Comparison of proximate and fatty acid compositions of wild brown trout and farmed rainbow trout

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Abstract

The purpose of this study was to compare the fatty acid and proximate composition of two commercially exploited trout species (wild brown trout (WBT) and farmed rainbow trout (FRT)). The mean crude lipid content in FRT (4.3%) was significantly higher than that in WBT (2.7%). Total saturated fatty acid concentration (27.7%) in WBT was significantly higher than that in FRT (21.4%). However, monounsaturated fatty acid (MUFA) and polyunsaturated fatty acid (PUFA) concentrations in FRT were significantly greater than those of WBT. While the omega-6 PUFA concentration of WBT was fairly low, total omega-3 PUFA concentration was significantly higher compared with omega-6 PUFA. In contrast to WBT, the FRT contained high omega-6 and low omega-3 PUFA concentrations. Linolenic, docosahexaenoic (DHA), eicosapentaenoic (EPA) acids and C20:3*n*-3 components of omega-3 PUFAs were higher and significantly different between the two species. The ratio of omega-3 to omega-6 fatty acids in WBT was significantly higher compared to FRT. The results indicated that muscle lipids of both species are rich in EPA + DHA, thus beneficial in human nutrition.

Keywords: SFA, MUFA, PUFA, *Salmo trutta macrostigma*, *Oncorhynchus mykiss*, EPA, DHA
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Introduction

Fish and fishery products have a high nutritional quality and thus play an important role in the human diet. Fishery products are high in protein, essential minerals and polyunsaturated fatty acids (PUFAs), n-3 and n-6, and low in cholesterol content (Venugopal & Shahidi, 1996; Fallah *et al*., 2011). Reports on health benefits of long-chain omega-3 (*n*-3) fatty acids attracted people's attention to a diet rich in fish. Chronic diseases such as coronary heart disease can be prevented by consuming at least two meals of fish, preferably oily fish, per week (Harris & Von Schacky, 2004).

Fish lipids are rich in long-chain *n*-3 PUFA, especially eicosapentaenoic acid (EPA, 20:5*n*-3) and docosahexaenoic acid (DHA, 22:6*n*-3). Long-chain *n*-3 PUFAs are mostly obtained through the diet, since they cannot be synthesized readily by living organisms. Researchers reported several beneficial effects of EPA and DHA on bone formation and metabolism, and in the prevention of cardiovascular disease, especially for foetuses, infants, adolescents, pregnant and lactating women (Muskiet *et al.*, 2006). The importance of long-chain *n*-3 PUFA has gained attention because of curative and preventive effects on coronary artery diseases, neurodevelopment in infants, cancer, fat glycaemic control, rheumatoid arthritis, multiple sclerosis, psoriasis and inflammation (Ward & Singh, 2005). These essential fatty acids in fish are beneficial to retina and brain development and functioning, and are nutrients for growth and development of the human body (Simopoulos, 1991).

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The difference in quality of meat between fish of wild and farmed origin has always been a matter of research, and chemical composition in particular has been investigated (Ackman & Takeuchi, 1986; Alasalvar *et al*., 2002; Yıldız *et al.*, 2008; Fallah *et al.*, 2011).

Genetic factors such as size, sex, lifecycle stage and environmental factors such as temperature, salinity, diet, species habitat, geographic location and seasonal changes, have a major impact on the fatty acid profile of fish (Rasoarahona *et al.*, 2005; Yıldız *et al.*, 2008; Ozogul *et al.*, 2011). Seasonal changes, age, sex, level of maturity and availability of food may affect their proximate composition. Changes in food availability, spawning period and season may significantly influence the moisture and lipid contents of fish and are inversely related to each other (Kaya & Erdem 2009; Ozogul *et al.*, 2011).

