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Can long chain *n*-3 fatty acids from feed be converted into very long chain *n*-3 fatty acids in fillets from farmed rainbow trout (*Oncorhynchus mykiss*)?

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Abstract. The link between the basic chemical and fatty acid composition of trout feed on one hand and trout (*Oncorhynchus mykiss*) meat (fillet) was investigated.. The content of 52 fatty acids from feed and trout meat lipids was determined by *in-situ* transesterification and capillary column gas-liquid chromatography. On average, 100 g of trout feed contained 7.4 g of moisture, 47.7 g of proteins, 6.09 g of ash, 21.4 g of fat, and as for fatty acid composition, 47.8 wt. % were monounsaturated, 34.0 wt. % were polyunsaturated and 18.1 wt. % were saturated fatty acids, with the PS ratio 1.88, *n*-6/*n*-3 ratio 1.74, 0.80 wt. % of *trans* and 3.28 wt. % of very long chain *n*-3 fatty acids. On average, 100 g of trout meat contained 76.1 g of moisture, 21.4 g of proteins, 1.34 g of ash, 2.52 g of fat, and in the fatty acid composition 42.1 wt. % were monounsaturated, 38.2 wt. % were polyunsaturated and 18.9 wt. % were saturated fatty acids, with the PS ratio 2.02, *n*-6/*n*-3 ratio 0.98, 0.95 wt. % of *trans* and 13.25 wt. % of very long chain *n*-3 fatty acids.

1. Introduction

Fish farming has been developed into a highly productive and efficient industry for the production of animal protein for human consumption. However, in the modern way of life, care for human health is very important. It is accepted that fish consumption has nutritional and health benefits in humans [1,2]. Fish meat is considered to be a good source of proteins of high biological value, polyunsaturated *n*-3 fatty acids (*n*-3 PUFA), minerals and vitamins. Preventive effects of *n*-3 PUFA on atherosclerosis, thrombosis or hypertension have been reported in numerous studies [3,4]. Additionally, it has been suggested that *n*-3 PUFA may have a favorable influence on diseases, such as asthma, stroke, cancer or diabetes [5].

Besides the fat content, their fatty acid (FA) composition, and above all the proportion and ratio of *n*-3 to *n*-6 FAs, as well as between saturated and unsaturated FA, the most important fish quality parameters are microbiological safety, color, texture and content of essential minerals; all of them contribute to high nutritional value of fish meat and their positive nutritional effects [6]. However, the composition of fish meat is highly variable; some factors of variability are the age, size or part of the fish [7], the sex, the season of the year [8], the quality of water [9], the diet [10,11] and the feeding system [10,12].

Research found that the histological changes observed suggest an effect of dietary lipid sources on the transport and metabolism of fat in the fish, but further studies are required to clarify this [10].

Consequently, the aim of this preliminary study was to investigate the FAs and basic chemical composition of trout feed on one hand and farmed trout meat on the other, suggest a possible link between FA profiles of feed and meat, as well to obtain some information about nutrient content in the muscle of fillets from farmed trout in Slovenia.

2. Materials and methods

Freshwater-reared rainbow trout (n = 10) were randomly selected from stocks of ready-for-sale animals obtained from Slovenian commercial farms, producing for the domestic market. At the same time, feed, with which fish were farmed, was collected. The sampling was carried out between March and April, 2017.

Fish were slaughtered in water and ice, packed in polystyrene boxes, and covered with ice. Boxes with fish were immediately transported to the laboratory where fish were weighed and processed. The peritoneal cavity was opened along a ventral midline incision; the entire visceral mass was discarded. An incision along the dorsal fin up to the caudal fin, and another incision behind the opercula, excluding lateral and ventral fins, were made to separate both fillets from each carcass. Each fillet was cut along the insertion line of the ribs to obtain a dorsal and a ventral fillet (figure 1). After skinning, separately the two dorsal and two ventral fillets from each fish were joined. On the dorsal fillets, FA composition and on the ventral fillets, basic chemical composition was analyzed. Ten representative fish (dorsal and ventral fillets) and ten associated fish feed samples were prepared for analysis in accordance with ISO standard method [13]. The samples were homogenized by using a homogenizer Grindomix GM 200 (Retch, Germany) at 5000-6000 rpm for 20 s and stored vacuum packed in plastic bags at -18 °C until further analysis.

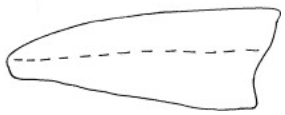

Figure 1. Insertion line of ribs rainbow trout [7].

