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The Effect of Season on the Fatty Acid Content of Deep Water Pink Shrimp in Marmara Sea

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Abstract: Total fatty acid composition of *Parapenaeus longirostris* (Lucas 1846), as called deep water pink shrimp collected from Marmara Sea, in spring and autumn was investigated by gas chromatographic method. Palmitic acid (C16:0), oleic acid (C18:1 ω9), docosahexaenoic acid (C22:6ω3) and stearic acid (C18:0) identified as the primary fatty acid constituents. PUFA (38.14%) in the spring was detected to be higher than SFA and MUFA. The contents of eicosapentaenoic acid (C20:5ω3) and C22:6ω3 in total fatty acid in the rose shrimp ranged from 7.46% (autumn) to 12.46% (spring) and from 5.34% (autumn) to 13.97% (spring), respectively. ω3/ω6 ratios are 2.95-2.88(%) in autumn and spring respectively. *P. longirostris* may be a valuable nutrient in terms of PUFA especially in spring and ω3/ω6 ratios for human consumption.

Keywords: Rose shrimp, fatty acid profile.

Marmara Denizindeki Derin Su Pembe Karidesi'nin Yağ Asidi İçeriğine Mevsimin Etkisi

Öz: Marmara Denizi'nden ilkbahar ve sonbaharda toplanan ve derin su pembe karidesi olarak adlandırılan *Parapenaeus longirostris*'in (Lucas 1846) toplam yağ asit bileşimi, gaz kromatografi yöntemi ile araştırılmıştır. Major yağ asidi bileşeni olarak palmitik asit (C16:0), oleik asit (C18:1ω9), dokosaheksaenoik asit (C22:6ω3) ve stearik asit (C18:0) tespit edilmiştir. İlkbaharda PUFA (%38.14), SFA ve MUFA'dan daha yüksek bulunmuştur. Pembe karideste eikosapentaenoik asit (C20:5ω3) ve C22:6ω3 içeriği toplam yağ asidinde sırasıyla, %7.46'dan (sonbahar) %12.46'ya (ilkbahar) ve %5.34'den (sonbahar), %13.97'ye (ilkbahar) değişmektedir. ω3/ω6 oranı sonbahar ve ilkbahar için sırasıyla 2.95 ve 2.88 (%)'dir. *P. longirostris* ω3/ω6 oranı bakımından ve özellikle ilkbaharda PUFA açısından insan tüketimi için değerli bir gıda olabilir.

Anahtar Kelimeler: Pembe karides, yağ asidi profili.

1. Introduction

Sea products contain high levels of ω3 polyunsaturated fatty acid (PUFA), especially eicosapentaenoic acid (EPA, C20:5ω3) and docosahexaenoic acid (DHA, C22: 6ω3). ω3 and ω6 PUFAs are considered as the basis for the growth and development of children. These are also precursors of the compound hormones known as eicosanoids, which are involved in various metabolic processes that are very important for the human body, especially for cardiovascular activity (Eder, 1995; Inhamuns and Franco, 2008). It has been reported that DHA is necessary for brain growth and functional development in children and is also necessary for normal

brain function in adults (Horrocks and Yeo, 1999).

EPA is the most significant essential fatty acid of the ω3 series in human nutrition because it is the forerunner of 3-series eicosanoids (Chen et al., 1995). Maes et al. (1999) notes that depression is associated with low levels of polyunsaturated fatty acids.

From the family Penaeidae, *Parapenaeus longirostris* (Lucas 1846, deep water pink shrimp) lives in depths ranging from 20 meters to 700 meters (Carpenter and Angelis, 2014; Soultani et al., 2016). *P. longirostris* is one of the world's most popular shellfish. *P. longirostris* is actually the target species of an important fishery of trawlers in the Mediterranean. *P. longirostris* caught by trawling in the Mediterranean and Spain, France, Italy, Algeria, Tunisia, and Turkey is the most important shellfish resources along the coast (Sbrana et al., 2006). Marmara Sea, Aegean Sea and Mediterranean Sea shrimp are also high potential in our country. *P. longirostris* is important seafood. The shrimp has rich protein, calcium and vitamins (A and D) and PUFA, such as DHA and EPA (Feliz et al., 2002). The fatty acid composition of different shrimp species is reported by many researchers (Ayas et al., 2013; Oksuz et al., 2009; Rosa and Nunes, 2003; Soultani et al., 2016). The main purpose of this study was to determine the fatty acid profile and ω3/ω6 fatty acids ratio of the muscle lipids of *P. longirostris* in Marmara Sea.