Wild fish is a finite resource, and the number of naturally grown fish species is declining owing to increasing demand. The huge demand for fish products over the past two decades has been ensured by aquaculture production. Farmed fish has a significant role to play in providing *n*-3 fatty acids to consumers. Owing to their attractiveness and accessibility in the food market, after Atlantic salmon, rainbow trout and brown trout are the most widely produced and consumed salmonid fish in Turkey, as well as in the world. Worldwide, rainbow trout and brown trout production capacities are 735 000 tons and 25 000 tons, respectively (FAO, 2011), and 11% of rainbow trout is produced in Turkey. Wild brown trout, which belong to the genus *Salmo*, are distinguished by their brownish-yellow colour with dark and red spots on an olive background. Europe and Turkey are the natural distribution regions of brown trout, which are caught in huge quantities. The unique aroma of brown trout ranks it the preferred trout by consumers.

The main objective of this study was to determine and compare the proximate composition and fatty acid profiles of wild brown trout (WBT) and farmed rainbow trout (FRT), and to evaluate their fatty acid composition in terms of human health and nutrition.

Material and Methods

Wild brown trout were caught with casting nets from Munzur River, Tunceli, in February, 2011. Farmed rainbow trout were taken in net cages from the fish population in Almus Dam Lake (Tokat Province) Turkey, in February, 2011. The cultivated rainbow trout were fed a commercial trout diet. The proximate composition and fatty acid profile of the commercial feed are presented in Table 1. The fish samples were kept on ice in isothermic fish boxes until delivered to the laboratory. Fish samples were packaged in plastic bags and stored at –30 ºC until analyses were conducted (within two months of sampling). The frozen fish were thawed overnight. Samples were taken in triplicate for every analysis. The head, fins, skin, bones and internal organs of sampled fish were discarded and only the muscle between the dorsal fin and *linea lateral* was used for analyses.

The chemical composition of the fish was determined according to the AOAC (1984) methods as follows: dry matter after drying at 105 ºC for 24 h, ash by combusting at 550 ºC for 12 h, crude protein (N x 6.25) by the Kjeldahl method after acid digestion, and crude lipid by ethyl ether extraction in a Soxhlet System. For fatty acid analysis, the crude oils of WBT and FRT were extracted with light petroleum ether (b.p. 40 - 60 °C) in a Soxhlet. The solvent was removed by rotary evaporator, and the extracted oil used for fatty acid analysis.

The oils were saponified according to standard IUPAC methods (IUPAC, 1988). Fatty acids were esterified with 10% (v/v) methanolic borontrifluoride (BF_3-MeOH) as reagent. The fatty acid methyl esters (FAMEs) of total lipids were obtained by transmethylation (AOAC, 1990). The temperature of the injector was 250 °C and the detector was 260 °C. Gas chromatographic (GC) analyses were performed with a Perkin Elmer Clarus 500 Series GC system, in split mode, 50 : 1, equipped with a flame ionization detector (FID) equipped with a TR-FAME (thermo scientific) apolar capillary column (30 m x 0.25 mm and 0.25 m ID). Helium (0.5 mL/min) was used as carrier gas. The injector temperature was set at 250 °C and the FID was operated at 260 °C. An initial column oven temperature of 100 °C was elevated to 220 °C at a rate of 2 °C/min. Fatty acid components were identified by comparing their retention times with those of authentic standards (Supelco 37 Comp. Fatty Acid Mix, 18919). The relative peak area percentages of the compounds were calculated based on the FID data. The fatty acids were calculated as percentages of total fat. The formulae recommended by Weihrauch *et al.* (1977) and Soriguer *et al.* (1997) were employed, converting the percentage values to weight. The formula for fish is as follows:

Factor (fish) = 0.933 – (0.143/total fat).

The conversion factor (CF) for *n* -3 fatty acids of *S. trutta*:
CF = 0.933 – (0.143/0.86) = 0.66; (0.66 x 40.72)/100 = 0.27 g/100 of *n-3*.

