



Comparison of Fatty Acid Profile of Edible Tissues of Wild Terrestrial Snail (*Helix lucorum* L. 1758) Collected in Two Province (Adana and Sinop)

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ABSTRACT

The aim of the present study is to compare the crude protein, fat content and fatty acids concentration of snail meat (*Helix lucorum* Linnaeus, 1758) obtained from Adana and Sinop Province (including 30 snail meat for both region) in Turkey. They were not statistically significant differences in fatty acid profile between two groups. But, in contrast to previous reports, may be due to geographical variation, the results show that the examined snails demonstrated a high content of fat that is between 3.74% and 4.20%. The analyses also indicated that snail meat from Adana province was richer in protein and fat content than Sinop province. In fatty acid composition for both region, monounsaturated fatty acid fraction (MUFA) was dominant followed by saturated fatty acid (SFA) and polyunsaturated fatty acid (PUFA). The ratio of n-3/n-6 and the content of PUFAs were found to be better in Adana province than Sinop. However, for both region, the ratio of PUFA/SFA was lower in *H. lucorum* than those recommended for nutritional.

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Türkiye’de İki İlden (Adana ve Sinop) Toplanan Doğal Karasal Salyangoz (*Helix lucorum* L. 1758)’un Yenilebilir Dokularındaki Yağ Asidi Profiline Karşılaştırılması

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ÖZ

Bu çalışmanın amacı, Türkiye’de Adana ve Sinop İli’nden (her iki bölge için 30 salyangoz eti) elde edilen salyangoz etinin (*Helix lucorum* Linnaeus, 1758) ham protein, yağ içeriği ve yağ asitleri konsantrasyonunu karşılaştırmaktır. Yağ asidi profilinde iki grup arasında istatistiksel olarak farklılıklar bulunmamıştır. Ancak, daha önceki çalışmaların aksine incelenen salyangozların %3,74 ile %4,20 arasında yüksek bir yağ içerisine sahip olduğu; bu farklılığın coğrafi farklılıklardan kaynaklanıyor olabileceği sonucuna varılmıştır. Analiz sonuçları, Adana ilinden elde edilen salyangoz etinin protein ve yağ içeriğinin, Sinop ilinden elde edilenden daha zengin olduğunu ortaya koymuştur. Her iki bölgeye ait salyangoz etinin yağ asidi bileşiminde, en fazla tekli doymamış yağ asidi oranı (MUFA) tespit edilmiş bunu doymuş yağ asidi (SFA) ve çoklu doymamış yağ asidi (PUFA) izlemiştir. Adana iline ait salyangozlarda n-3/n-6 ve PUFA içeriğinin oranının, Sinop iline göre daha iyi olduğu tespit edilmiştir. Bununla birlikte, *H. lucorum*’da her iki bölge için PUFA/SFA oranı, beslenme için önerilen oranlardan daha düşük bulunmuştur.

Introduction

Molluscs are an excellent source of protein and lipid which are characterized by a great variety of fatty acids especially in major lipid classes (Ekin et al., 2015). Mollusca contain at least 80.000 species and the Gastropoda is the only class of molluscs which have invaded land. Snails are members of Mollusca which are the second largest phylum of the animal kingdom (Zarai et al., 2011; Lukong et al., 2012). Snails are processed by different methods for consumption and they have been consumed since prehistoric times. While snail meat are mostly eaten in great quantities by many European countries, never consumed in Turkey. Snail meats are important export item for Turkey. They are exported by processed or fresh by Fishery Products Processing Plants to France, Italy, Greece, Spain, Germany, Hungary, USA, South America and to Far East countries such as Japan and China (Saglam and Gokhan, 2006; Olgunoglu and Olgunoglu, 2008; Baki, 2010; Uboh et al., 2014; Yıldırım et al., 2014). Some economically important edible snail species are *Helix aspersa*, *Helix pomatia*, *Helix lucorum*, *Helix aperta* (Born), *Eobania vermiculata* (Miller). Among them *Helix pomatia* is the most popular species. *Helix lucorum* is less valuable edible terrestrial snail (Abdulmajood and Bülte, 2001; Baltic, 2005; Olgunoglu and Olgunoglu, 2008). *Helix lucorum* is well adapted to human-modified landscapes such as gardens, parks, and arable land (Mumladze, 2013). It is an abundant snail in Turkey because of country's topographical structure, favorite weather and environmental condition, therefore it is also known as Turkish or Turkey snail (Olgunoglu and Olgunoglu, 2009; Çelik et al., 2017).

Recently, there has been a considerable amount of research related to chemical composition and fatty acids (Olgunoglu et al., 2011; Haider et al., 2015; Pasdaran et al., 2017a; Pasdaran et al., 2017 b; Göçer et al., 2018). Therefore, this study focused on *Helix lucorum* from the two province of the Turkey in order to compare their proteins and fatty acid profiles prior to their consumption.