2.1 Chemical composition

The moisture content of feed and fillet was determined on 5 g of previously homogenized samples dried in an oven at 105 °C (according to Association of Official Analytical Chemists (AOAC) 950.46) [14]. The total protein content (crude protein, N × 6.25) was determined by using the Kjeldahl method (according to AOAC 928.08) [15], and the ash content was determined by mineralization of the samples at 550 °C (according to AOAC 920.153) [16]. The fat content in feed and fillet was determined by the method described as AOAC Official Method 991.36 Fat (crude) in Meat and Meat Products [17]. Lipids were extracted with petroleum ether (boiling point ranged from 40 to 60 °C) after hydrolysis of the sample with hydrochloric acid. Data from the basic chemical analyses were expressed on a wet matter basis.

2.2 Fatty acid analysis

The FA composition of feed and fillet was determined by gas chromatography, where *in situ* transesterification [18] was used, modified by Polak et al. [19]. The FAMEs were determined by capillary gas chromatography on GC Agilent Technologies 6890 with a flame ionization detector and HP-88 capillary column (100 m × 0.25 mm × 0.20μm, Agilent Technologies). Separation and detection were performed under the following temperature conditions: 150º C, hold 10 min, rate 1.5 °C min^{-1} to 180º C, hold 40 min, 3º C min^{-1} to final temperature of 240º C. Total analysis time was 95 min. The injector and detector temperatures were 250º C and 280º C, respectively. The carrier gas was helium at a flow rate of 2.3 mL min^{-1}. Injected volume was 1 μL and injector split ratio was 1:30.

Nitrogen was used as the make-up gas at a flow rate of 45 mL min^{-1}; detector gases were hydrogen and synthetic air (21% O_2) at a rate of 40 mL min^{-1} and 450 mL min^{-1}, respectively.

The FAMEs were determined through their retention times in comparison to the relevant standard mixtures using: 37 Components FAME mix (Supelco, Bellefonte, USA); PUFA No. 1-animal source (Supelco, Bellefonte, USA); linoleic acid methyl ester *cis/trans* isomer Mix (Supelco, Bellefonte, USA); *cis*-7-octadecenoic methyl ester (Supelco, Bellefonte, USA) and *cis*-11-octadecenoic methyl ester (Supelco, Bellefonte, USA); methyl stearidonate (Fluka, Switzerland); Nu-Chek standards GLC-68D, GLC-85, GLC-411g (Nu-Chek, Minnesota, USA). The GLC-68D and GLC-85 standard mixtures were used to determine the response factor for each FA. The weight of each FA in the feed and fillets was determined using the response factor and the transformation factor of the FA content from the FAME content. The samples of feed and fillets were analyzed in duplicate. The FAMEs were expressed as weight percentages of the total FA content.

2.3 Data analysis

The data were analyzed for normal distributions using the UNIVARIATE procedure (SAS/STAT, USA). The differences according to the samples were analyzed through a general linear model procedure and Duncan test (SAS/STAT), with a 0.05 level of significance.

3. Results and discussion

Basic chemical and FA compositions of trout feed are presented in tables 1 and 2, respectively.

On average, 100 g of wet weight of trout feed contained 7.4±2.1 g of moisture, 47.7±5.0 g of proteins, 6.09±1.37 g of ash, 21.4±5.72 g of fat, and as for FA composition, 47.8±3.2 wt. % of total FAs were monounsaturated (MUFA), 34.0±2.4 wt. % were polyunsaturated (PUFA) and 18.1±1.1 wt. % were saturated fatty acid (SFA), with the PS ratio 1.88±0.12, *n*-6/*n*-3 ratio 1.74±0.34, 0.80±0.19 wt. % of *trans* FA and 3.28±0.94 wt. % of very long chain *n*-3 PUFA (data are not presented in tables).

The chemical composition of the ten trout feeds significantly differed ($P < 0.001$). The protein content in trout feed ranged from 39.9 to 55.0 g 100 g^{-1}, fat content from 12.9 to 29.1 g 100 g^{-1}, moisture content from 3.7 to 9.8 g 100 g^{-1} and ash content from 5.0 to 8.9 g 100 g^{-1}. These amounts for chemical parameters found are in full agreement with data reported by Rasmussen et al. [20], who stated following data for rainbow trout feed: content of protein 47.0 g 100 g^{-1}, fat 26.0 g 100 g^{-1}, dry matter 94.3 g 100 g^{-1}, and ash 7.5 g 100 g^{-1}.

