

COMPOSITION AND SEASONAL VARIATION OF FATTY ACIDS OF *CHALCALBURNUS TARICHI* IN VAN LAKE, TURKEY

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The seasonal variations of fatty acids compositions in the muscle lipids of *Chalcalburnus tarichi* in Van Lake were determined by using gas chromatography. Fish samples in two seasons (summer and winter) were obtained from Van Lake in Van, Turkey. The results obtained were subjected to statistical analyses by employing SPSS software and $p < 0.05$ was accepted as significant value. The results showed that polyunsaturated fatty acids levels were found to be higher than those of monounsaturated fatty acids in two seasons. Palmitic and stearic acid levels in the muscles were the highest (12.84% in summer and 31.06% in winter, respectively). Linoleic acid was the major PUFA in summer. Linoleic acid (C18:2 n6), docosahexaenoic acid (C22:6 n3), eicosapentaenoic acid (C20:5 n3), and arachidonic acid (C20:4 n6) were at the highest levels among the PUFAs. The percentages of total $\omega 3$ fatty acid were higher than those of total $\omega 6$ fatty acid in the fatty acid composition of *Chalcalburnus tarichi* in winter. Especially, in *Chalcalburnus* n-3/n-6 ratios which have nutritional importance for human health were 0.93% and 0.71% in winter and summer, respectively. In conclusion, seasonal variations and species differentiations affected fatty acid composition of *Chalcalburnus tarichi* in Van Lake.

Key words: fatty acid composition; seasonal variation; *Chalcalburnus tarichi*; Van Lake

СОСТАВ И СЕЗОНСКИ ВАРИРАЊА НА МАСНИТЕ КИСЕЛИНИ КАЈ *CHALCALBURNUS TARICHI* ВО ЕЗЕРО ВАН, ТУРЦИЈА

Сезонските варирања на составот на масните киселини во мускулите на рибата *Chalcalburnus tarichi* во езерото Ван беа одредени со користење на гасна хроматографија. Примероци од риба беа земени од езерото Ван во Ван, Турција, во две сезони (лето и зима). Добиените резултати беа предмет на статистички анализи со помош на софтверот SPSS и вредноста $p < 0.05$ беше прифатена како карактеристична на рибата. Резултатите покажаа дека нивоата на полинезаситени масни киселини беа повисоки од оние на мононезаситени масни киселини во двете сезони. Нивоата на палмитинска и стеаринска киселина во мускулите беа највисоки (12.84% во лето и 31.06% во зима, соодветно). Линолната киселина беше главна полинезаситена масна киселина во лето. Лиолна киселина (C18:2 n6), докозахексаеноинска киселина (C22:6 n3), еикозапентаеноинска киселина (C20:5 n3) и арашидонска киселина (C20:4 n6) беа на највисоко ниво меѓу полинезаситените масни киселини. Процентот на вкупни $\omega 3$ масни киселини кај *Chalcalburnus tarichi* беше повисок од вкупните $\omega 6$ масни киселини во вкупните масните киселини во зима. Особено, кај *Chalcalburnus* соодносот n-3/n-6, којшто има нутриционистичко значење за човековото здравје, беше со 0.93% и 0.71% во зима и лето, соодветно. Како заклучок, сезонските варирања и различноста на видот влијаат врз составот на масните киселини кај *Chalcalburnus tarichi* во езерото Ван.

Клучни зборови: состав на масни киселини; сезонски варирања; *Chalcalburnus tarichi*; езеро Ван

1. INTRODUCTION

Health benefits from the consumption of fish or fish oil may be related to polyunsaturated fatty acids (PUFAs) especially w-3 PUFAs (Sidhu,

2003). In recent years, this characteristic of fish has been widely researched. Previous studies reported that long-term, regular fish consumption, in other words w-3 PUFA intake, reduces the risk of contracting many diseases, such as cancer, lung

diseases, Alzheimer and, in particular, cardiovascular diseases (Simopoulos, 1991; Cunquer, 2000).

The fatty acid composition of fish may vary depending on diet, temperature, season, type and geographical differences, salinity and spawning periods (Bandarra et al., 1997). Fatty acid composition differs between herbivorous, carnivorous and omnivorous fish species (Henderson and Tocher, 1987)

Van lake is the largest lake in Turkey which is between the borders of the province of Van and Bitlis province, with east-west length of 70 km, surface area of 3574 km², the maximum depth of 451 m and the total volume of 607 km³, the world's largest soda lake and the fourth largest closed water basin. (Degens et al., 1978). *Chalcalburnus tarichi* live only in Van lake in Turkey. No reports have been published about the effects of seasonal variations on the fatty acid composition of *Chalcalburnus tarichi* in Van Lake. Considering these facts, it is believed that carrying out a systematic work on lipid profile of *Chalcalburnus tarichi* in this lake is necessary. The purpose of this study was to determine both the total fatty acid composition, and n-3/n-6 ratio variation of *Chalcalburnus tarichi* living in Van Lake.