Table 1 Proximate and fatty composition (%) of the commercial fish feed

Proximate composition %		Commerical Feed	± SD
Crude protein		45.2	0.0
Crude lipid		22.3	0.7
Crude cellulose		1.7	0.0
Ash		10.3	0.7
Nitrogen free extract		17.1	1.0
Moisture		3.4	1.0
Fatty acid composition %	Trivial name		
C12:0	Lauric acid	0.1	0.0
C14:0	Myristic acid	4.8	0.2
C16:0	Palmitic acid	17.2	0.3
C17:0	Heptadecanoic acid	0.4	0.1
C18:0	Stearic acid	2.7	1.0
C20:0	Arachidic acid	1.3	0.0
C21:0	Heneicosanoic acid	0.2	0.0
C22:0	Behenic acid	2.0	0.0
Total saturated fatty acids (SFA)		28.5	1.6
C14:1	Myristoleic acid	0.1	0.1
C16:1	Palmitoleic acid	4.9	0.2
C17:1	Heptadecenoic acid	0.2	0.0
C18:1n-9c	Oleic acid	22.6	0.5
C20:1	*cis*-11-eicosenoic acid	2.7	0.3
C22:1n9	Eruric acid	7.2	0.6
C24:1	Nervonic acid	2.0	0.1
Total monounsaturated fatty acids (MUFA)		39.6	0.7
C18:2n6c	Linoleic acid	10.8	0.3
C18:3n6	γ-Linoleic acid	0.1	0.1
C20:3n6	*cis*-8,11,14-eicosatrienoic acid	0.5	0.0
C22:2	*cis*-13,16-docosadienoic acid	0.5	0.1
Total n-6		11.9	0.3
C18:3n3	Linolenic acid	3.2	0.0
C20:3n3	*cis*-11,14,17-eicosatrienoic acid	0.7	0.1
C20:5n3	*cis*-5,8,11,14,17-eicosapentanoic	0.4	0.1
C22:6n3	*cis*-4,7,10,13,16,19-docosahexanoic	10.8	1.1
Total n-3		15.1	1.2
Total polyunsaturated fatty acids		27.0	0.9
Total fatty acids		100	0.00
n-3/n-6		1.3	0.1
Unidentified		4.9	0.1

Values are expressed as mean ± standard deviation (SD) (n = 3).

The data are presented as mean ± standard deviation (SD). All statistical analyses were performed using the MINITAB Release 13.1 Statistical Analysis Software Program for Windows, Version 10.0.1 (Minitab Inc., Chicago, Illinois, USA.). Differences in fatty acids between WBT and FRT were tested by one-way analysis of variance and Tukey's test. In all statistical tests, significance level was determined based on $P \leq 0.05$. All analytical determinations were performed in triplicate.

Results and Discussion

The mean values of the proximate composition of WBT and FRT are shown in Table 2. The average crude protein content of WBT and FRT was not significantly different from each other, but the mean crude lipid content in FRT (4.3%) was higher ($P < 0.05$) than that in WBT (2.7%). The higher fat composition (22.3%) of feed used in the FRT diet affected the fat ratio of fish muscle (Table 1). Comparing with wild fish, Alasalvar *et al.* (2002) stated that a high crude lipid concentration in farmed fish is a general phenomenon that is causes by a high dietary fat levels in the salmonid feed as well as restricted activity of the farmed FRT. Similar findings were reported by Kaya & Erdem (2009), Kayım *et al.* (2011) and Özoğul *et al.* (2011).

In this study, significant differences in lipid content were observed. Protein, moisture and ash contents did not differ significantly between WBT and FRT. The season, age, level of maturity, environmental factors, availability food and lipid, protein, energy contents of commercial feed have a significant effect on the proximate composition of fish (Kayım *et al.*, 2011). The protein in the body is used to cope with long starvation periods. Nevertheless, the main changes observed in the body composition are moisture and lipid content, which may show an inverse relation. The brook trout contains higher protein and dry matter contents and lower ash and crude lipid concentrations (Çelikkale *et al.* 1998; Şahin *et al*. 2011). Similar results for crude lipid of *Salmo trutta* have also been reported (Akpınar *et al*., 2009; Kaya & Erdem, 2009).