In all, 53 FAs were detected (> 0.01 g 100 g^{-1} FA) in the trout feeds; only thirteen of them are presented in table 2. For almost all FAs, their proportions and calculated nutrition information significantly differed between the different trout feeds ($P \leq 0.001$) except for C22:4*n*-6 ($P = 0.355$). The primary FA was oleic acid (C18:1*cis*-9), the content of which was 37.27±1.76 g 100 g^{-1} FA, followed by linoleic (C18:2*cc n*-6; 20.01±2.42 g 100 g^{-1} FA), palmitic (C16:0; 11.07±0.61 g 100 g^{-1} FA), α-linolenic (C18:3*n*-3; 5.12±0.44 g 100 g^{-1} FA), and FAs in amount under 4 g 100 g^{-1} FA, such as stearic (C18:0; 3.43±0.58 g 100 g^{-1} FA), eicosapentaenoic (C20:5*n*-3; 2.90±0.58 g 100 g^{-1} FA), vaccenic (C18:1*cis*-11; 2.77±0.08 g 100 g^{-1} FA), docosahexaenoic (C22:6*n*-3; 2.61±0.81 g 100 g^{-1} FA), palmitoleic (C16:1; 2.43±0.30 g 100 g^{-1} FA), gondoic (C20:1*cis*-11; 2.12±0.96 g 100 g^{-1} FA), and myristic acid (C14:0; 1.97±0.36 g 100 g^{-1} FA).

Basic chemical and FA compositions of farmed rainbow trout fillets are presented in tables 1 and 3, respectively.

On average, 100 g of wet weight of trout fillet contained 76.1±1.2 g of moisture, 21.4±0.9 g of proteins, 1.34±0.08 g of ash, 2.52±1.24 g of fat, and in FA composition, 42.1±5.1 wt. % of total FA were MUFA, 38.2±4.6 wt. % were PUFA, and 18.9±1.6 wt. % were SFA, with the PS ratio 2.01±0.27, *n*-6/*n*-3 ratio 0.98±0.28, 0.95±0.19 wt. % of *trans* FA and 13.25±4.72 wt. % of very long chain *n*-3 PUFA (data are not presented in tables).

The basic chemical composition of farmed rainbow fillets trout significantly differed between samples ($P < 0.01$), except for protein content ($P = 0.071$). The protein content in trout fillets ranged from 20.3 to 23.6 g 100 g^{-1}, the fat content from 0.8 to 5.0 g 100 g^{-1}, moisture content from 74.4 to

78.1 g 100 g^{-1} and ash content from 1.24 g 100 g^{-1} to 1.54 g 100 g^{-1}. These amounts for chemical parameters found are not in full agreement with data reported elsewhere. Protein contents were reported to be at the lower limit of those in our study (in the range of 19.3 to 20.3 g 100 g^{-1}), while the fat contents reported were at the upper limit compared to our study (in the range of 4.0 to 6.7 g 100 g^{-1}) for dorsal and ventral fish fillets or fillets from fish reared in standing moisture [7,20].

In all, 52 FAs were detected (> 0.01 g 100 g^{-1} FA) in the fillets from farmed rainbow trout; twelve of them are presented in table 3. For almost all fatty acids, their proportions and calculated nutrition information significantly differed between different trout fillets ($P \leq 0.05$) except for C13:0, C17:1*cis*-10 and C18:1*trans*-11 ($P > 0.05$). The primary FA was oleic acid (C18:1*cis*-9), content of which ranged from 24.33 to 36.68 g 100 g^{-1} FA, followed by linoleic (C18:2*cc n*-6; from 14.57 to 19.99 g 100 g^{-1} FA), palmitic (C16:0; from 11.07 to 15.56 g 100 g^{-1} FA), and docosahexaenoic acid (C22:6*n*-3; from 7.04 to 21.61 g 100 g^{-1} FA). Our results are in line with those reported in literature [2,10,21] for the relative concentrations of individual FAs in the lipid fraction. In contrast, other researchers found that C22:6*n*-3 followed by C16:0 were the predominant FAs in the dorsal muscle of cultivated rainbow trout [22]. This is probably due to the use of different lipid sources in the diet because the FA composition of the muscular tissue in fish reflects, to a large extent, that of the diet [23].

The lower part of (table 3) gives the indicators related to human health for the trout fillets. The nutritional quality of fat has been evaluated in terms of the ratio of PUFA:SFA (PS), the atherogenicity index (AI) [24], and the ratio of *n*-6/*n*-3 FA. In a balanced diet, the recommended ratio for PS is 0.4 or higher [25,26], for AI as low as possible, and for ratio *n*-6:*n*-3 less than 4 [27]. In this regard, our results showed that differences ($P \leq 0.001$) in the PS ratio occurred between the different rainbow trout fillets, but the PS ratios ranged from 1.69 to 2.46, which is within the recommended range. Also determined AI values (0.20 to 0.28), which is considered as the rightful estimation for lipid nutritional quality, is also quite comparable with rabbit meat (0.70), deer meat (0.40 to 0.72), beef (0.51), lamb (1.07) and chicken (0.42) [28,29,30,31,32]. An unfavorable *n*-6/*n*-3 ratio of the PUFAs is considered to be a risk factor for cancer and coronary heart disease, so it is recommended that this *n*-6/*n*-3 ratio is < 4.0 [27]. In the present study, an average *n*-6/*n*-3 ratio of 0.98 was achieved, while in the literature that value was 0.62 for cultured rainbow trout by Stancheva et al. [33].

