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Merluccius merluccius L.'un Total Yağ Asidi Kompozisyonunda Mevsimsel Değişiklikler

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Öz: Bu çalışmada sonbahar ve ilkbaharda Marmara Denizi'nden alınan *Merluccius merluccius* L. total yağ asit kompozisyonu gaz kromatografik yöntemle araştırılmıştır. Palmitik asit (C16:0), stearik asit (C18:0), oleik asit (C18:1) ve dokosaheksaenoik asit (C22:6) majör yağ asitleri olarak bulunmuştur. Her iki mevsimde balık kaslarında doymuş yağ asitleri (SFA), doymamış (MUFA) ve aşırı doymamış yağ asitlerinden (PUFA) daha yüksek bulunmuştur. Tavuk balığında, C20:5-ω3 ve C22:6 içeriği toplam yağ asidinde sırasıyla %5.76'dan (sonbahar) %7.33'e (ilkbahar) ve %14.84'den (sonbahar), %25.97'ye (ilkbahar) değişmektedir. Balık dokularındaki yağ asidi bileşimi diyet, boyut, yaş, üreme periyodu, tuzluluk, sıcaklık, mevsim ve coğrafi konumdan etkilenmektedir. *M. merluccius* yağ asidi bakımından insan tüketimi için değerli bir besin olabilir.

Anahtar kelimeler: Balık, yağ asidi bileşimi.

Seasonal changes in the total fatty acid composition of *Merluccius merluccius* L.

Abstract: In this study, total fatty acid composition of *Merluccius merluccius* from Marmara Sea, in autumn and spring was investigated by gas chromatographic method. Palmitic acid (C16:0), stearic acid (C18:0), oleic acid (C18:1) and docosahexaenoic acid (C22:6), were identified as the major fatty acid constituents. Saturated fatty acids (SFAs) were found to be higher than polyunsaturated fatty acids (PUFAs) and monounsaturated fatty acids (MUFAs) in the fish muscle in both seasons. The contents of C20:5-ω3 and C22:6 in total fatty acid in the European hake ranged from 5.76% (autumn) to 7.33 % (spring) and from 14.84% (autumn) to 25.97% (spring), respectively. Total fatty acid compositions of fish tissues can be affected by diet, size, age, reproductive cycle, salinity, temperature, season and geographical location. *M. merluccius* may be a valuable food for human consumption in terms of fatty acids.

Keywords: Fish, fatty acid composition.

1. Introduction

Fish preferentially utilise lipids rather than carbohydrates as an energy source and accumulate considerable amounts of lipids in their muscle, liver or adipose tissue (Sheridan, 1988). The ω3 and ω6 PUFAs are considered essential to the growth and development of children and they are precursors of composite hormones known as eicosanoids, involved in several metabolic processes of great importance for the human body, mainly related to cardiovascular activity (Eder, 1995; Inhamuns and Franco, 2008). EPA is the most important essential fatty acid of n3 series in the human diet because it is the precursor of the 3-series eicosanoids (Chen et al., 1995). Major depression is associated with lowered n-3 PUFA levels (Hibbeln, 1998; Maes et al., 1999).

European hake *Merluccius merluccius* is an important economic seafood in the Marmara Sea. *M. merluccius* were caught seasonally at the Marmara Sea. The main objective of this study was to measure the muscle fatty acid composition and ω3/ω6 fatty acids ratio of European hake.

2. Materials and Methods

M. merluccius used in this study were obtained from Marmara Sea, Turkey. The samples were collected in the spring and autumn of 2015. After being caught, they were transported on ice to the laboratories, filleted and frozen. At the beginning of each analysis, the samples were allowed to equilibrate to room temperature, ground and homogenized in chloroform/methanol mixture (2:1, v/v).