2. Materials and Methods

The samples of *P. longirostris* to be analyzed were taken from Marmara Sea in two different seasons (spring and autumn). The number of samples analyzed for each season should be given. They were caught by the local fishermen in the middle of March and October for each season during 2014-2015 and gender differences were not taken into account. Samples have been carried to the laboratories in frozen form. Samples were fractionated using an Ultra-Turrax T25 homogenizer, which was used for this method by Folch et al. (1957). Moss et al. (1974) method was used for transesterification with BF_3 methanol.

The mixture of fatty acid methyl esters in hexane/chloroform was analyzed using an HP Agilent 6890N model gas chromatograph. Capillary column has been used. Helium has been used as carrier gas.

3. Results and discussion

Total fatty acid composition of muscle lipids of *P. longirostris* is presented in Table 1. 32 fatty acids identified in muscle lipids *of P. longirostris* for two seasons (autumn and spring). The highest fatty acids in the *P. longirostris* were C16:0 (palmitic acid), C22:6ω3 (DHA), C18:0 (stearic acid),

C18:1ω9 (oleic acid), and C16:1ω7 (palmitoleic acid).

Table 1. Fatty acid composition of muscle lipids of *Parapenaeus longirostris* (Values are % of total fatty acid expressed as mean± standard deviation)

Fatty acids	Autumn	Spring
C12:0	0.89 ± 0.00*	0.02 ± 0.00
C13:0	0.17 ± 0.00	0.01 ± 0.00
C14:0	2.00 ± 0.03	1.09 ± 0.04
C15:0	0.97 ± 0.03	1.07 ± 0.03
C16:0	25.97 ± 0.09	19.67 ± 0.39
C17:0	1.55 ± 0.01	2.19 ± 0.06
C18:0	8.57 ± 0.06	9.15 ± 0.13
C19:0	0.23 ± 0.02	0.36 ± 0.02
C20:0	0.27 ± 0.03	0.23 ± 0.01
C21:0	0.26 ± 0.01	0.30 ± 0.02
C22:0	0.25 ± 0.04	0.33 ± 0.09
C24:0	0.65 ± 0.01	0.72 ± 0.01
SFA	**41.75 ± 0.06**	**35.10 ± 0.61**
C14:1 ω5	0.19 ± 0.01	0.18 ± 0.00
C15:1 ω5	0.36 ± 0.01	0.40 ± 0.02
C16:1 ω7	12.75 ± 0.12	3.68 ± 0.79
C17:1 ω8	0.51 ± 0.02	1.35 ± 0.06
C18:1 ω9	19.48 ± 0.10	15.10 ± 0.34
C18:1 ω7	5.72 ± 0.06	4.88 ± 0.22
C20:1 ω9	0.71 ± 0.09	1.0 ± 0.01
C22:1	0.19 ± 0.03	0.09 ± 0.01
MUFA	**39.88 ± 0.44**	**26.67 ± 1.36**
C18:2 ω6	0.85 ± 0.04	2.41 ± 0.08
C18:3 ω6	0.32 ± 0.04	0.35 ± 0.06
C18.3 ω3	0.21 ± 0.01	0.42 ± 0.01
C20:2 ω6	0.65 ± 0.04	1.54 ± 0.08
C20:3 ω6	0.08 ± 0.03	0.08 ± 0.01
C20:3 ω3	0.03± 0.01	0.13 ± 0.01
C20:4 ω6	2.35 ± 0.03	4.71 ± 0.05
C20:5 ω3	7.46 ± 0.10	12.46 ± 1.38
C22:2 ω6	0.13 ± 0.01	0.18 ± 0.01
C22:5 ω6	0.27 ± 0.00	0.45 ± 0.03
C22:5 ω3	0.60 ± 0.02	1.47 ± 0.01
C22:6 ω3	5.34 ± 0.32	13.97 ± 0.56
PUFA	**18.28 ± 0.64**	**38.14 ± 1.95**
ω3	13.49 ± 1.24	28.01 ± 1.94
ω6	4.58 ± 2.44	9.71 ± 0.03
ω3/ω6	2.95 ± 4.86	2.88 ± 0.19

*Average of three lots analysed.