FA chains differ in length, often categorized from short to very long. Figure 2 shows the percentages of medium- (with aliphatic tails of 6 to 12 carbons), long- (with aliphatic tails of 13 to 21 carbons) and very long-chain (with aliphatic tails of 22 or more carbons) FA in feed (diet) source and in trout fillet lipids. On average, a greater percentage of very long chain FAs (i.e. C22:5*n*-3, C22:6*n*-3) in trout fillet in comparison with feed was detected, reflecting the lower percentage of some long chain FAs (i.e. C18:3*n*-3) in fillet compared to feed (figure 3). Furthermore, the *n*-3/*n*-6 ratios and percentages of very long chain *n*-3 PUFA revealed that these values were significantly higher ($P \leq 0.001$) in the trout fillets than in the feeds (2.62 *vs.* 1.96; 16.8 *vs*. 7.4). According to Aslan et al. [34], FA composition of fish from aquaculture does not always depend on that of feed because of the fish metabolism. However, our data on the percentage of C18:3*n*-3, C20:5*n*-3 and C22:6*n*-3 observed in feed and fillets suggest an effect of feed (diet) source on metabolism of fat in trout fillet (Figure 3). It can be concluded that long chain *n*-3 PUFA from feed can be converted into very long chain *n*-3 PUFA in farmed rainbow trout fillets. This fact was also seen by Rebolé et al. [2], who showed that the level of C18:3*n*-6 was lower, whereas the level of C22:6*n*-3 was higher in the muscle than in the feed. This fact seems to support the documented effectiveness of rainbow trout and other freshwater fish species in elongating and desaturating precursor shorter-chain PUFAs to longer derived homologs [10,35].

There is scientific evidence that *trans* FA intake is associated with cardiovascular diseases in different ways [36]. Therefore, the recommendation for introducing *trans* FA in human body is limited to 1% of energy [37,38]. Naturally-occurring *trans* FAs produced in the gut of some animals and foods made from these animals (e.g., milk and meat products) can contain small quantities of these fats; low contents of *trans* FAs were also detected in our study (feed: 0.80±0.19 g 100 g^{-1} FA; fillet: 0.95±0.19 g 100 g^{-1} FA; data are not presented in tables). Twelve *trans* FA were detected in the feed and farmed

rainbow trout fillets, but just eight of them were present in amounts under the limit of detection (> 0.01 g 100 g^{-1} FA) and taken into account in the calculation.

Table 1. Basic chemical composition of feed and farmed rainbow trout fillets.

Parameter	Sample [x]											
(g 100 g^{-1})	S1	S1	S3	S4	S5	S6	S7	S8	S9	S10	SE [y]	P value [z]
Feed												
Protein	54.99$^{a\,u}$	47.85^{de}	39.86^{h}	49.59^{dc}	47.99^{de}	51.57^{bc}	53.93^{ba}	41.51^{hg}	43.87^{fg}	45.87^{fe}	1.37	≤ 0.001
Fat	22.74^{c}	28.66^{a}	22.58^{dc}	29.07^{a}	12.88^{f}	25.28^{b}	23.39^{c}	21.20^{d}	13.86^{fe}	14.64^{e}	0.18	≤ 0.001
Moisture	4.97^{e}	5.32^{ced}	5.17^{ed}	5.71^{cb}	8.53^{a}	5.29^{ed}	5.54^{cbd}	8.86^{a}	5.72^{cb}	5.79^{b}	0.63	≤ 0.001
Ash	8.39^{d}	9.26^{b}	8.62^{cd}	6.70^{e}	3.86^{f}	8.94^{cb}	8.22^{d}	3.67^{f}	9.81^{a}	6.96^{e}	0.22	≤ 0.001
Trout fillet												
Protein	20.83^{bc}	20.47^{c}	21.06^{bac}	21.99^{bac}	21.42^{bac}	21.85^{bac}	22.56^{a}	22.49^{ba}	20.68^{c}	20.43^{c}	0.70	0.071
Fat	4.39^{b}	3.24^{c}	0.87^{f}	1.68^{e}	4.75^{a}	1.36^{e}	2.61^{d}	2.29^{d}	1.63^{e}	2.41^{d}	0.15	≤ 0.001
Moisture	75.23^{cb}	75.11^{cb}	77.91^{a}	77.07^{a}	74.60^{c}	77.40^{a}	74.94^{cb}	75.79^{b}	75.84^{b}	77.31^{a}	0.45	≤ 0.001
Ash	1.29^{bc}	1.27^{c}	1.27^{c}	1.38^{ba}	1.41^{a}	1.39^{ba}	1.38^{ba}	1.46^{a}	1.27^{c}	1.24^{c}	0.04	0.004

[x] S – rainbow trout (*Oncorhynchus mykiss*)
[y] Standard error of mean.
[z] Statistical probability of sample effect.
[u] Means with a different superscript within rows ($^{a\text{-}i}$) differ significantly.