The total lipids obtained were saponified by refluxing with methanol (50%) containing 5% sodium hydroxide for 1 h. Samples of fillets extracted by the method described by Folch et al., (1957) were transesterified with BF_3 methanol (Moss et al., 1974). The saponifiable lipids were converted to their methyl esters by using the standard boron tri-fluoride-methanol (BF3) method. Fatty acids methyl esters were analyzed on a HP Agilent 6890N model gas chromatograph, equipped with a flame ionization detector and fitted with HP-88 capillary column (100 m, 0.25 mm i.d. and 0.20 µm). Injector and detector temperatures were 240 and 250°C respectively. Column temperature program was 160^0C for 2 min then increasing at 4°C /min up to 185°C then increasing at 1°C /min up to 200°C where it was maintained for 46.75 min. Carrier gas was helium (1 ml/min) and split ratio was 10:1. Identification of normal fatty acids was carried out by comparing sample FAME peak relative retention times with those obtained for Alltech standards. Results were expressed as FID response area relative percentages. Each reported result is the average of three GC analyses. The results are represented as means±SD.

3. Results and discussion

Total fatty acid composition of *Merluccius merluccius* is presented in Table 1. We found 32 fatty acids in muscle lipids of European hake. The highest fatty acids in the fish were 22:6 ω3, 16:0, 18:0, 18:1 ω9 and 20:5 ω3 in both season (spring-autumn).

Palmitic acid was found to be the primary saturated fatty acid, 27.89% (spring) and 32.56% (autumn) for *M. merluccius.* Similar results for other fish species have also been reported in the literature (Celik et al., 2005; Güler et al., 2008; Rahman et al., 1995). Stearic acid C18:0 was the second highest SFA in this study. For all seasons, the predominant fatty acids were found to be C16:0 and C18:0 in SFA; C16:1 n-7 and 18:1 n-9c in MUFA (Küçükgülmez et al., 2008). Many factors, such as diet salinity, temperature, species,

sex, size and geographic location, influence the fatty acid profile of fish (Martino and Cruz 2004).

Oleic acid C18:1 ω9 was identified as a primary monounsaturated fatty acid (MUFA) in the hake. This fatty acid in muscle tissue of hake was found to be 12.58-12.88%. Similarly Roncarati et al., (2012) found that C18:1 ω9 was the major MUFA in muscle tissue of hake, *M. merluccius* living in different seas. Palmitoleic acid C16:1 ω7 (3.64-6.77%) was the second most abundant MUFA in the present study. C14:1 ω5 and C22:1 ω9 were found to be low amounts in the MUFA fractions of the muscle investigated. MUFA contents were lower than the SFAs and PUFAs. Variations in the fatty acid composition might be related to the changes in nutritional habits of the fish (Norrobin et al., 1990). In other study, in raw hake fillets, SFA levels were found to be 45.88% of total fatty acids (Telahigue et al., 2013).

The ω3/ω6 ratio is a good index for comparing relative nutritional value of fish oils (Pigott and Tucker, 1990). An increase in the human dietary ω3/ω6 fatty acid ratio is essential in the diet to help prevent coronary heart disease by reducing plasma lipids and to reduce cancer risk (Kinsella et al., 1990). Our study has revealed that *M. merluccius* is a species having a high nutritional value for human consumption due to its high ω3/ω6.

The present data showed that DHA (22:6 ω3) was the predominant fatty acid in muscle lipids of hake. The total PUFAs, especially EPA and DHA, in the fatty acid compositions of hake was found to be higher in the winter season (Küçükgülmez et al., 2008). In this study, DHA levels in spring was higher than autumn. The contents of 20:5 ω-3 and 22:6 in the European hake ranged from 5.76% (autumn) to 7.33% (spring) of total fatty acid and from 14.84% (autumn) to 25.97% (spring), respectively. Sargent (1996) reported that ω3 PUFA, principally DHA, has a role in maintaining the structure and functional integrity of fish cells. The content of PUFA, such as EPA and DHA, in fish muscle are dependent on diet (Sargent, 1997). Freshwater fish normally contain n-6 PUFAs, whereas marine fish are rich in n-3 fatty acids, especially DHA and EPA (Wang et al., 1990). In our study, PUFAs levels were found to be 38.15-25.74% in spring and autumn respectively. DHA is the highest level in PUFAs (25.97% in spring). EPA levels was quite important. It was found to be the second highest fatty acid in PUFAs (7.33-5.76%). This study has shown that European hake is a desirable item in the human diet in the Marmara Sea of Turkey when the levels of EPA, DHA and ω3/ ω6 ratio are considered. The fish analysed in this study was found to be good sources of ω3 fatty acids.

