

Fatty acid composition and cholesterol content of mussel and shrimp consumed in Turkey

Türkiye'de tüketilen midye ve karides türünün yağ asidi kompozisyonu ve kolesterol içeriği

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Abstract

Seafoods contain many polyunsaturated fatty acids. Two of them, eicosapentaenoic (EPA, 20:5 n-3) and docosahexaenoic (DHA, 22:6 n-3) have beneficial effects reducing the risk of cardiovascular diseases. Fatty acid compositions and cholesterol contents of mussel and shrimp widely consumed in Turkey were examined by GLC. The mussel was found to have the highest EPA (0.124 g/100 g), DHA (0.169 g/100 g) and the lowest cholesterol (20.2 mg/100 g) contents. The shrimp species had higher cholesterol (109.3 and 109.7 mg/100 g) and lower EPA (0.032 and 0.036 g/100 g), DHA (0.016 and 0.019 g/100 g) contents than mussel. Therefore the mussel consumption would be suitable for a preventive diet.

Key words : Fatty acids, cholesterol, mussel, shrimp

Introduction

Polyunsaturated omega-3 (n-3) fatty acids; eicosapentaenoic acid (EPA, 20:5 n-3) and docosahexaenoic acid (DHA, 22:6 n-3) show preventive effects against cancer, diabetes, cardiovascular and immune diseases (Vitale and Broitman, 1981; Logniskar *et al.*, 1983; Mehta *et al.*, 1987; von Schacky, 1987; Leaf and Weber, 1988; Clubb *et al.*, 1989; Fisher *et al.*, 1989; Willich and Winther, 1995). These fatty acids occur mostly in high amounts in seafoods. Therefore to determine fatty acid compositions, total lipid and cholesterol contents of seafoods will be beneficial for recommendation of a

preventive diet (Krzynowek *et al.*, 1982; Gordon, 1982; Fogerty *et al.*, 1986; Vlieg and Body, 1988; Body and Vlieg, 1989; Zlatanos and Sagredos, 1993).

In this work a systematic examination was made on fatty acid compositions and cholesterol contents of a mussel (*Mytilus galloprovincialis*) and two shrimp (*Parapenaeus longirostris* and *Penaeus semisulcatus*) species widely consumed in Turkey.

Materials

Fresh seafood samples were purchased from central fish market-Istanbul (Table 1).

Used chemical substances and organic solvents were of analytical grade.

Methods

1. Lipid extraction

Whole mussel tissue or skinned shrimp were homogenized. 5 g of homogenized sample was mixed well with 10 g cleaned sea-sand and 20 g anhydrous sodium sulfate and then percolated overnight with a mixture of hexane-acetone (2:1) in a glass column with a teflon stopcock. After distillation solvent of the percolate (600 ml) under vacuum, the remaining fat residue was held to constant weight in a desiccator and then weighed.

2. Fatty acids and cholesterol analysis

Total lipids were saponified for 3 h at 100°C in alcoholic KOH (%10). From the mixture, the non-saponifiable material first directly and then, after acidification with H₂SO₄, the fatty acids were extracted with diethyl ether. After distillation of diethyl ether, the residues were weighed to calculate the amounts of fatty acids.

The free fatty acids were converted into their methyl esters (FAME) with diazometane and applied to GLC. The standard fatty acid methyl esters (Applied Science and Sigma) were used for the identification of peaks. Cholesterol analysis of the non-saponifiable part of total lipids were carried

out according to gas chromatography of sterols method with little modifications (AOAC, 1990). 5 α -cholestane (Sigma) was used as internal standard.

Gas liquid chromatography:

Instrument: Varian 1400 gas chromatograph

Data handling: Waters 730 data module

Column:

For FAME: 2mx2mm. ss. 10% Silar-10C on 100-120 mesh Gas-Chrom Q II

For cholesterol: 2mx2mm, glass, 3% OV-17 on 100-120 mesh Gas-Chrom Q

Column temperature:

For FAME: Programmed: 175°C for 12 min, rising to 215°C at 6°C/min, 215°C for 35-45 min

For cholesterol: Isothermal: 270°C

Detector: FID: For FAME: 260°C. For cholesterol: 300°C

Injector: For FAME: 250°C. For cholesterol: 300°C

Carrier gas: N₂

Results and Discussion

The amounts of total lipid in examined seafood species are shown in Table 2. Shrimp-I (*Parapenaeus longirostris*) and shrimp-II (*Penaeus semisulcatus*) have 0.93% and 0.58% total lipid, respectively. Mussel (*Mytilus galloprovincialis*) is the most fatty (2.70%) among them. Saponified parts of lipids are 48.4% in mussel, 31.5% in shrimp-I and 56.3% in shrimp-II.

