to detect the percentage content of fatty acids (FA) and some minerals (Ca, Mg, K, Na, Zn, Fe) of 40 mantis shrimp (*Erugosquilla massavensis*) obtained from Northeastern Mediterranean Sea, Turkey. The protein and fat contents were identified as 13.10±0.1% and 2.06±0.5, respectively. Distribution of fatty acids in samples was SFA > MUFA > PUFA. The order of average mineral concentrations found in samples was Mg>K>Na>Ca>Zn>Fe. The results showed that the ratio of PUFA/SFA (0.29) of mantis shrimp was not within the range reported as good (0.45) for human diets.

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Introduction

Mantis shrimp, *E. massavensis* is a potentially edible benthic crustacean that have a small yet growing economic important in the markets (rare on the markets of Cyprus, Israel and Turkey) and it is also an important resource for the Mediterranean demersal fisheries in Spain, Italy, Egypt, and Morocco (Rossetti et al., 2005; Fahmy and Hamdi, 2011, Salam and Hamdi 2015; Fard et al., 2016; Sealifebase, 2018). In Asia, the importance in mantis shrimp as a fishery resource has long been recognized (Zamri et al., 2016). Therefore this crustacean is a favorite seafood in Japan, China, Malaysia, Indonesia, Hong Kong, and Taiwan and has been commercially exploited by small bottom-trawlers and gill nets (Fard et al., 2016).

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E. massavensis originating from Persian Gulf and Red Sea migrated through Suez Canal into the Mediterranean Sea where it was firstly recorded off the Mediterranean coast of Egypt (Amor et al., 2015). *E. massavensis* is distributed along the entire Mediterranean coast of Turkey, with a westernmost limit extending as far as Fethiye (Türeli et al., 2017). The species more recently was recorded from the eastern region of the Libyan coast and then from Tunisian waters. *E. massavensis* is now widely distributed along the Levantine coasts; the south, eastern and western Aegean Sea; the Marmara Sea; westwards toward Egypt; and the central Mediterranean. (Foka et al., 2017). Although it has been reported from the varying depths between 150-200 m in southern Aegean coast of Turkey (Özcan et al., 2008), it is regularly caught between 20 and 80 m above the muddy, sandy, argillaceous funds and of gravel (Rossetti et al., 2005; Gökoğlu et al., 2008; Sealifebase, 2018).

Recently, many studies have been done on the nutritional value of seafood which has low saturated fat, high omega-3 polyunsaturated fatty acids (PUFA), and high-quality protein, amino acids and minerals (Gökoglu and Yerlikaya, 2003; Celik et al., 2004; Olgunoglu et al., 2011; Ayas and Ozogul, 2012; Olgunoglu and Olgunoglu, 2017, Göçer et al., 2018). Especially polyunsaturated fatty acids (PUFAs) have been recognized to have special pharmacological and physiological effects on human health. They are beneficial for the reduction of coronary artery disease (Cherif et al., 2008). The minerals in diets also participate in several biochemical reactions and serve as components of bones, soft tissues and co-factors and co-activators of various enzymes important in human nutrition (Soundarapandian et al., 2014). Therefore, many authors have recently investigated the mineral and the fatty acid (FA) profiles of different crustacean species in various parts of the World (Oksuz et al., 2009; Tag El-Din et al., 2009; Saglık and Imre, 1997; Ouraji et al., 2011; Turan et al., 2011; Yanar et al., 2011; Fatima et al., 2013). However, the studies on fatty acid profiles in mantis shrimp (*E. massavensis*) is very limited. Most studies on mantis shrimp focus on the biology, fishery, and population structures (Fard et al., 2016). Literature reviews have also showed that there is no enough information on investigation of the mineral contents of mantis shrimp was available. Therefore, the current study is carried out to evaluate the nutritional value and the fatty acid profiles of mantis shrimp (*E. massavensis*) caught in the Northeastern Mediterranean Sea, Turkey.

Material and Methods

Collection and Preparation of Samples

Mantis shrimp were captured along the coast of Mediterranean Sea (Turkey) by using fishing nets in June 2017 (Figure 1). Immediately, after capturing, mantis shrimp were stored in a plastic container over a layer of ice in a cooler and transferred to the laboratory. After removing the heads, shells and intestines, the meat of mantis shrimps are kept at –18°C until chemical analysis. The total number of samples was 40.