Table 1. Fatty acid composition of fillets of *Merluccius merluccius* (%)

Fatty acids	Means±S.D. (Spring)	Means±S.D. (Autumn)
C 12:0	0.02±0.01	0.06±0.01
C 13:0	0.02±0.01	0.01±0.00
C 14:0	2.46±0.01	3.37±0.01
C 15:0	0.52±0.01	0.76±0.01
C 16:0	27.89±0.14	32.56±0.16
C 17:0	0.12±0.08	0.34±0.06
C 18:0	9.06±0.03	10.37±0.13
C 19:0	0.14±0.01	0.19±0.01
C 20:0	0,13±0.01	0.20±0.01
C 21:0	0,35±0.01	0.29±0.04
C 22:0	0.05±0.01	0.03±0.01
C 24:0	0.33±0.04	0.35±0.04
SFA	41.05±0.17	48.49±0.01
C 14:1 ω5	0.07±0.01	0.12±0.01
C 15:1 ω5	0.07±0.01	0.12±0.01
C 16:1 ω7	3.64±0.02	6.77±0.01
C 17:1 ω8	0.20±0.02	0.27±0.02
C 18:1 ω9	12.58±0.01	12.88±0.00
C 18:1 n7	3.34±0.04	4.32± 0.01
C 20:1 ω9	0.82±0.09	1.18±0.13
C 22:1 ω9	0.02±0.01	0.03±0.02
MUFA	20.71±0.15	25.67±0.14
C 18:2 ω6	0.99±0.05	1.04±0.01
C 18:3 ω6	0.25±0.01	0.46±0.02
C 18:3 ω3	0.36±0.03	0.29±0.01
C 20:2 ω6	0.17±0.06	0.14±0.04
C 20:3 ω6	0.01±0.00	0.01±0.00
C 20:3 ω3	0.06±0.00	0.13±0.02
C 20:4 ω6	1.30±0.01	1.37±0.02
C 20:5 ω3	7.33±0.02	5.76±0.12
C 22:2 ω6	0.07±0.01	0.12±0.01
C 22:5 ω6	0.61±0.01	0.45±0.03
C 22:5 ω3	1.06±0.05	1.17±0.05
C 22:6 ω3	25.97±0.16	14.84±0.18
PUFA	38.15±0.03	25.74±0.11
ω3	34.41±0.09	21.88±0.13
ω6	3.39±0.09	3.58±0.01
ω3/ω6	10,17±0.30	6.12±0.05

[a]Average of three lots analysed.
[b]Values reported are means±S.D.

References

Celik M, Diler A, Kücükgülmez A (2005). A comparison of the proximate compositions and fatty acid profiles of zander (*Sander lucioperca*) from two different regions and climatic conditions. *Food Chemistry* 92: 637-641.

Chen IC, Chapman FA, Wei C-I, Porteir KM, O'Keefe SF (1995). Differentiation of cultured and wild sturgeon (*Acipencer axyrinchus desotoi*) based on fatty acid composition. *Journal of Food Science* 60(3): 631-635.

Eder K (1995). Gas chromatographic analysis of fatty acid methyl esters. *Journal of Chromatography B* 671: 113-131.