Table 2 Proximate composition of *Salmo trutta* sp. (wild brown trout) and *Oncorhynchus mykiss* (farmed rainbow trout)

Components	Wild brown trout	Farmed rainbow trout
Protein %	$18.1^{a} \pm 2.0$	$17.9^{a} \pm 1.01$
Lipid %	$2.7^{a} \pm 0.3$	$4.3^{b} \pm 1.5$
Moisture %	$74.8^{a} \pm 1.1$	$75.6^{a} \pm 1.2$
Ash %	$1.6^{a} \pm 0.4$	$2.1^{a} \pm 0.4$

Values are expressed as mean ± SD (n = 3) on a dry weight basis.
Mean values in row with different superscripts were significantly different ($P < 0.05$).

The fatty acid compositions of muscle lipids in WBT and FRT are listed in Table 3. The fish feed or nutrition regimen of the fish is closely correlated with body composition. The findings on fatty acid profiles of the diet and muscle lipids for FRT comply with reports in the literature. The total saturated fatty acid (SFA) (27.7%) content of WBT was higher ($P < 0.05$) compared with FRT (21.4%). However, other fatty acid concentrations of the feed used, resulted in an increase ($P < 0.05$) in total monounsaturated fatty acid (MUFA) (28.60 %) and PUFA (26.4%) concentrations of WBT compared with FRT. The assimilation patterns of dietary fatty acids in fish muscle reflect the content of the dietary lipid sources (Arzel *et al*., 1994; Alasalvar *et al*., 2002; Kaya & Erdem, 2009). Fallah *et al*. (2011) reported that the SFA content of rainbow trout is approximately 25%, which is in agreement with the findings of the present study.

The major fatty acids identified in WBT were C16:0 (palmitic acid), C18:1*n*-9c (oleic acid), C18:3*n*3 (linolenic acid), C16:1 (palmitoleic acid), C18:2*n*-6c (linoleic acid), C18:0 (stearic acid), C20:5*n*-3 (eicosapentaenoic acid, EPA) and C22:6*n*-3 (docosahexaenoic acid, DHA), C14:0 (myristic acid) (Table 3). The fatty acids in FRT were PUFA (36.40%), MUFA (34.80%) and SFA (21.40%). Farmed rainbow trout contained higher ($P < 0.05$) C18:1*n*-9c (oleic acid), C20:1 (cis-11-eicosenoic acid), C22:1*n*-9 (eruric acid), C24:1 (nervonic acid), C18:2*n*-6c (linoleic acid), C18:3*n*-6 (γ-linoleic acid), C20:2 (cis-11,14-eicosadienoic

acid), C22:2 (cis-13,16-docosadienoic acid) and C22:6*n*-3 (DHA) concentrations, whereas C15:0 (pentadecanoic acid), C16:0 (palmitic acid), C16:1 (palmitoleic acid), C20:4*n*-6 (arachidonic acid), C18:3*n*-3 (linolenic acid), C20:3*n*-3 (cis-11,14,17-eicosatrienoic acid) and C20:5*n*-3 (EPA) concentrations were lower than in WBT (P <0.05).