Chemical Analysis

The crude protein analysis of mantis shrimp samples was carried out according to the Kjeldahl Method and the fat was determined according to the Acid Hydrolysis Soxtec System (AOAC, 1995). Inductively coupled plasma-optical emission spectrometry (Perkin Elmer-NexION 350X) was used to determine phosphorus (K), magnesium (Mg), sodium (Na), calcium (Ca), zinc (Zn) and iron (Fe) in the samples. The analyses were performed at least in triplicate and the concentrations were expressed as mg/100g wet weight. IUPAC (1979) Methods II. D. 19 was used to prepare the methyl esters of fatty acids of mantis shrimp samples. To determine the fatty acid composition of samples, analyses were done by using a Perkin Elmer Autosystem XL Gas Chromatography and Flame Ionization Detector (FID) equipment and a Supelco 2330 fused silica capillary column (30 m × 0.25 mm × 0.20 µm film thickness).

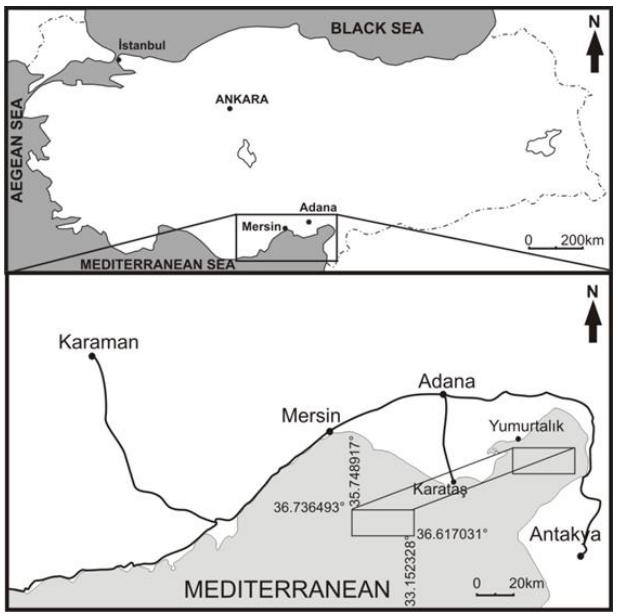

Figure 1. Sampling area in the Northeastern Mediterranean Sea

Results

There are limited studies in relating to fatty acids and macro minerals of mantis shrimp, which were investigated in this study. Table 1 shows, protein and fat contents of *E. massavensis* examined in the study. The fat and protein content of aquatic organisms is a crucial factor to evaluate the nutritional condition (Mahaliyana et al., 2015). According to the results of our study mantis shrimp consists of 13.10±0.1% protein and 2.06±0.5% fat, respectively.

Table 1. The quantity of the crude protein and fat in *E. massavensis*

Parameters	*Erugosquilla massavensis*
Protein	13.10±0.1%
Fat	2.06±0.5%

The fatty acid profile in the fat of analyzed mantis shrimp was shown in Table 2.

Table 2. The quantity of the crude protein and fat in *E. massavensis*

Fatty Acids	*Erugosquilla massavensis* (%)
C4:0	0.40±0.02
C6:0	0.22
C10:0	0.13±0.03
C11:0	0.75±0.01
C12:0	0.30±0.01
C13:0	0.16
C14:0	3.57±0.02
C15:0	1.10±0.01
C16:0	21.59±0.13
C17:0	0.93±0.02
C18:0	15.21±0.01
C20:0	0.26±0.01
C21:0	0.47±0.43
C22:0	0.18±0.02
C23:0	11.83±0.02
C24:0	0.28±0.02
ΣSFA	**57.38**
C14:1	0.36±0.03
C15:1	0.51±0.04
C16:1	18.09±0.12
C17:1	0.11±0.05
C18:1n-9	3.94±0.01
C22:1n-9	0.46±0.55
C24:1	1.20±0.14
ΣMUFA	**24.67**
C18:2n-6	0.93±0.14
C18:3n-6	0.62±0.03
C20:2	1.63±0.16
C20:3n-6	3.73±0.12
C20:4n-6	0.29
C20:5n-3 (EPA)	0.61±0.33
C22:2	0.12±0.00
C22:6n-3 (DHA)	8.66±0.53
ΣPUFA	**16.59**
Σn3	9.27
Σn6	5.57
PUFA/SFA	**0.29**

The fatty acid content was 57.38% saturated (SFAs), 24.67% monounsaturated (MUFAs), and 16.59% polyunsaturated acids (PUFAs). Distribution of fatty acids in *E. massavensis* were seen as SFA > MUFA > PUFA. The major saturated fatty acids (SFAs) of mantis shrimp in this study were C16:0 (palmitic acid, 21.59±0.13%) and C18:0 (stearic acid, 15.21±0.01%). The most abundant monounsaturated fatty acids (MUFA) is oleic acid (C18:1n-9) with a level of 3.94±0.01%. The highest PUFAs was docosahexaenoic acid (DHA, C22:6n-3), contributing approximately 52% of the total PUFA content.