GS chromatograms of the examined samples are shown in Fig. 1-3.

Fatty acid compositions of both shrimp species are similar (Table 3). 16:0, 18:1 n-9 and 20:5 n-3 are dominated fatty acids. Only 18:1 n-9 and 18:0 percentages are different from each other. While 18:1 n-9 is twice higher in shrimp-I, 18:0 is twice lower. Cholesterol contents of both shrimp species are the same and very high (Table 2) compared to the mussel's. Hence the shrimps are not convenient for a preventive diet.

There is not a difference between our findings with the results of Christie *et al.*, (1988) on dominant fatty acids as 16:0, 16:1 n-7, 20:5 n-3 and 22:6 n-3. The percentages of these fatty acids are 26.2%, 9.1%, 9.5% and 12.9% in our examination, whereas 18.11%, 23.05%, 14.11% and 5.33% in Christie *et al.*, (1988). Total n-3 fatty acids contents are similar in both.

Besides palmitic acid, EPA and DHA are the dominated fatty acids of mussel, their contents are higher than in shrimps and many other fish species examined previously (Sağlık, 1994). On the other hand the cholesterol content of mussel has been found very low. According to these results, fried mussel seems to be suitable for a preventive diet.

Seafood	Fishing month
Mussel (<i>Mytilus galloprovincialis</i>)	September
Shrimp-I (<i>Parapenaeus longirostris</i>)	September
Shrimp-II (<i>Penaeus semisulcatus</i>)	October

Table 1. Examined seafoods and fishing months

Seafood	Total lipid (g/100 g)	EPA 20:5 n-3 (g/100 g)	DHA 22:6 n-3 (g/100 g)	Total n-3 (g/100 g)	Cholesterol (mg/100 g)
Mussel	2.70	0.124	0.169	0.369	20.2
Shrimp-I	0.93	0.032	0.016	0.050	109.3
Shrimp-II	0.58	0.036	0.019	0.061	109.7

Table 2. Total lipid, EPA, DHA, total n-3 fatty acid and cholesterol amounts of examined seafoods

Table 3. Fatty acid composition of examined seafoods
(Percentages in total fatty acids)

Fatty acids	Mussel	Shrimp-I	Shrimp-II
12:0	---	0.8	1.0
14:0	5.5	6.1	10.9
15:0	0.9	0.7	1.6
16:0	26.2	23.1	19.1
16:1 n-7	9.1	12.1	6.3
17:0	---	---	2.3
18:0	5.3	6.2	11.2
18:1 n-9	6.5	22.2	12.7
18:2 n-6	2.8	2.9	3.1
18:3 n-3	2.5	---	---
18:4 n-3	2.6	0.6	0.6
20:0	---	---	0.6
20:1 n-9	7.5	1.7	1.4
20:3 n-3	0.2	---	0.3
20:4 n-6	1.4	1.8	6.7
20:5 n-3	9.5	11.1	11.0
22:1 n-11	---	0.6	0.3
22:4 n-6	---	2.5	0.5
22:5 n-3	0.5	---	0.6
22:6 n-3	12.9	5.6	5.9
24:1 n-9	---	0.7	1.1
Other	6.6	1.3	2.8

--- : Non-detected

Other: Total percentage of unidentified peaks

FATTY ACIDS

12:0	Lauric acid
14:0	Myristic acid
15:0	Pentadecanoic acid
16:0	Palmitic acid
16:1 n-7	Palmitoleic acid
17:0	Margaric acid
18:0	Stearic acid
18:1 n-9	Oleic acid
18:2 n-6	Linoleic acid
18:3 n-3	Linolenic acid
18:4 n-3	Octadecatetraenoic acid
20:0	Arachidic acid
20:1 n-9	Eicosenoic acid
20:3 n-3	Eicosatrienoic acid
20:4 n-6	Arachidonic acid
20:5 n-3	Eicosapentaenoic acid
22:1 n-11	Docosenoic acid
22:4 n-6	Docosatetraenoic acid
22:5 n-3	Docosapentaenoic acid
22:6 n-3	Docosahexaenoic acid
24:1 n-9	Nervonic acid