Table 2. Fatty acid composition (selected fatty acids) and calculated nutritional information of fish feed.

Fatty acid (FA)	Feed sample [x]											
(g 100 g^{-1} total FA)	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	SE [y]	P value [z]
C14:0	1.22^{h}	1.97^{d}	1.90^{e}	2.55$^{a\,u}$	2.01^{c}	1.98^{d}	1.84^{f}	2.01^{c}	1.75^{g}	2.50^{b}	0.01	≤ 0.001
C14:1*cis*-7	0.04^{g}	0.04^{f}	0.04^{d}	0.08^{b}	0.07^{c}	0.04^{f}	0.04^{f}	0.07^{c}	0.04^{e}	0.10^{a}	0.00	≤ 0.001
C15:1*cis*-5	0.01^{e}	0.01^{dc}	0.01^{dc}	0.03^{a}	0.01^{c}	0.01^{dc}	0.01^{dc}	0.01^{dc}	0.01^{d}	0.02^{b}	0.00	≤ 0.001
C16:0	10.59^{e}	11.29^{d}	11.88^{a}	9.87^{f}	10.62^{e}	11.33^{dc}	11.55^{b}	10.57^{e}	11.40^{c}	11.59^{b}	0.05	≤ 0.001
C18:0	3.35^{f}	3.91^{d}	3.61^{e}	2.89^{g}	2.76^{i}	3.95^{c}	4.03^{b}	2.75^{i}	4.28^{a}	2.80^{h}	0.01	≤ 0.001
C18:1*cis*-9	40.08^{b}	37.67^{c}	35.22^{f}	36.92^{d}	40.51^{a}	37.61^{c}	36.80^{d}	40.47^{a}	36.33^{e}	31.09^{g}	0.06	≤ 0.001
C18:2 *cc n*-6	23.58^{a}	20.18^{e}	22.95^{b}	16.68^{i}	17.04^{g}	20.14^{e}	21.68^{c}	16.96^{h}	21.46^{d}	19.44^{f}	0.02	≤ 0.001
C18:3*n*-3	5.87^{a}	5.33^{c}	5.23^{e}	5.08^{f}	4.59^{g}	5.33^{c}	5.41^{b}	4.60^{g}	5.30^{d}	4.41^{h}	0.01	≤ 0.001
C20:4*n*-6	0.28^{e}	0.69^{c}	0.25^{f}	0.23^{g}	0.22^{h}	0.70^{b}	0.58^{d}	0.22^{h}	0.91^{a}	0.23^{g}	0.00	≤ 0.001
C20:5*n*-3	1.65^{i}	3.46^{b}	3.32^{c}	2.34^{h}	2.66^{g}	3.46^{b}	3.06^{d}	2.71^{f}	2.82^{e}	3.48^{a}	0.01	≤ 0.001
C22:4*n*-6	0.13^{ba}	0.14^{ba}	0.12^{ba}	0.07^{b}	0.12^{ba}	0.15^{a}	0.13^{ba}	0.12^{ba}	0.14^{a}	0.16^{a}	0.03	0.355

C22:5*n*-3	0.45^{f}	0.57^{d}	0.58^{d}	0.61^{c}	0.78^{b}	0.57^{d}	0.54^{e}	0.78^{b}	0.57^{d}	0.88^{a}	0.01 ≤ 0.001
C22:6*n*-3	1.99^{g}	2.05^{f}	2.20^{e}	2.61^{d}	3.47^{c}	2.05^{f}	1.96^{h}	3.55^{b}	2.01^{g}	4.21^{a}	0.01 ≤ 0.001
SFA [w]	16.71^{ef}	19.11^{ba}	19.16^{ba}	16.68^{f}	16.89^{d}	19.02^{b}	19.22^{a}	16.84^{ed}	19.25^{a}	18.37^{c}	0.07 ≤ 0.001
MUFA[†]	47.82^{c}	46.89^{d}	44.48^{g}	54.53^{a}	50.93^{b}	46.96^{d}	45.76^{e}	50.93^{b}	45.60^{f}	44.33^{h}	0.07 ≤ 0.001
PUFA[§]	35.40^{c}	33.91^{e}	36.28^{b}	28.69^{g}	32.08^{f}	33.93^{e}	34.93^{d}	32.14^{f}	35.05^{d}	37.16^{a}	0.06 ≤ 0.001
n-3[#]	10.67^{f}	12.20^{d}	12.23^{d}	10.76^{f}	13.80^{c}	12.20^{d}	11.75^{e}	13.94^{b}	11.77^{e}	16.32^{a}	0.04 ≤ 0.001
n-6[]	24.80^{a}	21.80^{e}	24.14^{b}	18.04^{h}	18.38^{g}	21.82^{e}	23.27^{d}	18.30^{g}	20.98^{f}	23.38^{c}	0.05 ≤ 0.001
n-6/*n*-3	2.32^{a}	1.79^{c}	1.97^{b}	1.68^{d}	1.33^{e}	1.79^{c}	1.98^{b}	1.31^{f}	1.29^{g}	1.99^{b}	0.01 ≤ 0.001
PS	2.12^{a}	1.77^{e}	1.89^{c}	1.72^{f}	1.90^{c}	1.78^{e}	1.82^{d}	1.91^{c}	1.82^{d}	2.02^{b}	0.01 ≤ 0.001
AI[]	0.19^{g}	0.25^{c}	0.25^{b}	0.25^{dc}	0.23^{f}	0.25^{c}	0.25^{d}	0.23^{f}	0.27^{a}	0.24^{e}	0.00 ≤ 0.001
trans[$]	0.70^{c}	1.01^{a}	1.00^{ba}	0.61^{de}	0.57^{e}	1.01^{a}	0.97^{ba}	0.57^{e}	0.95^{b}	0.66^{dc}	0.02 ≤ 0.001
VLC *n*-3[&]	2.46^{h}	2.65^{f}	2.80^{e}	3.26^{d}	4.30^{c}	2.65^{f}	2.53^{g}	4.37^{b}	2.60^{f}	5.15^{a}	0.02 ≤ 0.001