The concentration levels of six minerals (Ca, Mg, K, Na, Zn, Fe) of *E. massavensis* are shown in Table 3. The order of average mineral concentrations found in *E. massavensis* samples were Mg>K>Na>Ca>Zn>Fe (Table 3).

Table 3. The mineral contents (mg/100g) in *Erugosquilla massavensis*

Parameters	*E. massavensis*
Calcium (Ca)	90.07±1.22
Magnesium (Mg)	431.43±10.13
Potassium (K)	272.40±6.22
Sodium (Na)	90.43±2.13
Zinc (Zn)	3.36±0.03
Iron (Fe)	0.24±0.07

Discussion

Seafood helps human beings to maintain good health by providing all essential nutrients consuming a variety of foods in balanced proportions, and will prevent deficiency diseases and chronic diet-related disorders (Rexi et al., 2015). The nutritional composition of marine organisms may change greatly from one species to another species depending on collection method, handling procedures, age, sex, environment and season with protein levels ranging from 16 - 21% and lipids 0.1 - 25% (Ozer, 2004; Lilly et al., 2017). The protein and fat content of *E. massavensis* is close to what has been previously reported for other different marine organisms.

The results on fatty acids profile obtained in our study are agreement with studies reported by several authors on fatty acids found in various species and subspecies of sea and freshwater shrimps (Oksuz et al., 2009; Tag El-Din et al., 2009; Saglık and Imre, 1997; Ouraji et al., 2011; Turan et al., 2011; Yanar et al., 2011; Fatima et al., 2013). However, in a similar study on mantis shrimp (*E. massavensis*), different percentage compositions of fatty acids were also reported by Ayas and Ozogul (2012). In their study, SFA, MUFA and PUFA rates in *E. massavensis* were reported as 33.82%, 23.84% and 35.44% respectively. The results obtained in this study showed differences with the findings of the mentioned researchers. These differences may be explained by geographical variation, seasonal conditions and different types of diet and feeding system in mantis shrimp. Fatty acid content could be also influenced by maturity period, size and age of shrimp. In the present study, PUFA/SFA ratio was of 0.29 for the mantis shrimp, which was lower than the minimum suggested (0.45) for a human healthy diet (Mendoza et al., 2014). In our study, in contrast to previous reports for some marine organisms, the examined *E. massavensis* demonstrated a lower percentage of EPA and DHA. The difference could be attributed to locations of sampling and the kind of solvents used for lipid extraction (Ridzwan et al., 2014).

Calcium (Ca) and Magnesium (Mg) are major component of bones therefore they are important for bone formation. Small fish is known to be a good source of these minerals Potassium (K) and sodium (Na) are important for muscle contractions, transmission of impulses in the nerves and sugar metabolism. Zinc (Zn) is a component of many metalloenzymes, important for gene expression and cellular growth. Iron (Fe) is mostly

important for transporting oxygen around the body (Mogobe et al., 2015).

Palani et al. (2014) pointed out that the average Ca contents in the fish species range from 64 to 1887 mg/100g. Bernard and Bolatito (2016) reported that mineral level of Mg, Ca, Na, K, Zn, Fe as 174.8 mg/100g, 134.8 mg/100g, 199.2 mg/100g, 52.45 mg/100g, 42.1 mg/100g, 28.05 mg/100g for *Penaeus notialis* and as 128.8 mg/100g, 142.2 mg/100g, 117.3 mg/100g, 89.1 mg/100g, 45.55 mg/100g, 41.25 mg/100g for *Penaeus monodon* respectively. The values of various minerals in *Parapenaus longirostris* obtained from Marmara Sea were found to be in the range of 79.04-101.61 mg/100g for Ca, 49.57-65.02 mg/100g for Mg, 281.37-331.78 mg/100g for Na, 370.22-447.96 for K, 1.109-1.770 for Zn and 6.176-8.843 mg/100g for Fe (Ozden, 2010).

Conclusion

The result of the present study demonstrated that the PUFA/SFA of mantis shrimp (*E. massavensis*) from Mediterranean Sea was not within the range reported as good for human diets. This study also showed that this species has low protein, fat and mineral contents except Mg, K and Ca when compared with other economical shrimp species.

Conflict of Interest

The authors declare that there is no conflict of interest.

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