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Comparative Study of Fatty Acid Composition of Golden Mullet Fillet and Roe Oil (*Liza aurata* Risso, 1810)

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Abstract: In the present study, the fatty acid compositions of golden mullet fillet and roe oil were determined. Palmitic acid (C16:0) was the dominant saturated fatty acid in golden mullet fillet and roe oil with 14.39 and 6.45%, respectively. The major unsaturated fatty acids of golden mullet fillet oil, were detected as palmitoleic acid (C16:1, 17.32%), oleic acid (C18:1, 17.09%) and α-linolenic acid (C18:3, 8.72%). The most abundant unsaturated fatty acids of roe oil were determined as palmitoleic (C16:1, 21.33%), oleic (C18:1, 19.51%), α-linolenic (C18:3, 7.34%), Linoleic acid (C18:2, 6.77%) and docasahexaenoic acid (C22:6, 6.35%). The total unsaturated fatty acids of roe oil (68.59%) were higher than that of golden mullet fillet oil (56.37%). Amounts of ω-3 unsaturated fatty acids in the roe and fillet oil were 19.52 and 14.51%, respectively. Furthermore, the total amounts of eicosapentaenoic acid (C20:5) and docasahexaenoic acid (C22: 6) of roe oil were nearly 2 times higher than those of the golden mullet fillet. Further, the lipid percentage and the amounts of C14:0, C16:0, C18:2, C18:3, C20:5 and C22:6 fatty acids differed significantly ($p<0.05$) between fillet and roe oil. In addition, significant differences were observed among ω-3 and ω-6 series between both fillet and roe oil.

Key words: Fatty acid composition, golden mullet *Liza aurata*, omega-3, fillet, roe

INTRODUCTION

Golden mullet (*Liza aurata*) is one of the mullet species which is a coastal migratory fish and important for food and roe. It is a principal economic fish of Caspian Sea and consumers prefer it for nutrition. Especially mullets caught from the Caspian Sea have very delicious taste. Golden mullet usually live in sea and is very durable to ecological factors (as salinity, oxygen, etc.) except cold water.

During the spring and summer, golden mullet migrates to the coastal waters containing abundant food, whereas it migrates to deep waters in winter (Khoroshko, 1981). Its primary foods are zeoplanktons, mollusks larvae, detritus, algae, prephyton and some small aquatics (Belyaeva *et al*., 1989) on the bed of sea. Spawning period of this fish is comparatively long; from July to September in the Southern Caspian Sea in the depths between 300 to 600 m (Khoroshko, 1981). Its fecundity is 441,000 to 742,000 eggs (Hedayatifard *et al*., 2002). In Northern of Iran, golden mullet roes are processed by dry salting method and submitted to the local consumer.

Many studies have been conducted on fish flesh and its oil. Fish flesh is composed of high quality proteins and lipids (oil) that are high in monounsaturated and polyunsaturated fatty acids (Ackman, 2005; Exler, 1987).

Fish oil generally contain 20% saturated and 80% unsaturated fatty acids (Chen *et al*., 1995; Grün *et al*., 1999; Hedayatifard and Moeini, 2003; Ludorff and Meyer, 1973; Suziki *et al*., 1986). Fatty acid components of fish oil vary with several factors such as sex, nutrition, catching season, species, maturity, temperature, etc., (Kietzmann *et al*., 1969; Hedayatifard and Moeini, 2003; Üstün *et al*., 1996). The caviar is an expensive product with a high nutritional value. Not only the roes of sturgeon

fish are the mostly consumed as caviar all over the world, but also the caviar produced from some Caspian Sea fish roes like *Liza aurata*, *Liza saliens*, *Rutilus frisii kutum* and *Rutilus rutilus caspicus* is partly popular, in Northern provinces of Iran. The fatty acid composition of the roe generally resembles that of the fish flesh oil. There are many studies on the caviar microflora (Altuğ and Bayrak, 2003; Eun *et al*., 1994), processing (Hsu and Deng, 1980; Keyvanfar, 1971; Keyvan, 2003; Sengör *et al*., 2002), proximate composition and identification of roe and caviar of fish species (Chen *et al*., 1996; Rehbein, 1985).

However, information on the fatty acids of Iranian fish species and roes are lacking. The goal of present study was to investigate the fatty acid compositions of Caspian Sea golden mullet fillet of Iranian origin and its roe oil.