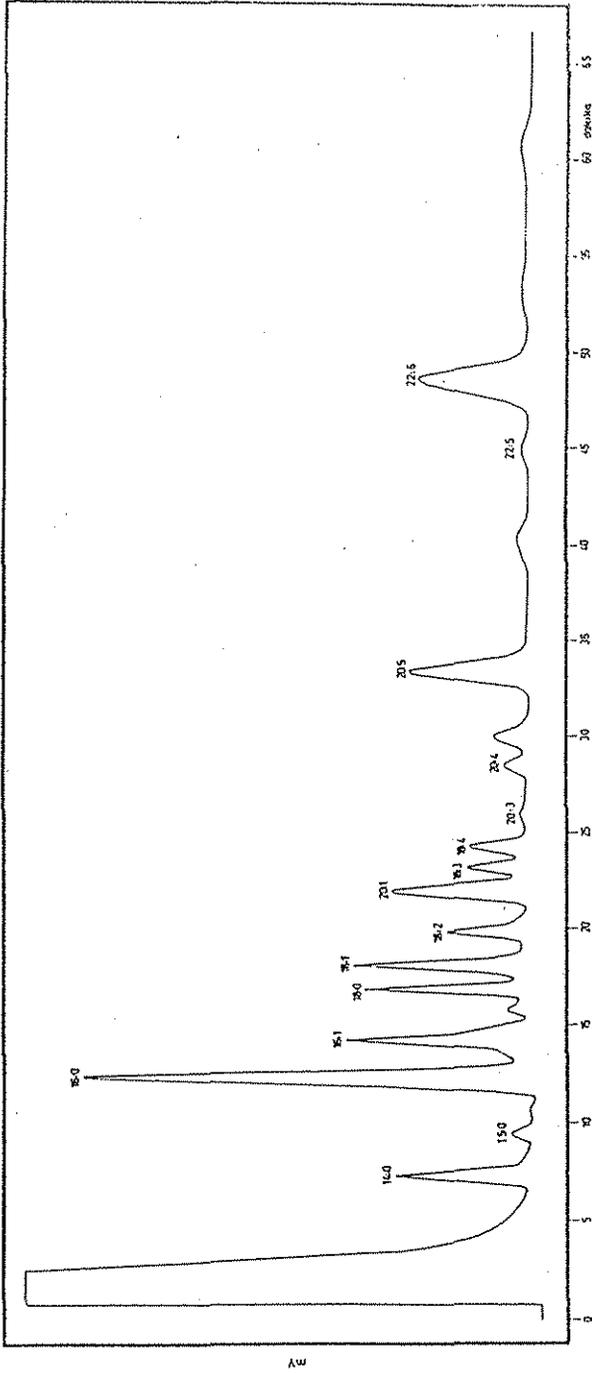


Figure 1. Gas chromatogram of mussel fatty acid methyl esters

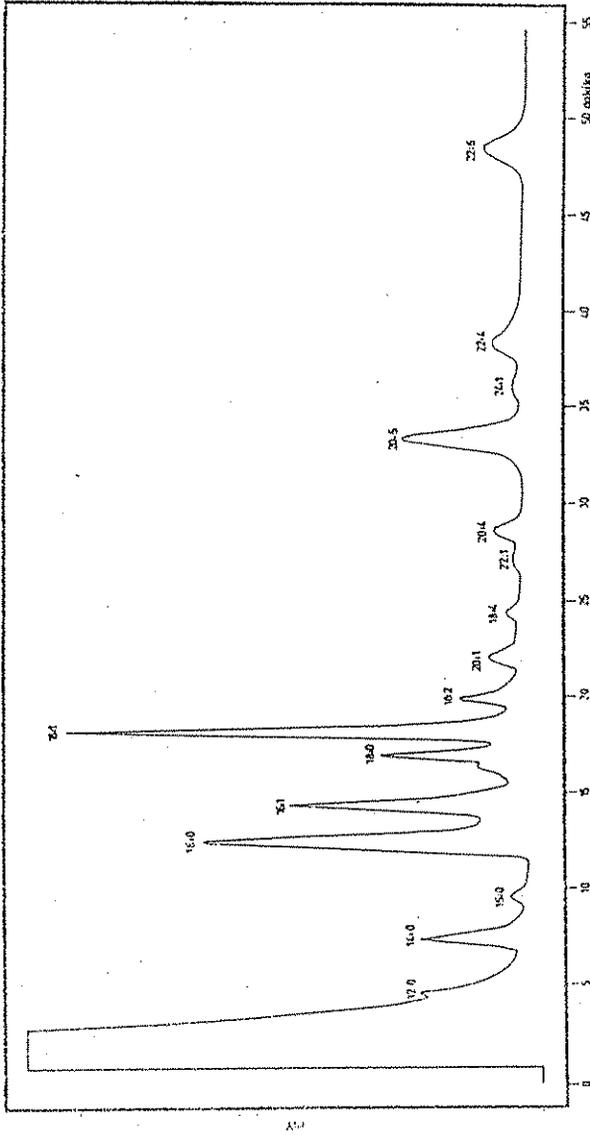


Figure 2. Gas chromatogram of shrimp-I fatty acid methyl esters

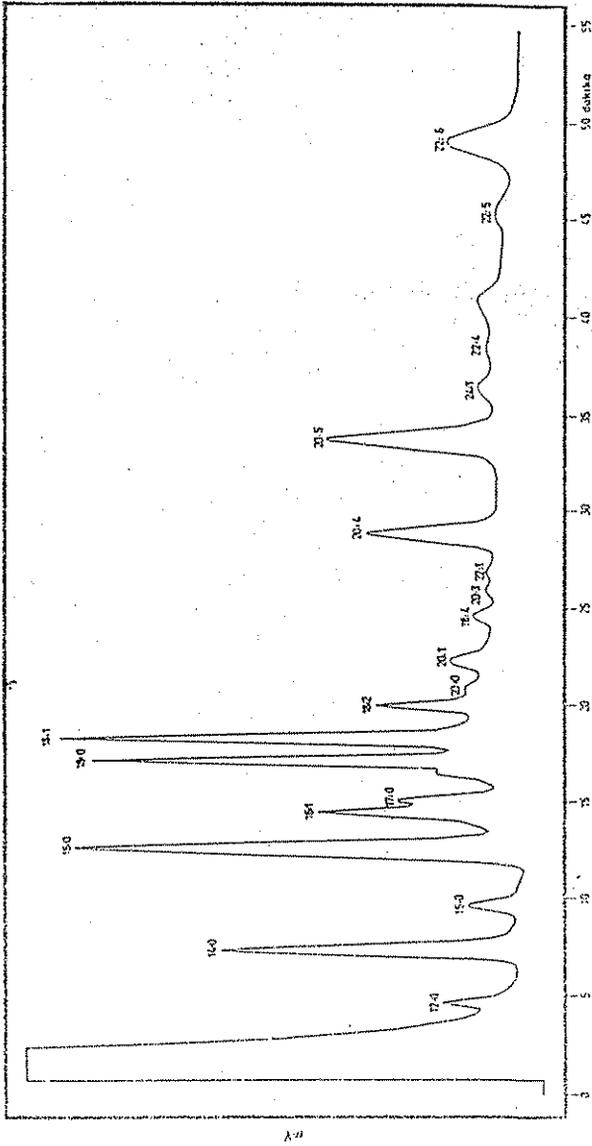


Figure 3. Gas chromatogram of shrimp-II fatty acid methyl esters

Özet

Deniz ürünleri birçok polidoymamış yağ asidi içerir. Bu asitlerden ikisi; eikosapentaenoik (EPA, 20:5 n-3) ve dokosaheksaenoik (DHA, 22:6 n-3) asit kalp-damar hastalıkları riskini azaltan yararlı etkilere sahiptir. Türkiye'de çok fazla tüketilen bir midye ve iki karides türünün yağ asidi kompozisyonları ve kolesterol içerikleri GLC ile incelendi. Midyenin en yüksek EPA (0.124 g/100 g), DHA (0.169 g/100 g) ve en düşük kolesterol (20.2 mg/100 g) içeriğine sahip olduğu bulundu. Karides türleri midyeden daha yüksek kolesterol (109.3 and 109.7 mg/100 g) ve daha düşük EPA (0.032 and 0.036 g/100 g), DHA (0.016 and 0.019 g/100 g) içeriğine sahiptir. Bu bakımdan midye koruyucu bir diyet için uygun görünmektedir.

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