Folch J, Lees M, Sloane Stanley GH (1957). A simple method for the isolation and purification of total lipids from animal tissues. *Journal of Biological Chemistry* 226: 497-509.

Güler GO, Kıztanır B, Aktümsek A, Citil OB, Özparlak H (2008). Determination of the seasonal changes on total fatty acid composition and ω3/ ω6 ratios of carp (*Cyprinus carpio* L.) muscle lipids in Beysehir Lake (Turkey). *Food Chemistry* 108: 689-694.

Hibbeln JR (1998). Fish consumption and major depression. *Lancet* 351: 1213.

Inhamuns AJ, Franco MRB (2008). EPA and DHA quantification in two species of freshwater fish from Central Amazonia. *Food Chemistry* 107: 587-591.

Kinsella JE, Lokesh B, Stone RA (1990). Dietary n-3 polyunsaturated fatty acids and amelioration of cardiovascular diease:possible mechanisms. *American Journal of Clinical Nutrition* 52(1): 1-28.

Küçükgülmez A, Çelik M, Ersoy B, Yanar Y, Sangün L (2008). Seasonal variations in proximate and fatty acid compositions of two commercially important fish, hake (*Merluccius merluccius*) and lizardfish (*Saurida undosquamis*), from the Northeastern Mediterranean Sea. *Journal of Muscle Foods* 352-361.

Maes M, Christophe AB, Delanghe J, Altamura C, Neels H, Meltzer HY (1999). Lowered omega3 polyunsaturated fatty acids in serum phospholipids and cholesteryl esters of depressed patients. *Psychiatr Res* 85: 275-291.

Martino RC, Cruz GM (2004). Proximate composition and fatty acid content of Mangrove oyster *Crassostrea rhizophorae* along the year seasons. *Braz Arch Biol Technology* 47: 955-960.

Moss CW, Lambert MA, Merwin, WH (1974). Comparison of rapid methods for analysis of bacterial fatty acids. *Applied Microbiology* 28: 80-85.

Norrobin MF, Olsen RE, Tande KS (1990). Seasonal variation in lipid class and fatty acid composition of two small copepods in Balsfjorden, Northern Norway. *Marine Biology* 105: 205-211.

Pigott GM, Tucker BW (1990). Effects of technology on nutrition. New York: Marcel Dekker.

Rahman SA, Huah TS, Hassan O, Daud NM (1995). Fatty acid composition of some Malaysian freswater fish. *Food Chemistry* 54(1): 45-49.

Roncarati A, Brambilla G, Meluzzi A, Iamiceli AL, Fanelli R, Moret R, Ubaldi A, Miniero R, Sirri F, Melotti P, di Domenico A (2012). Fatty acids profile and proximate composition of fillets from *Engraulis encrasicholus*, *Mullus barbatus*, *Merluccius merluccius* and *Sarda sarda* caught in Tyrrhenian, Adriatic and Ionian seas. *Journal of Applied Ichthyology* 28: 545-552.

Sargent JR (1996). Origins and functions of egg lipid. In N.R. Bromage and R.J. Roberts (Eds.), Broodstock management and egg and larval quality (pp. 353-372). Oxford: Blackwell.

Sargent JR (1997). Fish oils and human diet. *British Journal of Nutrition* 78: 5-13.

Sheridan MA (1988). Lipid dynamics in fish: Aspects of absorption, transportation, deposition and mobilization. *Comparative Biochemistry and Physiology* 90: 679-690.

Telahigue K, Hajji T, Rabeh I, El Cafsi M (2013). The changes of fatty acid composition in sun dried, oven dried and frozen hake (*Merluccius merluccius*) and sardinella (*Sardinella aurita*). *African Journal of Biochemistry Research* 7(8): 158-164.

Wang YJ, Miller LA, Peren M, Addis PB (1990). Omega-3 fatty acids in lake superior fish. *Journal of Food Science* 55(1): 71-73.