Material and Methods

Materials

Snail samples were obtained from Sinop province (which is located in the Western Black Sea Region of Turkey) and Adana province (which is located in the Mediterranean Region of Turkey) in April and May 2017 (Figure 1). Immediately, after collection, snails were stored in a container, and transferred to the laboratory, where the shells and intestines were removed carefully as manuel to obtain edible parts of snail for analysis. After that, snails were kept at -18°C until chemical analysis. The total number of samples was 30 for each province.

Methods

The crude protein analysis of snail meat samples was carried out according to the Kjeldahl Method and the fat was determined according to the Acid Hydrolysis Soxtec System (AOAC,1995).

IUPAC Methods II. D. 19 (1979) was used to prepare the methyl esters of fatty acids of snail 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 mx 0.25 mm x 0.20 μm film thickness).

Statistical Analyses

For data analysis, The independent-samples t test was used to evaluate the difference between the means of two independent groups. The mean values were obtained from 3 experiments and reported as $X \pm SD$. Significance of differences was defined at $P \leq 0.05$.

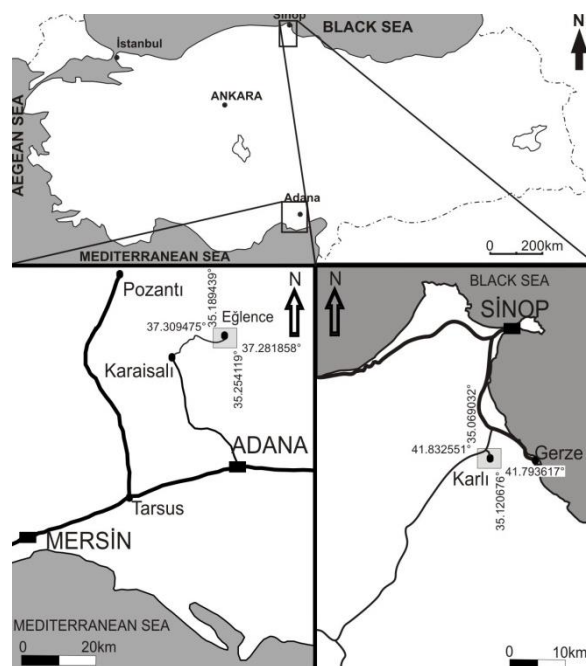


Figure 1 Sampling Area

Results and Discussion

The quantity of the crude protein and fat contents of wild terrestrial snail (*Helix lucorum*) collected in two province (Adana and Sinop) from Turkey are shown in Table 1.

Table 1 The quantity of the crude protein and fat contents of *Helix lucorum*

Parameters	Snail from Adana Province	Snail from Sinop Province
Fat (%)	4.20 \pm 0.16	3.74 \pm 0.15
Protein (%)	10.28 \pm 0.10	8.77 \pm 0.18

Mean values in the same row having the same superscript are not significantly different ($P > 0.05$). Values are shown as means \pm SD

The quantity of the crude protein and fat contents of snail meat from Adana province was found to be higher than the snail meat from Sinop province ($P > 0.05$). The protein content of *H.lucorum* ranged between 8.77% and 10.28%. The fat content was identified to differ between 3.74% and 4.20%. The amount of fat content in two snails species recorded by Uboh et al. (2014) varied from 2.40 (*Archachatina marginata*) to 2.85 (*Achatina achatina*). Some studies on different snail species showed that the fat

content of snail meat varies from 0.41% to 2.66% (Gül and Fenercioglu, 1992; Özogul et al., 2005; Fagbuaro et al., 2006; Milinsk et al., 2006; Olgunoglu and Olgunoglu, 2009).

Table 2 The profiles and percentage composition of 23 different fatty acids in *Helix lucorum*

Fatty Acids	Snail from Adana Province %	Snail from Sinop Province %
C4:0	1.00 ^a ±0.00	0.58 ^a ±0.00
C8:0	0.37 ^a ±0.00	0.31 ^a ±0.00
C10:0	0.47 ^a ±0.00	0.85 ^a ±0.00
C12:0	2.25 ^a ±0.28	2.36 ^a ±0.57
C14:0	0.70 ^a ±0.11	0.44 ^a ±0.12
C16:0	13.63 ^a ±0.36	11.74 ^a ±0.40
C17:0	1.27 ^a ±0.11	1.06 ^a ±0.11
C20:0	5.51 ^a ±0.28	4.53 ^a ±0.29
C21:0	2.21 ^a ±0.11	3.39 ^a ±0.01
C22:0	4.61 ^a ±0.11	3.51 ^a ±0.11
∑SFA	32.02	28.77
C14:1	0.63 ^a ±0.01	0.73 ^a ±0.09
C15:1	0.62 ^a ±0.01	0.87 ^a ±0.01
C17:1	0.68 ^a ±0.01	0.46 ^a ±0.01
C18:1n-9	29.71 ^a ±0.11	31.09 ^a ±0.05
C20:1	0.59 ^a ±0.01	0.43 ^a ±0.01
C22:1n-9	2.09 ^a ±0.05	2.68 ^a ±0.04
C24:1	2.08 ^a ±0.04	1.28 ^a ±0.16
∑MUFA	36.40	37.54
C18:2n-6	4.31 ^a ±0.12	3.55 ^a ±0.98
C18:3n-6	0.52 ^a ±0.01	0.44 ^a ±0.01
C20:3n-6	0.49 ^a ±0.05	0.60 ^a ±0.05
C20:5n-3(EPA)	1.55 ^a ±0.02	0.20 ^a ±0.01
C22:2	0.86 ^a ±0.03	0.95 ^a ±0.02
C22:6n-3 (DHA)	1.83 ^a ±0.02	1.81 ^a ±0.01
∑PUFA	9.56	7.55
∑n3	3.38	2.01
∑n6	5.32	4.59
n3/n6	0.63	0.44
PUFA/SFA	0.30	0.26