Table 3 Fatty acid composition (%) of wild brown trout and farmed rainbow trout

Fatty acid %	Trivial name	Wild brown trout %	Farmed rainbow trout %
C12:0	Lauric acid	0.6 [a] ± 0.3	0.1 [a] ± 0.0
C14:0	Myristic acid	2.6 [a] ± 0.7	2.6 [a] ± 0.4
C15:0	Pentadecanoic acid	0.3 [a] ± 0.1	0.1 [b] ±0.0
C16:0	Palmitic acid	19.1 [a] ± 1.0	13.9 [b] ± 1.0
C17:0	Heptadecanoic acid	0.6 [a] ± 0.2	0.3 [a] ± 0.2
C18:0	Stearic acid	4.2 [a] ± 1.1	4.3 [a] ± 0.6
C20:0	Arachidic acid	0.2 [a] ± 0.1	0.2 0 [a] ± 0.0
C22:0	Behenic acid	0.2 [a] ± 0.1	0.2 [a] ± 0.1
Total saturated fatty acids (SFA)		27.7 [a] ± 2.0	21.4 [b] ± 1.3
C14:1	Myristoleic acid	0.1[a] ± 0.03	0.1[a]± 0.0
C15:1	cis-10-pentadecenoic acid	0.2[a] ± 0.1	0.2[a]± 0.0
C16:1	Palmitoleic acid	10.6[a] ± 1.5	3.6[b] ± 0.1
C17:1	Heptadecenoic acid	0.3[a] ± 0.1	0.2[a] ± 0.1
C18:1*n*-9c	Oleic acid	16.7[a] ± 2.2	25.8[b] ± 4.6
C20:1	cis-11-eicosenoic acid	0.5[a] ± 0.3	1.9[b] ± 0.7
C22:1*n*-9	Eruric acid	0.1[a] ± 0.0	0.2[b] ± 0.1
C24:1	Nervonic acid	0.1[a]± 0.0	0.2[b] ± 0.1
Total monounsaturated fatty acids (MUFA)		28.6[a]± 1.2	34.8[b]± 0.5
C18:2*n*-6c	Linoleic acid	4.2 5[a] ± 0.	22.3 [b] ± 0. 6
C18:2*n*-6t	Linoelaidic acid	0.1 [a] ± 0.0	0.1 [a] ± 0.1
C18:3*n*-6	γ-Linoleic acid	0.2 [a] ± 0.0	0.2 [b] ± 0.0
C20:3*n*-6	cis-8,11,14-eicosatrienoic acid	0. 3 [a] ± 0.1	0.4 [a] ± 0.1
C20:4*n*-6	Arachidonic acid	0.7 [a] ± 0.0	0.4 [b] ± 0.1
C20:2	cis-11,14-eicosadienoic acid	0.4 [a] ± 0. 2	1.1 [b] ± 0.5
C22:2	cis-13,16-docosadienoic acid	0.2 [a] ± 0.0	0.2 [b] ± 0.1
Total *n*-6		5.9 [a] ± 0. 8	25.1 [b] ± 0.7
C18:3*n*-3	Linolenic acid	13.3 [a] ± 1.9	3.0 [b] ± 0.1
C20:3*n*-3	cis-11,14,17-eicosatrienoic acid	1.0 [a] ± 0.1	0.4 [b] ± 0.3
C20:5*n*-3	cis-5,8,11,14,17-eicosapentanoic acid	3.1 [a] ± 0.4	2.1 [b] ± 0.1
C22:6*n*-3	cis-4,7,10,13,16,19-docosahexanoic acid	3.1 [a] ± 1.0	5.8 [b] ± 0.4
Total *n*-3		20.5[a]± 0.8	11.3[b]± 0.5
Total polyunsaturated fatty acids (PUFA)		26.4[a]± 0.4	36.4[b] ± 0.9
Total fatty acids		82.7[a] ± 2.2	92.6[b] ±1.0
n-3/*n*-6		3.5[a]± 0.6	0.5[b] ± 0.0
Unidentified		17.3 [a] ± 2.1	7.4[b] ± 0.1

Values are expressed as mean ± SD (n = 3).
Mean values in row with different superscripts were significantly different (P <0.05).

