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A Study on Fatty Acid Profile and Some Major Mineral Contents of Sea Cucumber (Holothuria (platyperona) sanctori) from Mediterranean Sea (Turkey)

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Abstract
This study was carried out to detect the concentration of fatty acid and some major minerals (P, Mg, Na, Ca) in sea cucumber (*Holothuria (platyperona) sanctori*) obtained from Mediterranean sea (Turkey). In fatty acid composition, the monounsaturated fatty acids (MUFAs) fraction was dominant (14.85%) followed by polyunsaturated fatty acid (PUFAs, 9.53%) and saturated fatty acids (SFAs, 9.04%). The order of avarega macro minerals concentrations found in samples was Ca>Na>Mg>P. End of the study, the results showed that *Holothuria (platyperona) sanctori*) obtained from Mediterranean sea (Turkey) has a low amount of major mineral and fatty acid content when compared with other economical sea cucumber species. However, PUFA/SFA and n3/n6 ratios were found (1.05 and 1.87) in good range.
Keywords: Fatty acids, minerals, sea cucumber, *Holothuria (platyperona) sanctori*, Mediterranean sea

1. Introduction

Sea cucumbers, belonging to the phylum Echinodermata and class Holothuroidea are marine invertebrates They are distributed worldwide in marine habitats, from shallow betnthic area to deep seas (Rahman, 2014; Wen et al., 2016). In general, they are classified into 3 groups according to their visual color; red, green, and black sea cucumbers. The red types inhabit the gravel bed offshore, while the green and the black types inhabit the sand-muddy bottom inshore. The major edible part is the body wall mainly consisting of collagen and mucopolysaccharides, and their color variation affects the taste and the price (Lee et al., 2012).

There are about 1400 living species of sea cucumber in a variety of forms, and only 37 species from Holothuroidea class lives in the Mediterranean Sea. Several species of them have been known to be edible. Currently there are over 66 different species of sea cucumbers being harvested and widely traded in both tropical and temperate regions of the World (Aydın, 2016; Haider et al., 2015; Liu et al., 2017; Oedjoe, 2017).

In the marketplace, sea cucumber species are known as “beche-de-mer,” “trepang,” or “haisom” (Sicuro and Levine, 2011). Commercial sea cucumber species are also reported in Turkey in the Aegean, Mediterranean and Marmara seas. Although sea cucumber meat are mostly eaten in great quantities by many Asian countries, almost never consumed in Turkey. However consumption of sea cucumbers is becoming more popular around the World. Therefore the demand for them has increased dramatically in recent years (Aydın et al., 2011, Liu et al., 2017). The total annual global catch is in the order of 100.000 tones of live animals annually (Haider et al., 2015). Interest in sea cucumber species from the Mediterranean Sea is fairly recent (Santos et al., 2017) therefore they are becoming an important export item for Turkey nowadays. They are exported by Fishery Products Processing Plants to USA, Namibia, Taiwan, Vietnam and China. Among commercial sea cucumber species found in Turkey, *Holothuria tubulosa*, *Holothuria polii*, *Holothuria mammata*, *Stichopus regalis* and *Holothuria sanctori* are known as the most commonly exported species. They are usually marketed as frozen, cooked-dried, cooked-salted andcooked-salted-dried product (Caklı et al., 2004; Aydın, 2008; Aydın et al., 2011, Aydın et al., 2013).

Sea cucumbers are a highly nutritious food, but little is known about their nutrient content. On the other hand, the increase of the commercial value of sea cucumber necessitated more detailed investigation. Biochemical composition as one of the most important of all subjects varies in accordance with geographical region of the species (Culha et al., 2017). Therefore, in view of these facts, the present study was carried out on *Holothuria* (*platyperona*) *sanctori* in order to assess their biochemical composition (protein, fat, mineral and fatty acid contents) prior to their consumption.

2. Materials and Methods

2.1. *Collection and preparation of samples.*

Sea cucumbers were collected along the coast of Mediterranean Sea (Turkey) by diving in June 2017 (Figure 1). Immediately, after collection, sea cucumber were stored in a plastic container over a layer of ice in a cooler and transferred to the laboratory. After evisceration, the sea cucumbers are kept at –18 ̊C until chemical analysis. The total number of samples was 25.

2.2 *Chemical analysis*

The crude protein analysis of sea cucumber 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 (P), magnesium (Mg), sodium (Na) and calcium (Ca) in the samples. The analyses were performed at least in triplicate and the concentrations were expressed as mg/100g wet weight. IUPAC Methods II. D. 19 (1979) was used to prepare the methyl esters of fatty acids of sea cucumber samples. To determine the fatty acid composition of samples, analyses were done by using a Perkin Elmer Autosystem XL Gas Chromotography and Flame Ionization Detector (FID) equipment and a Supelco 2330 fused silica capillary column (30 mx 0.25 mm x 0.20 µm film thickness).