Palmitic acid from saturated fatty acids is the highest percentage in the autumn (25.97%). Likewise, palmitic acid was also found to be the highest fatty acid in the spring season (19.67%). The percentage of palmitic acid in the autumn is higher than the spring. According to Yerlikaya et al. (2013), the main SFAs in shrimp species were palmitic acid and stearic acid. Whereas palmitic acid content of shallow water shrimp species ranged between 14.27–17.99%, it was 19.03–21.16% in deep sea species. The highest value for C16:0 (21.16 ± 0.39 %) was determined in *P. longirostris*. Saglik and Imre (1997) determined 23.1% C16:0 and 6.2% C18:0 for *P. longirostris*. These values are similar to the results of this study.

Oleic acid was identified as a primary monounsaturated fatty acid (MUFA) in autumn. This fatty acid in muscle tissue of shrimp was found to be 19.48%. In another study of fatty acids in shrimp; the dominant saturated fatty acid (SFA) is palmitic acid. The most common MUFA was C18:1ω9. EPA and DHA are predominantly PUFAs, respectively. These four fatty acids represented 55-70% of the total fatty acid content of the three species analyzed. PUFA fraction (42.1-48.4%) followed by MUFA (26.3-34.6%) and SFA (22.9-27.4%) (Rosa and Nunes, 2003). In our study, PUFA in the spring (38.14%) was found to be higher than SFA and MUFA. In addition to, our present work, it has been found that SFAs, MUFAs and PUFAs have ranged from 41.75% to 35.10%, from 39.88% to 26.67% and from

18.28% to 38.14% for shrimp, respectively. In this study, which detects fatty acids, there are enough fatty acids that are important for health. Palmitoleic acid (12.75%) was the second most abundant MUFA for autumn in the present study. Similarly Sağlık and Imre (1997) found that C16:1 ω7 was the second major MUFA in muscle tissue of shrimp.

In other study (Soultani et al., 2016) DHA and EPA were predominant PUFAs in the lipid of both shrimp muscle and cephalothorax followed by arachidonic acid (C20:4 ω6 AA). AA was found to be the third highest PUFA in samples collected in spring (4.71%) in present study. Variations in the fatty acid composition may be related to changes in the fish's eating habits (Norrobin et al.,1990). The high level of DHA (13.97%) increases the PUFA content in shrimp in spring. In spring, a high rate C20:5 (12.46%) raises in the PUFA amount in shrimp. DHA and EPA have extremely useful properties for the prevention of human coronary artery disease (Leaf and Weber, 1988). The findings of other researchers represent the highest values of PUFA for DHA and EPA; however, the results varied according to shrimp species. Like other marine derived organisms, shrimp species are good sources of PUFA. *P. longirostris* is a food source that can be renewed according to these results. According to Ayas et al. (2013), fatty acid composition of crustaceans is associated with external factors such as life cycle and temperature, water salinity, feed and season. In our study, PUFAs levels were found to be 38.14% in spring. DHA is the highest level in PUFAs (13.97%). The ω3/ω6 ratio is a good index to compare the relative nutritional value of fish oils (Pigott and Tucker, 1990). An increase in the ratio of ω3/ω6 fatty acids in human diets is necessary in the diet to help prevent coronary heart disease by reducing plasma lipids and reducing cancer risk (Kinsella et al., 1990). Our study has revealed that *P. longirostris* is a species having a high nutritional value for human consumption due to its high ω3/ω6. These ratios are 2.95 and 2.88(%) in autumn and spring respectively. This study has shown that *P. longirostris* may be a valuable nutrient in terms of PUFA especially in spring and ω3/ω6 ratios for human consumption.

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