[x] S – rainbow trout (*Oncorhynchus mykiss)*.
[y] Standard error of mean.
[z] Statistical probability of sample effect.
[u] Means with a different superscript within rows ($^{a-h}$) differ significantly.
[w] Saturated fatty acid: C8:0 + C10:0 + C11:0 + C12:0 + C13:0 + C14:0 + C15:0 + C16:0 + C17:0 + C18:0 + C20:0 + C21:0 + C22:0 + C23:0 + C24:0.
[†] Monounsaturated fatty acid: C12:1*cis*-11 + C14:1*trans*-7 + C14:1*cis*-7 + C15:1*cis*-5 + C15:1*cis*-10 + C16:1*trans*-7 + C16:1*trans*-9 + C16:1*cis*-9 + C17:1*trans*-10 + C17:1*cis*-10 + C18:1*trans*-7 + C18:1*trans*-8 + C18:1*trans*-9 + C18:1*trans*-10 + C18:1*trans*-11 + C18:1*cis*-7 + C18:1*cis*-8 + C18:1*cis*-9 + C18:1*cis*-11 + C20:1*cis*-5 + C20:1*cis*-8 + C20:1*cis*-11 + C21:1*trans*-12 + C21:1*cis*-12 + C22:1*cis*-13 + C24:1*cis*-15.
[§] Polyunsaturated fatty acid: C18:2*tt n*-6 + C18:2*tc n*-6 + C18:2*ct n*-6 + C18:2*cc n*-6 + C18:3*n*-6 + C18:4*n*-6 + C18:3*n*-3 + C18:4*n*-3 + C20:2*n*-6 + C20:3*n*-6 + C20:4*n*-6 + C20:3*n*-3 + C22:2*n*-6 + C20:5*n*-3 + C22:3*n*-3 + C22:4*n*-6 + C22:5*n*-6 + C22:5*n*-3 + C22:6*n*-3.
[#] C18:3*n*-3 + C18:4*n*-3 + C20:3*n*-3 + C20:5*n*-3 + C22:3*n*-3 + C22:5*n*-3 + C22:6*n*-3.
[] C18:2*tt n*-6 + C18:2*tc n*-6 + C18:2*ct n*-6 + C18:2*cc n*-6 + C18:3*n*-6 + C18:4*n*-6 + C20:2*n*-6 + C20:3*n*-6 + C20:4*n*-6 + C22:2*n*-6 + C22:4*n*-6 + C22:5*n*-6.
[] Index of atherogenicity: (C12:0 + 4 □ C14:0 + C16:0 + Σ(*trans*))/(Σ(*n*-6) + Σ(*n*-3) + C18:1*cis*-9 + other MUFA) [24].
[$] C14:1*trans*-7 + C16:1*trans*-7 + C16:1*trans*-9 + C17:1*trans*-10 + C18:1*trans*-7 + C18:1*trans*-8 + C18:1*trans*-9 + C18:1*trans*-10 + C18:1*trans*-11 +C18:2 *trans* + C18:2 *trans*-7 *cis*-9 + C21:1*trans*-12.
[&] Very long chain *n*-3: C22:3*n*-3 + C22:5*n*-3 + C22:6*n*-3.

Table 3. Fatty acid composition and calculated nutritional information of farmed rainbow trout fillets.