Oleic acid (C18:1*n*-9c) was identified as the primary MUFA in both fish species and was higher (P <0.05) in FRT than in WBT. Higher oleic acid (C18:1*n*-9c) concentrations reported in cultured sea bass, rainbow trout, brown trout and sea bream have also been related to the feeding of commercial feed (Alasalvar *et al*., 2002; Kaya & Erdem, 2009; Fallah *et al*., 2011; Kayım *et al*., 2011). Palmitoleic acid (C16:1) was also high at 10.6% in WBT and at 3.6% in FRT (P <0.05). Oleic acid (C18:1*n*-9c) and palmitoleic acid (C16:1) accounted for about 90% of total MUFA.

The mean PUFA concentration in FRT was higher (P< 0.05) compared to that in WBT. The average *n*-3 PUFA concentrations in WBT were higher (P< 0.05) than in FRT. The *n*-6 PUFAs in FRT have a higher level of C18:2*n*-6c (linoleic acid) than WBT. This *n*-6 fatty acid is present in plant oils used in the commercially produced fish feed, and accumulates largely unchanged in the lipids of marine fish owing to their reduced capacity for chain elongation and desaturation (Owen *et al*., 1975). The higher amount of C18:2*n*-6c (linoleic acid) in cultured fish is also correlated with aquafeed ingredients (Morishita *et al*., 1989; Serot *et al*., 1998; Alasalvar *et al.*, 2002). Arachidonic acid (C20:4*n*-6) was another major *n*-6 PUFA, in agreement with findings of other researchers on both fish species (Aras *et al*., 2003; Kaya & Erdem, 2009; Kayım *et al.*, 2011). Cis-11,14-eicosadienoic acid (C20:2), C20:3*n*-6 (cis-8,11,14-eicosatrienoic acid); C18:3*n*-6 (γ-linoleic acid), C22:2*n*-6 (cis-13,16-docosadienoic acid) and C18:2*n*-6t (linoelaidic acid) concentrations were low in the *n*-6 PUFA of the fish investigated.

Fish in cold water have high PUFA concentrations. Linolenic acid (C18:3*n*-3), C22:6*n*-3 (DHA), C20:5*n*-3 (EPA) and C20:3*n*3 (cis-11,14,17-eicosatrienoic acid) concentrations were at higher levels (P <0.05) among the *n*-3 PUFAs found in both fish species. Linolenic acid (C18:3*n*-3) was the predominant *n*-3 PUFA in wild brown trout.

Eicosapentaenoic acid (EPA) and DHA of *n*-3 PUFAs also have beneficial effects in human health. Humans can obtain these essential components only by consuming seafood and freshwater products. These fatty acids play a vital role in human nutrition and disease prevention (Sargent, 1997; Alasalvar *et al*., 2002).

The concentration of EPA in WBT lipids was higher (P <0.05) than that in FRT, which is in good agreement with concentrations reported previously for trout (Blanchet *et al.*, 2005; Kaya & Erdem, 2009; Akpınar *et al.*, 2009; Kayım *et al.*, 2011), sea bass (Alasalvar *et al.*, 2002; Sağlık *et al.*, 2003) and other fish species (Ozogul *et al.*, 2011). The total percentage of DHA in FRT was higher than that in WBT, while the total percentage of EPA in WBT was lower than in FRT. Docosahexaenoic acid (DHA) values for FRT and WBT were 5.8% and 3.1%, respectively (P <0.05) (Table 3). Kaya & Erdem (2009) reported similar results. The lower DHA contents were reported for both trout species investigated by Kayım *et al.* (2011) and Akpinar *et al.* (2009) and for other fish species investigated by Aggelousis & Lazos (1991), Alasalvar *et al.* (2002) and Ozogul *et al.* (2011). In contrast, Fallah *et al.* (2011) reported that the levels of DHA and EPA are higher in FRT compared with wild rainbow trout.