2. MATERIALS AND METHODS

2.1. Sample collection

Chalcalburnus tarichi, used in this study, were obtained from Van Lake, Turkey. In the present study, the seasons chosen for analysis were summer and winter. The samples were collected in the middle month of each season during 2010 and 2011. Three individuals were sampled in each season. Fishes were transported in ice to the laboratory and dorsal muscle tissues were taken as the samples. The samples were frozen at -26 °C until analyzed. At the beginning of the analysis, the samples were allowed to equilibrate to room temperature.

2.2. Fatty acid analysis

In the extraction of fatty acids from the tissues studied, the basic method of Folch et al., (1957) was used for this, samples were homogenized in a chloroform/methanol (2/1, v/v) mixture.

Table 1

Effect of seasons on the total fatty acid composition (%) of muscle lipids of *Chalcalburnus tarichi*^A

Fatty acids (%)	Summer	Winter
C 6:0	0.00 ± 0.00	–
C 8:0	0.01 ± 0.00 ^B	0.00 ± 0.00
C 10:0 ^C	0.02 ± 0.01	0.00 ± 0.00
C 12:0	0.12 ± 0.03	0.01 ± 0.00
C 14:0	2.45 ± 0.06	3.13 ± 0.14
C 15:0	0.28 ± 0.04	0.47 ± 0.08
C 16:0	12.84 ± 0.12	9.65 ± 0.63
C 17:0	0.86 ± 0.07	0.10 ± 0.05
C 18:0	26.13 ± 0.75	31.06 ± 1.67
C 20:0	0.74 ± 0.02	0.01 ± 0.00
C 21:0	0.36 ± 0.07	0.69 ± 0.07
C 22:0	0.47 ± 0.00	0.50 ± 0.05
C 24:0	1.12 ± 0.10	4.06 ± 0.28
Σ SFA ^D	45.36 ± 0.76	50.57 ± 1.91
C 14:1n-5	1.13 ± 0.07	1.98 ± 0.04
C 15:1n-5	0.11 ± 0.02	0.27 ± 0.01
C 16:1n-7	3.42 ± 0.13	6.76 ± 0.39
C 17:1n-8	0.63 ± 0.05	0.60 ± 0.03
C 18:1n-9	8.27 ± 0.71	8.74 ± 0.26
C 20:1n-9	2.10 ± 0.08	1.89 ± 0.08
C 22:1n-9	0.03 ± 0.02	0.07 ± 0.01
C 24:1n-9	0.00 ± 0.00	0.00 ± 0.00
Σ MUFA ^D	15.67 ± 0.64	20.29 ± 0.20
C 18:2n-6	15.09 ± 0.22	11.94 ± 0.92
C 18:3n-3	2.59 ± 0.06	1.40 ± 0.12
C 20:2n-6	0.68 ± 0.09	0.42 ± 0.04
C 20:4n-6	7.00 ± 0.27	1.87 ± 0.15
C 20:5n-3	5.75 ± 0.27	4.46 ± 0.19
C 22:2n-6	0.03 ± 0.01	0.06 ± 0.01
C 22:3n-3	0.00 ± 0.00	0.53 ± 0.06
C 22:5n-3	6.66 ± 0.08	5.41 ± 0.32
C 22:6n-3	1.20 ± 0.14	3.06 ± 0.08
Σ PUFA ^D	38.97 ± 0.13	29.13 ± 1.72
Σ n-3	16.19 ± 0.00	14.86 ± 0.62
Σ n-6	22.79 ± 0.14	14.28 ± 1.10
n-3/n-6	0.71 ± 0.00	1.04 ± 0.04

^AAverage of three lots analyses. ^BValues reported are means ± SD. ^{Cabc} values for each sample with different letters in the same fraction are significantly different at P < 0.05. ^D SFA: Saturated fatty acid, MUFA: Monounsaturated fatty acid, PUFA: Polyunsaturated fatty acid.

The method of AOCS (1972) was employed in order to obtain the methyl esters of fatty acids by using BF₃ (14%).

Fatty acid methyl esters (FAMES) were analyzed on a Shimadzu 15-A model gas chromatograph (GC), equipped with a flame ionization detector (FID) and a 1.8 m × 3 mm internal diameter packed glass column containing 100/120 Chromosorb WAW coated with 10% SP 2330. Injector and detector temperatures were 225 and 245 °C, respectively. Column temperature program was 190 °C for 45 min then increasing for 30 °C/min up to 220 °C where it was maintained for 5 min. The total run time was 51 min. Nitrogen used was as carrier gas (1 ml/min).