Fatty acid (FA)	Trout sample											
(g 100 g^{-1} total FA)	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	SE	*P* value
C14:0	1.15^{d}	1.67^{a}	1.19^{d}	1.19^{d}	1.70^{a}	0.99^{e}	1.51^{b}	1.48^{b}	1.31^{c}	1.41^{cb}	0.05	≤ 0.001
C14:1*cis*-7	0.03^{c}	0.04^{b}	0.03^{d}	0.04^{b}	0.05^{a}	0.03^{d}	0.04^{b}	0.04^{b}	0.04^{b}	0.03^{c}	0.00	≤ 0.001
C16:0	11.49^{ef}	12.14^{cd}	11.07^{f}	13.15^{b}	11.88^{ed}	11.75^{ed}	12.64^{cb}	11.39^{ef}	15.56^{a}	11.42^{ef}	0.26	≤ 0.001

C18:0	3.27^{d}	3.29^{d}	3.49^{c}	3.06^{e}	3.31^{d}	3.10^{e}	3.71^{b}	3.05^{e}	3.95^{a}	2.85^{f}	0.06	≤ 0.001
C18:1*cis*-9	36.08^{a}	35.68^{a}	29.40^{c}	24.33^{e}	36.68^{a}	27.86^{dc}	32.60^{b}	36.14^{a}	26.51^{d}	32.55^{b}	0.82	≤ 0.001
C18:2*cc n*-6	19.88^{a}	14.76^{e}	18.06^{b}	14.57^{e}	15.31^{de}	16.24^{dc}	16.88^{c}	14.86^{e}	14.35^{e}	19.23^{a}	0.49	≤ 0.001
C18:3*n*-3	4.21^{a}	3.01^{e}	3.06^{e}	3.18^{dce}	3.27^{dc}	3.28^{c}	3.46^{b}	3.14^{dce}	3.09^{de}	4.34^{a}	0.08	≤ 0.001
C20:4*n*-6	0.14^{a}	0.12^{bac}	0.07^{e}	0.13^{ba}	0.13^{ba}	0.07^{ed}	0.11^{bac}	0.10^{dc}	0.10^{bc}	0.11^{bc}	0.01	0.0013
C20:5*n*-3	2.07^{gf}	2.18^{f}	3.48^{b}	4.10^{a}	1.79^{g}	3.16^{cb}	2.85^{cd}	2.35^{ef}	2.97^{cd}	2.62^{ed}	0.17	≤ 0.001
C22:4*n*-6	0.06^{a}	0.05^{b}	0.00^{d}	0.00^{d}	0.05^{a}	0.00^{d}	0.04^{c}	0.04^{c}	0.00^{d}	0.04^{c}	0.00	≤ 0.001
C22:5*n*-3	0.60^{c}	0.68^{c}	0.95^{b}	0.94^{b}	0.59^{c}	1.22^{a}	0.87^{b}	0.91^{b}	0.85^{b}	0.87^{b}	0.04	≤ 0.001
C22:6*n*-3	7.04^{f}	9.63^{e}	13.10^{dc}	21.61^{a}	8.57^{fe}	17.98^{b}	9.87^{e}	10.94^{de}	15.28^{c}	9.28^{fe}	1.07	≤ 0.001
SFA	17.67^{de}	18.94^{c}	18.63^{c}	19.06^{c}	18.66^{c}	18.33^{dc}	20.02^{b}	17.64^{de}	23.08^{a}	17.44^{e}	0.34	≤ 0.001
MUFA	45.60^{b}	47.37^{ba}	39.15^{d}	33.38^{e}	48.30^{a}	37.15^{d}	42.95^{c}	47.06^{ba}	37.09^{d}	43.32^{c}	1.00	≤ 0.001
PUFA	36.05^{e}	32.97^{f}	40.99^{c}	46.96^{a}	32.36^{f}	43.67^{b}	36.34^{e}	34.77^{e}	38.96^{d}	38.50^{d}	0.70	≤ 0.001
n-3	14.55^{g}	16.63^{feg}	21.07^{dc}	31.25^{a}	15.49^{fg}	26.14^{b}	17.77^{fe}	18.47^{de}	23.26^{c}	17.87^{fe}	1.17	≤ 0.001
n-6	22.19^{a}	17.06^{ed}	21.16^{a}	16.31^{e}	17.54^{cd}	18.37^{cb}	19.26^{b}	16.83^{ed}	16.57^{ed}	21.37^{a}	0.48	≤ 0.001
n-6/*n*-3	1.53^{a}	1.03^{cd}	1.01^{cd}	0.52^{f}	1.13^{cb}	0.71^{e}	1.09^{cb}	0.91^{d}	0.71^{e}	1.20^{b}	0.06	≤ 0.001
PS	2.04^{d}	1.74^{g}	2.20^{c}	2.46^{a}	1.73^{g}	2.38^{b}	1.81^{f}	1.97^{e}	1.69^{g}	2.21^{c}	0.03	≤ 0.001
AI	0.21^{gf}	0.25^{b}	0.21^{ef}	0.23^{c}	0.24^{b}	0.20^{g}	0.25^{b}	0.22^{d}	0.28^{a}	0.22^{ed}	0.00	≤ 0.001
trans	0.91^{cbd}	1.05^{b}	1.41^{a}	0.71^{e}	0.96^{cbd}	0.84^{ced}	0.99^{cb}	0.81^{ed}	0.86^{cd}	0.93^{cbd}	0.07	≤ 0.001
VLC *n*-3	7.70^{f}	10.37^{e}	14.10^{dc}	22.62^{a}	9.24^{fe}	19.28^{b}	10.80^{e}	11.91^{de}	16.22^{c}	10.24^{fe}	1.11	≤ 0.001