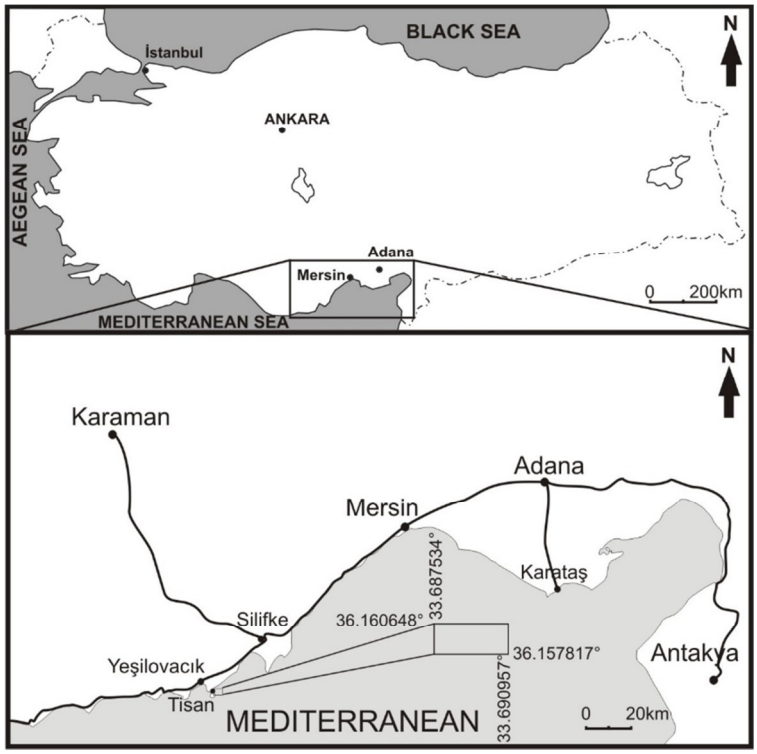

Figure 1. Sampling area in the Northeastern Mediterranean Sea

3. Results and Discussion

Table 1 shows, protein and lipid contents of *Holothuria sanctori* examined in the study. The lipid and protein contents in *Holothuria (platyperona)sanctori* were 1.55% and 8.02% respectively.

Table 1. The quantity of the crude protein and lipid in *Holothuria (platyperona) sanctori*

Parametres	*Holothuria sanctori*
Fat	0.55±0.05%
Protein	8.02±0.12%

Protein is very important in considering the quality of the meat and the texture of aquatic organisms. Fat components play an important role to determine the physical characteristics of the food such as aroma, texture, taste and appearance. (Oedjoe, 2017). Sea cucumbers generally contain a lower protein content than marine fish and shellfish. Proximate compositional data for fresh sea cucumbers vary greatly; protein 2.5–13.8%, fat 0.l–0.9% (Salarzadeh et al., 2012). Bilgin and İzci (2016) reported that the lipid and protein contents in *H. forskali* were 0.256% and 11.99% respectively. Lipid and protein contents were also reported as 0.16% and 8.18% respectively, for *Holothuria tubulosa* in Turkish Sea (Çaklı et al., 2004). In another study carried out by Aydın et al., (2011) in order to determine the proximate composition and fatty acid profile of three different commercial sea cucumbers from Turkey, lipid contents were 0.15%, 0.18% and 0.09 % for *Holothuria polii, Holothuria tubulosa* and *Holothuria mammata* and the protein contents were 8.66%, 8.82% and 7.88% respectively. Özer et al., (2004) have defined a range in total protein and fat percentage for sea cucumber of 5.78–9.53% and 0.06–0.37% respectively. The results obtained in present study, are consistent with those made in other species of sea cucumber from Turkey.

There are limited studies in relating to macro minerals of sea cucumber species, which were investigated in this study. Minerals constitute important components of hormones, enzymes and enzyme activators. Determination of some minerals which are essential for people such as Na, Mg, Ca, and P is important in terms

of the nutritional point of view. Seafoods contain a high concentration of macro minerals than those of their terrestrial counterparts (Erkan and Özden, 2007; Özoğul et al., 2008; Dehelean and Magdas**,** 2013). The order of avarega macroelements concentrations found in *Holothuria sanctori* samples was Ca>Na>Mg>P (Table 2).