Identification of fatty acids was carried out by comparing the sample FAME peak relative retention times with those obtained for Alltech (Carolean Industrial Drive, Satate Collage, PA) standards. Results were expressed as FID response area relative percentages. Each reported result is the average value of three GC analyses. The results are offered as mean ± SD in Table 1.

2.3. Statistical analysis

Each reported result is the average value of three GC analyses. The results were given as means and standard deviations (±SD). Statistical analyses were performed by using SPSS 16.0 software, and multiple comparison tests were carried out. The results were submitted to analysis of variance (ANOVA), at 0.05 significance level, using SPSS 16.0. The mean values were compared by Duncan test.

3. RESULTS AND DISCUSSION

Seasonal variations of total fatty acid composition of *Chalcalburnus tarichi* are presented in Table 1. We found 30 fatty acids in the muscle lipids of *Chalcalburnus*. The highest fatty acids in the fish in two seasons were found to be 18:0, 18:2 n-6, 16:0, 16:1n-7, 22: 6 n-3, 18:1 n-9 and 20:4 n-6.

Oleic acid (C18:1 n9) was identified as a primary monounsaturated fatty acid (MUFA) in the *Chalcalburnus tarichi* for two seasons. This fatty acid in the muscle tissue of *Chalcalburnus* was found to be at levels of 8.74% and 8.27% in winter and summer, respectively. Similarly, Haliloglu et

al., (2004) found that oleic acid is the major MUFA in the muscle in the tissue of rainbow trout. Palmitoleic acid was the second most abundant MUFA (3.04–6.90%) in the present study. The high levels of oleic, palmitoleic, and arachidonic acids had been reported as a characteristic property of *Chalcalburnus tarichi* (Ergun et al., 1992).

Monounsaturated fatty acids were lower than total saturated fatty acids. The ratio of total SFAs ranged from 45.36 to 50.57%. In winter, a high amount of linoleic acid (31.06%) increased the PUFA content and a high amount of linoleic acid and DHA increased the PUFA content in winter. Variations in the fatty acid composition might be related to the changes in nutritional habits of the fish (Norrobin et al., 1990). In our study, total SFA, palmitic acid and stearic acid were affected by seasonal variations in *Chalcalburnus tarichi*.

In this study, *Chalcalburnus tarichi* was rich in PUFA, especially linoleic acid, and other predominant PUFA were DHA in *Chalcalburnus tarichi* in winter. These results agree with Kalyoncu et al., (2009) who have reported that EPA, DHA and arachidonic acid were the most abundant PUFA in zander muscle lipids in Egirdir Lake, Turkey. In our study, in *Chalcalburnus tarichi*, major PUFA was linoleic acid and other high levels of PUFA were DHA, and linolenic acid in summer whereas major PUFA was linoleic acid and others were linoleic acid and arachidonic acid in summer. In a previous study, DHA, EPA, AA and linoleic acid were most abundant PUFA in carp in summer and winter (Karacali et al., 2011). In our study, the total PUFA was higher than the total MUFA in *Chalcalburnus tarichi* in winter. Low level of DHA was decreased total PUFA in summer in *Chalcalburnus tarichi*. These results agree with Ozyurt et al., (2006) who has reported that PUFA is higher than the total SFA and total MUFA in *Sepia officinalis*.

The results in the present work indicate that the n-3/n-6 ratio of *Chalcalburnus tarichi* is lower in summer 0.71, which may rise up to 1.04 in winter. Relatively high n-3/n-6 ratios (0.39–3.53) in different freshwater fishes were also registered by Cengiz et al., (2010). The present study indicates that *Chalcalburnus tarichi* are good in terms of n-3/n-6. The n-3/n-6 ratio is a good index for comparing relative nutritional value of fish oils. An increase in the human dietary n-3/n-6 fatty acid ratio is essential to help prevent coronary heart disease by reducing plasma lipids (Gokce et al.,

2004). The ratios of n-3/n-6 PUFA contents were ranged from 2.71 to 9.36 in marine fish species living in Turkish waters (Tanakol et al., 1999).

4. CONCLUSION

In conclusion, seasonal variations and species differentiations have effected fatty acid composition of *Chalcalburnus tarichi* in Van Lake. This study has revealed that *Chalcalburnus tarichi* in the Van Lake of Turkey is a desirable item in the human diet when the levels of EPA, DHA and n-3/n-6 ratio are considered. The fish identified in this study was found to be good source of n-3 fatty acids.

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