Abbreviations are explained in the legend of table 2.

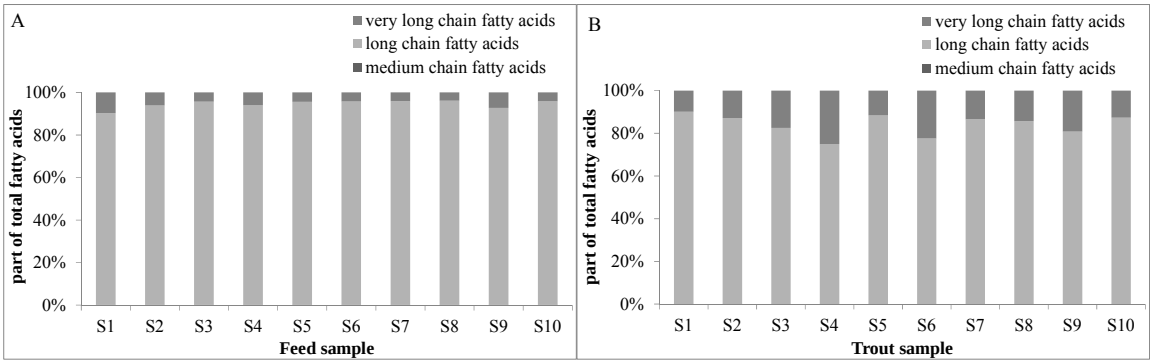

Figure 2. Percentage of medium-, long- and very long-chain fatty acids among total fatty acids in feed (diet) source (A) and in trout fillet lipids (B).

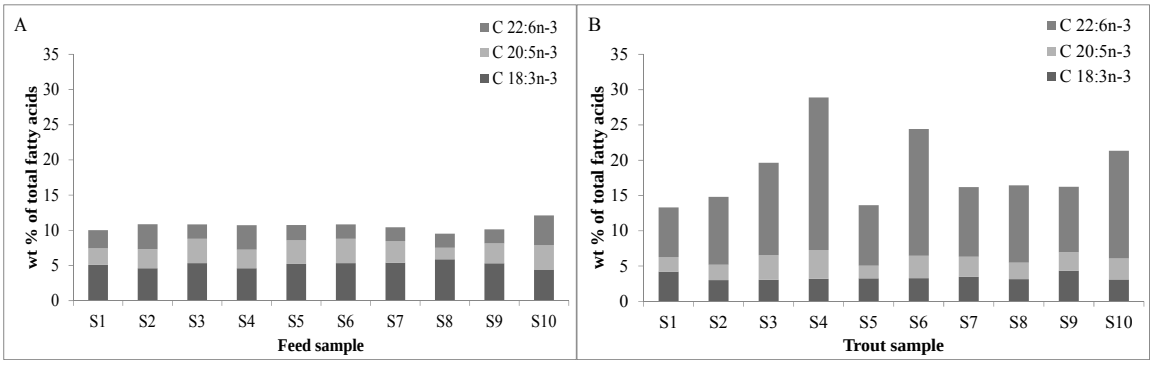

Figure 3. Weight% of C18:3*n*-3 (linolenic FA), C20:5*n*-3 (eicosapentaenoic FA) and C22:6*n*-3 (docosahexaenoic FA) in feed source (A) and in trout fillet lipids (B).

4. Conclusion

Preliminary studies in the field of FA and basic chemical composition of trout feed on one hand, and trout (*Oncorhynchus mykiss*) fillet meat on the other, showed that, despite wide variability between observed parameters, some conclusions can be drawn. In the present study, the FA profile and basic chemical composition of rainbow trout farmed in Slovenia were defined. On the basis of nutritional quality of the fat in the trout fillets, it can be concluded that rainbow trout farmed in Slovenia provides an important source of healthy fats, as it contains favorable *n*-3/*n*-6 ratios and PS and AI indices, all within recommended limits. Our data also suggest that long chain *n*-3 PUFA from feed can be converted into very long chain *n*-3 PUFA in trout fillets. From these points of view, farmed rainbow trout could be a healthy choice in human diet.

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