Table 2. The major mineral contents (mg/100g) of *Holothuria sanctori*

Parametres	***Holothuria sanctori***
Calcium (Ca)	656.73±0.12
Magnesium (Mg)	155.77±0.15
Sodium (Na)	552.39±.0.29
Phosphorus (P)	10.91±.0.19

Ca is the major element evaluated in this study. Chang-Lee et al. (1989) pointed out that calcium has been reported to be present in sea cucumbers in large quantities. In a study on two species of sea cucumber, Haider et al., (2015) reported the mineral content of *Holothuria arenicola* and *Actinopyga mauritiana*. Ca contents of these species were 5700 mg/100g and 2610 mg/100g respectively. Mg contents were 4750mg/100g and 1870mg/100g respectively. Na contents were reported as 4750mg/100g and 6220 mg/100g respectively. The avarage mineral contents in the present study were identified as lower than those reported previously. The macro minerals levels of seafood may be expected to be influenced by season, age, maturity, sex, water temperature, spawning cycle and availability of food, types of diet and feeding system of organism (Olgunoglu and Olgunoglu, 2017).

Table 2. The profiles and percentage composition of fatty acids in (*Holothuria* (*platyperon*a) *sanctori*)

Fatty Acids	***Holothuria* (*platyperon*a) *sanctori* %**
C4:0	0.44±0.02
C8:0	0.21±0.00
C10:0	0.62±0.03
C11:0	0.22±0.01
C12:0	0.21±0.01
C14:0	0.34±0.02
C15:0	0.48±0.01
C16:0	1.23±0.13
C17:0	0.31±0.02
C18:0	0.53±0.01
C20:0	0.55±0.01
C21:0	2.42±0.43
C22:0	0.50±0.02
C23:0	0.67±0.02
C24:0	0.31±0.02
∑SFA	**9.04**
C14:1	1.26±0.19
C15:1	0.82±0.04
C16:1	4.62±0.12
C17:1	0.69±0.05
C18:1n-9	0.38±0.01
C22:1n-9	5.40±0.55
C24:1	1.68±0.14
∑MUFA	**14.85**
C18:2n-6	1.34±0.14
C18:3n-6	0.73±0.03
C20:2	1.56±0.16
C20:3n-6	0.66±0.12
C20:5n-3 (EPA)	1.55±0.33
C22:2	0.13±0.00
C22:6n-3 (DHA)	3.56±0.53
∑PUFA	**9.53**
∑n3	5.11
∑n6	2.73
n3/n6	1.87
PUFA/SFA	1.05

The profiles and percentage composition of twenty-nine different fatty acids in *Holothuria* (*platyperona*) *sanctori*) are presented in Table 2. The fatty acids analyzed were grouped as saturated fatty acids (SFAs), monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acid (PUFAs)

In the present study, the percentage of fatty acids was identified as lower than those reported by Aydın et al., (2011) and Bilgin and İzci (2016) for some sea cucumber species from Turkey. But the values obtained in this study, were close to those reported by Widianingsih et al (2017) who determined C 16:0, C18:1n-9, C18:2n-6, C20:5n-3 (EPA) to be 0.045%, 0.054%, 0.016% and 0.009%, respectively.

According to Aydın et al., (2011) the total polyunsaturated fatty acid (PUFA) contents are the highest than total saturated (SFA) and total monosaturated fatty acid (MUFA) in *Holothuria polii*, *Holothuria tubulosa* and *Holothuria mammata*. According to Widianingsih et al. (2016) SFA is the highest than MUFA and PUFA in *Paracaudina australis*. In the present study, MUFA was the highest (14.85%) followed by PUFA (9.53%) and SFA (9.04%). Regarding the fatty acid profile, in our study, *Holothuria* (*platyperona*) *sanctori* presented lower total percentages of monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids, than was reported by Aydın et al., (2011) and Bilgin and İzci (2016). The main reason for the difference may be explained by seasonal changes in feeding behaviours and geographical variations in sea cucumber (Santos et al., 2017). Besides, according to Özer et al. (2004), the handling procedures are also likely to affect the chemical composition of sea cucumbers.

According to some nutritional recommendations the PUFA/SFA ratio in human diets should be above 0.45 and the n3/n6 ratio should range between 1:8 and 2:5; the ratios observed for *Holothuria* (*platyperona*) *sanctori* in this study is therefore consistent with those reported by Alfaia et al. (2010) and Santos et al., (2017).

In our study, in contrast to previous reports, the examined sea cucumber demonstrated a lower content of fatty acid and major minerals. However, PUFA/SFA and n3/n6 ratios were found in good range according to nutritional recommendations.

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