MATERIALS AND METHODS

Sample Preparation

Seventy six golden mullet (*Liza aurata* Risso, 1810) samples were obtained from Southern Caspian Sea in October-December, 2006. The average length of golden mullet was 41.75 cm and the average weights of the fish and its roe were about 0.875 and 0.208 kg, respectively. Prior to analysis, the fish were gutted and head, tail, fins, viscera and skin were removed. Fish roes were used as raw caviar. All fish and roe samples were immediately transferred to the laboratory.

Lipid Extraction and Fatty Acid (FA) Analysis

The fish were filleted and homogenized. Lipids were extracted from the homogenized edible portion of flesh by the standard AOAC official method 948.15 (Helrich, 1990) using petroleum ether for 6 h in soxhelet extraction apparatus. Lipids of the roe samples were obtained using the same method after the membrane were removed from roes. The fatty acid compositions of golden mullet fillet and roe oil were determined by Capillary Gas Chromatography (CGC) technique. For the determination of fatty acid composition, the oil samples were converted to their corresponding methyl esters by BF3-methanol esterification by the AOCS official method Ce 2-66 (AOCS, 1972).

The fatty acid methyl esters were quantified by gas-liquid chromatography method using a packed column, D.E.G.S -15% and Flame-Ionization Detector (FID) in Simadzo-14 A gas chromatograph (Japan). Helium (99.999% pure) was used as the carrier gas at a flow rate of 45 mL min^{-1}. The detector and injector temperatures were chosen as 210 and 200°C, respectively. The oven temperature was set to 140°C for 5 min and heated to 190°C with a heating rate of 5°C min^{-1} and the temperature of the oven was also isothermal. Peaks were identified by comparing the retention times with those of a mixture of standard methyl esters (Sigma Chemical Co. Ltd., Poole, UK). All of the other chemicals used in the experiments were analytical grade (Merck, Darmstadt, Germany).

The lipid and fatty acid contents between fillet and roe oil were compared statistically, using t-test and Excel for windows, XP.

RESULTS AND DISCUSSION

The fatty acid compositions of golden mullet and its roe oil are shown in Table 1. In addition, the averages of its fatty acids series are shown in Table 2.

The results showed that palmitic acid (C16:0) was the dominant saturated fatty acid in all samples. The predomiuance of C16:0, C16:1 and C18:1, fatty acids in golden mullet and its roe may be attributed to the fish diets (Sengör *et al*., 2003). Fatty acid composition of fish lipid was highly dependent on a number of factors, especially fish diets (Fowler *et al*., 1994; Karakoltsidis *et al*., 1995; Ökkes *et al*., 1996; Sathivel *et al*., 2002).

Table 1: Fatty acid composition of Caspian Sea golden mullet fillet and roe oil (*Liza aurata*) (g/100 g lipid)

Fatty acids	14:00	16:00	16:01	18:00	18:1n9	18:2n6	18:3n3	20:00	20:4 n6	20:5n3	22:6n3
Fillet	5.42[a]	14.39[a]	17.32[a]	2.14[a]	17.09[a]	5.96[a]	8.72[a]	0.54[a]	1.49[a]	2.24[a]	3.55[a]
± SD	0.51	1.36	3.86	1.25	1.06	1.34	2.39	0.12	0.14	0.86	1.25
Roe	1.02[b]	6.45[b]	21.33[a]	2.01[a]	19.51[a]	6.77[b]	7.34[b]	1.50[a]	1.46[a]	5.83[b]	6.35[b]
± SD	0.23	1.54	1.18	0.08	4.71	0.93	0.41	0.09	0.79	0.68	0.92

The data are expressed as the average of three samples. Different letter(s) show significant difference at $p<0.05$ in fillet and roe oil

Table 2: Average of fatty acids series in Caspian Sea golden mullet fillet and roe oil (*Liza aurata*) (g/100 g lipid)

Fatty acid series	In fillet tissue (%)	In roe oil (%)
Saturated fatty acids	22.49	10.98
Unsaturated fatty acids	56.37	68.59
Omega-3 series (ω-3)	14.51	19.52
Omega-6 series (ω-6)	7.45	8.23
Monoenoic fatty acids	34.41	40.48
ω-3 + ω-6	21.96	27.75
EPA + DHA	5.79	12.18
Polyenoic fatty acids	21.96	27.75
High unsaturated fatty acids	7.28	13.64
Lipid	9.25	10.32

Levels of palmitoleic (C16:1) and oleic (C18:1) acids of golden mullet fillet oil were 17.32 and 17.09%, respectively. Other unsaturated fatty acid contents of golden mullet fillet oil, such as linoleic (C18:2), α-linolenic (C18:3) and docasahexaenoic (C22.6) were significantly higher than roe oil ($p<0.05$) with 5.96, 8.72 and 3.55%, respectively. Table 2 shows total lipid contents in roe and the fillet are 10.32±1.33% and 9.25±1.05%, respectively.