The ratio of *n-3* to *n-6* fatty acids was higher (P <0.05) in WBT than in FRT, in agreement with the data reported for other fish species (Van Vliet & Katan, 1990). The results indicate that the natural environment is an excellent source of *n*-3 rich foods. The low *n*-3/*n*-6 ratio obtained for farmed fish supports the findings of others. The *n-3/n-6* PUFA ratios are higher in wild fish species than in the farmed fish (Grigorakis *et al.*, 2002). Güler *et al.* (2007) noted that the *n-3/n-6* ratio is a beneficial index comparing nutritional value and human health of fish oils. The ratio was reported as varying from 1 to 4 in freshwater fish species (Valfre *et al*., 2003). The profiles of muscular tissue fatty acids for three trout species *(Salvelinus alpinus, Salmo trutta fario, Oncorhynchus mykiss)* grown under the same conditions indicated that the *n-3*/*n-6* ratio (1.58) of rainbow trout was the highest (Haliloğlu *et al*., 2002). The ratios were higher than in the FRT and lower than in the WBT in the current study. However, Johansson *et al.* (2000) reported a lower *n-3*/*n-6* ratio (0.20) for rainbow trout.

Since commercial feeds usually contain high proportions of lipids rich in SFA and MUFA, but are deficient in *n-3* PUFA (Table 1), cultured fish lipids contain low *n-3* PUFA concentrations compared to the wild species. The nutritional quality of lipid components is reduced with a lower *n-3* PUFA rate in cultured fish. However, beneficial health aspects and consumers' demands can be compensated by proper choice of dietary lipid. The cost effectiveness of aquafeed formulations is a main factor (Ackman & Takeuchi, 1986).

The fatty acid composition of trout species in g/100 g wet weights is presented in Table 4. The variation in fatty acid composition of fish is important as a source of the essential components for human nutrition. The British Nutrition Foundation (1992) recommended a daily consumption of 0.2 g of EPA and DHA for a balanced and healthy diet.

To reduce the death risk from coronary heart disease, the American Heart Association recommends approximately 1.0 g/day of EPA and DHA, or two servings of fatty fish per week (Kris-Etherton *et al.*, 2002). In this respect, the two fish species investigated are suitable for human nutrition, since lipids in fish meat are rich in both EPA and DHA. The EPA and DHA concentrations per 100 g of meat from FRT were adequate (0.30), whereas WBT meat did not contain sufficient EPA and DHA, probably owing to the sampling season of WBT. The results demonstrated that WBT and FRT should be consumed at about 200 g per week to reach the recommended amount EPA and DHA, according to the British Nutrition Foundation (1992).

Table 4 Σ SFA, Σ MUFA, Σ PUFA, *n-6*, *n-3*, EPA, DHA content of wild brown trout and farmed rainbow trout (g/100 g fish)

Species	Wild brown trout (%)	Farmed rainbow trout (%)
Lipid	2.7	4.3
Σ SFA	0.7	0.8
Σ MUFA	0.7	1.3
Σ PUFA	0.6	1.4
n-6	0.2	1.0
n-3	0.5	0.4
EPA	0.1	0.1
DHA	0.1	0.2
EPA+ DHA	0.2	0.3

Values are expressed as means (n = 3).
SFA: saturated fatty acids; MUPA: monounsaturated fatty acids;
PUFA: polyunsaturated fatty acids; EPA: eicosapentaenoic acid;
DHA: docosahexaenoic acid.

Conclusion

The differences in total lipid concentration of FRT and WBT may be attributed to diet ingredients of the fish studied. The SFA content and *n-3* and *n-3/n-6* PUFA ratio were higher in WBT compared with the FRT, whereas the corresponding MUFAs, PUFAs and the ratio of n-6 PUFAs were lower. Because of the higher lipid content in the muscle of FRT, a person will consume higher SFA, MUFA, PUFA, *n-6* and EPA+DHA per 100 g of FRT fillets than consuming WBT. The results revealed that the *n-3* content of farmed fish can only be higher than or close to the *n-3* content of wild fish when feeding them a diet containing a high fat ratio.

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