In a study on Roman snail's meat (*Helix pomatia*) from different regions of Turkey, the content of crude protein was recorded as 12.96% (Ikauniec et al., 2014), in another study on *H. Lucorum*, protein content was found between 10.22% and 11.49% respectively (Olgunoglu and Olgunoglu, 2008; 2009). It was also reported that the amount of protein in snail meat could varies from 9.50% to 12.56% depending on feed intake (Milinsk et al., 2006). Cital et al. (2014) stated that in their study for *Helix aspersa* the quantity of protein was found between 14.12% and 12.31% in autumn and spring. As a whole in the present study the protein content was found similar while content of lipid was identified higher than those reported previously for some snail species. It was reported that the level of protein and fat content of species greatly varies during the catching seasons and changed in environmental conditions (Sutharshiny and Sivashanthini, 2011). Therefore this difference may be due to geographical variation and the fat content is also influenced by seasonal variations, age and maturity (Cital et al. (2014). The profiles and percentage composition of 23 different fatty acids in *Helix lucorum* 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, in both region, MUFA was the highest followed by SFA and PUFA. The major saturated fatty acids (SFA) in *Helix lucorum* from two province was palmitic acid (16:0) followed by arachidic acid (C20:0) and behenic acid C22:0. The caprylic acid (C8:0) was the least SFA in the samples for two province. The total SFA values in snail meat from Adana (32.02) was found higher than from Sinop (28.77) ($P>0.05$). The Major three MUFAs in both samples consisted of C18:1 n-9, C22:1n-9 and C24:1. Oleic acid (C18:1 n-9) was the primary monounsaturated fatty acid for the both snail meat. The total MUFA percentage in snail meat from Sinop (37.54) was higher than snail meat from Adana (36.40) ($P>0.05$).

Mean values in the same row having the same superscript are not significantly different ($P>0.05$). Values are shown as means \pm SD

Among the polyunsaturated fatty acids in *H. lucorum* for both region, linoleic acids (C18:2 n-6) were found to be prevailed among the n-6 acids; docosahexaenoic acid (C22:6n-3) were dominant among the n-3 acids, Similar results were reported in some studies on different snails species. For example, Özogul et al. (2005) stated that the major fatty acids determined in the snail *Helix pomatia* from the region of the south of the Turkey were C16:0 (12%) C18:0 (19%), C22:0 (7%), C18:1n-9 (17%), and C18:2n-6 (16%). According to Cital et al., (2014) the highest fatty acids of *Helix aspersa* are C18:2n-6 linoleic acid, C18:1n-9 oleic acid, C20:4 arachidonic and C16:0 palmitic acid, respectively. The principal acids in PUFA group were reported to be linoleic acid (C18:2), eicosapentaenoic acid (C20:5, EPA) and docosahexaenoic acid (C22:6, DHA) (Osibona et al., 2009; Olgunoglu, 2013). Our results are in agreement with the results reported on grouping of PUFAs.

The ratios of PUFA/SFA and n-3/n-6 are widely used as indices to assess the nutritional value of fat for human consumption. According to some nutritional recommendations the PUFA/SFA ratio in human diets should be above 0.45 (Alfaia et al., 2010). A high ratio of n-3/n-6 is beneficial for reducing the risk of coronary heart diseases, and the ratio has been suggested to be a useful indicator for comparing relative nutritional values of oils (Özparlak, 2013; Olgunoglu and Artar 2016). In the present study the PUFA/SFA ratio was found to be 0.30 and 0.26 for snail meats from Adana and Sinop respectively. The ratio of n-3/n-6 was higher in snail from Adana (0.63) than the snail meat from Sinop (0.44).

In our study, in contrast to previous reports, the examined snails demonstrated a high content of fat. Besides, the ratio of PUFA/SFA was lower in *H. lucorum* than those recommended for nutritional. However, the ratio of n-3/n-6 and the amount of PUFAs were found in good range in snail meat from Adana than Sinop. It could be demonstrated that the snail meat from Adana is a desirable item in human diet when the levels of n3/n6 and PUFA/SFA ratios were considered to snail meat from Sinop.

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