Major fatty acids of roe oil were C16:0, C16:1, C18:1, C18:2 C18:3, C20:5 and C22:6. These results agree with the results reported by Lu *et al*. (1979) and Şengür *et al*. (2003). They reported that the major saturated and unsaturated fatty acids of gray mullet roe were C16:0, C16:1 and C18:1, respectively. Palmitic acid contents of fillet and roe oil were 14.39 and 6.45%, respectively.

Table 2 shows fatty acids profiles contents of roe oil comparing with those of mullet fillet oil. The total monounsaturated fatty acid contents of mullet fillet and roe oil were 34.41 and 40.48%, respectively.

On the other hand, total polyunsaturated fatty acid contents of mullet fillet and roe oil were 21.96 and 27.75%, respectively.

Regarding to the lipid percentage and the amounts of C14:0, C16:0, C18:2, C18:3, C20:5 and C22:6 fatty acids, there is different significance between the fillet and roe, statistically ($p<0.05$). The difference between ω-3 and ω-6 unsaturated fatty acids in both fillet and roe oil was also significant, statistically ($p<0.05$).

Table 2 show total of saturated, unsaturated, mono and polyenoic fatty acids were 22.49, 56.37, 34.41 and 21.96% in fresh fillet, respectively. Also, the mentioned (FA) series were 10.98, 68.59, 40.48 and 27.75% in fish roe oil, respectively.

Total lipid contents in roe were higher than the fillet (Table 2). In addition, rate of ω-3 + ω-6 was 21.96 and 27.75% in fillet and roe oil, respectively. These results defines that golden mullet is one of the best sources for unsaturated oil.

In conclusion, the present study revealed the fatty acid compositions of golden mullet fillet and roe oil in spawning period of golden mullet, which have not previously been studied in Iran. C16:0, C16:1, C18:1, C18:3 and C22:6 were the most abundant fatty acids in fish and roe oil samples. It has been known there is significant seasonality in genders in amount of fatty acid in some fish like *Capoeta capoeta umbla* (Ökkes *et al*., 1996) and *Esox luxius* (Hedayatifard and Shabani, 2005). To test this hypothesis, further experiments should be carried out on golden mullet fillet oil of different seasonal periods.

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REFERENCES

Ackman, R.G., 2005. Marine Lipids and Omega-3 Fatty Acids. In: Handbook of Functional Lipids, Akon, C.C. (Ed.). Taylor and Francis Group, New York, USA., pp: 311-324.

Altuğ, G. and Y. Bayrak, 2003. Microbiological analysis of caviar from Russia and Iran. Food Microbiol., 2: 83-86.

AOCS., 1972. Official Methods and Recommended Practices of the American Oil Chemists Society. 2nd Edn., American Oil Chemists Society, Champaign.

Belyaeva, V.N., E.N. Kazanchev and V.M. Raspopov, 1989. Caspian Sea: Ichthyofauna Commercial Resources. House Nauka, Moscow.

Chen, I.C., F.A. Chapman, C.I. Wei, K.M. Portier and S.F. O'Keefe, 1995. Differentiation of cultured and wild sturgeon (*Acipencer oxyrinchus* desotoi) based on fatty acid composition. J. Food Sci., 60: 631-635.

Chen, I.C., F.A. Chapman, C.I. Wei and S.F. O'Keefe, 1996. Preliminary studies on SDS-PAGE and isoelectric focusing identification of sturgeon sources of caviar. J. Food Sci., 61: 533-539.

Eun, J.B., H.J. Chung and J.O. Hearnsberger, 1994. Chemical composition and microflora of channel catfish (*Ictalurus punctatus*) roe and swim bladder. J. Agric. Food Chem., 42: 714-717.

Exler, J., 1987. Composition of Foods: Finfish and Shellfish Products. United State Department of Agriculture, Human Nutrition Information Service, Agriculture Handbook 8-15 (Updated 1992). Washington, DC., pp: 192.

Fowler, K.P., C.G. Karahadian, N.J. Greenberg and R.M. Harrell, 1994. Composition and quality of aquacultured hybrid striped bass fillets as affectedby dietary fatty acids. J. Food Sci., 59: 70-75.

Grün, I.U., H. Shi, L.N. Fernando, A.D. Clarke, M.R. Ellersieck and D.A. Beffa, 1999. Differentiation and identification of cultured and wild crappie (*Pomoxis* sp.) based on fatty acid composition. Lebensmittel-Wissenschaft und-Technol., 32: 305-311.

Hedayatifard, M., S. Moeini, A. Keyvan and M. Yosefian, 2002. The qualitative and quantitative identification of fatty acids in muscle of golden mullet *Liza aurate*. Iran. J. Marine Sci., 1: 73-77.

Hedayatifard, M. and S. Moeini, 2003. Quantitative and qualitative identification of fatty acids in Persian sturgeon tissue *Asipenser persicus* and effect of long term freezing on them. J. Agric. Sci., 14: 123-132.

Hedayatifard and M. Shabani, 2005. The seasonal variations of fatty acid composition in muscle tissue of *Esox luxius* (Linnaeus, 1758). Research Project, Department of Fisheries, Agriculture College, Islamic Azad University, Gaemshahr Branch, pp: 50.

Helrich, K., 1990. Official Methods of Analysis. 15th Edn., Association of Official Analytical Chemists, Inc., Virginia, USA.

Hsu, W.H. and J.C. Deng, 1980. Processing of cured mullet roe. J. Food Sci., 45: 97-106.

Karakoltsidis, P.A., A. Zotos and S.M. Constantinides, 1995. Composition of the commercially important mediterranean finfish. Crustaceans and molluscs. J. Food Comp. Anal., 8: 258-273.

Keyvan, A., 2003. Sturgeon Fish of Iran. Iranian Fisheries Co., Tehran, Iran, pp: 400.

Keyvanfar, A., 1971. Caviar Technology in Iran. Bulletin No. 2, Iranian Institute of Nutrition and Food Industry, Tehran, Iran, pp: 55.

Khoroshko, A.L., 1981. Opuation abundance and structure in the long finned mullet (Gen. Liza, Muglidae) during acclimation in the Caspian Sea. Kasp Nirkh, Krasno Vodsk, pp: 62-69.

Kietzmann, U., K. Priebe, D. Rakou and K. Reichstein, 1969. Seefisch als Lebensmittel. Paul Parey Verlag, Hamburg Berlin, pp: 63-79, 99-100.

Lu, J.Y., Y.M. Ma, C. Williams and R.A. Chung, 1979. Fatty and amino acid composition of salted mullet roe. J. Food Sci., 44: 676-677.

Ludorff, W. and V. Meyer, 1973. Fische und Fischerzeugnisse. Paul Parey Verlag, Hamburg- Berlin, pp: 174-191.

Ökkes, Y., V. Konar and S. Celik, 1996. The seasonal variation of fatty acid composition in muscle tissue of *Capoeta capoeta umbla*. Truk. J. Biol., 20: 231-243.

Rehbein, H., 1985. Caviar: Proximate composition, amino acid content and identification of fish species. Z. Lebensm. Unters. Forsch., 180: 457-462.

Sathivel, S., W. Prinyawiwatkul, C.C. Grimm, M.J. King and S. Lloyd, 2002. FA composition of crude oil recoverd from catfish viscera. J. Am. Oil Chem. Soc., 79: 989-992.

Sengör, G.F., A. Cihaner, N. Erkan, Ö. Özden and C. Varluk, 2002. Caviar production from golden mullet (*Mugil cephalus*) and the determination of its chemical composition and roe yield. Turk. J. Vet. Anim. Sci., 26: 183-187.

Sengör, G.F., Ö. Özden, N. Erkan, M. Tüter and H.A. Aksoy, 2003. Fatty acid compositions of flathead grey mullet (*Mugil cephalus* L., 1758) fillet, raw and beeswaxed caviar oil. Turk. J. Fish. Aquatic Sci., 3: 92-96.

Suziki, H., K. Okazaki, S. Hayakawa, S. Wada and S. Tamura, 1986. Influence of commercial dietary fatty acids on polyunsaturated fatty acids of cultured freshwater fish and comparison with those of wild fish of same species. J. Agric. Food Chem., 34: 58-60.

Üstün, G., A. Akova and L. Dandik, 1996. Oil content and fatty acid composition of commercially important Turkish fish species. J. Am. Oil Chem. Soc., 73: 389-391.