Scientific Papers. Series D. Animal Science. Vol. LX, 2017
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

POLYUNSATURATED FATTY ACID (PUFA) CONTENTS OF MEAT AND EGG OF RAINBOW TROUT FISH (*ONCORHYNCHUS MYKISS*)

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Abstract

Long-chain omega-3 polyunsaturated fatty acids (PUFA), including eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) and the ratio of n3/n6 is important factor for a healthy life. Fish and seafood are good source of PUFA. This research aimed to determine the fatty acid profile of rainbow trout meat and egg, compare the PUFA contents of these supplies and reveal their relation with health. Rainbow trout meat and egg contains high amount of PUFA, followed by MUFA and SFA. PUFA/SFA ration in trout meat is 1.64, meanwhile this ratio is 2.23 in trout egg. EPA+DHA content of the eggs are (23.23) higher than fish flesh (14.01). Rainbow trout egg meets the recommended values of PUFA/SFA, n3/n6 and EPA+DHA contents better than rainbow trout meat. Both fatty acids supplies have atherogenicity and thrombogenicity index values close to the recommended levels. Rainbow trout meat and its egg are good sources of long-chain PUFA.

Key words*: Rainbow trout, fish egg, Oncorhynchus mykiss, PUFA, Omega-3 fatty acids.*

INTRODUCTION

Polyunsaturated fatty acids are fatty acids that contain more than one double bond in their carbon chain and mostly composed of 18-20 carbons. They are categorized into two main sections; omega-6 (ω6 or n-6) and omega-3 (ω3 or n-3) depending on the position of the first double bond from the methyl end group of the fatty acid (Venegas-Calerón et al., 2010). PUFA are reported to be in relation with prevention of cardiovascular diseases and have certain efficacy in preventing illnesses with an inflammatory component (Grosso et al., 2016). They are also reported to reduce hypertension, asthma, immune system disorders, susceptibility to mental illness, protection against heart disease, and improved brain and eye functions (Yerlikaya et al., 2013).

The essential omega-3 (n3) PUFA α-linolenic acid (ALA, C18:3n3) can be converted in humans to the long chain PUFA eicosapentaenoic acid (EPA, C20:5n3) and docosahexaenoic acid (DHA, C22:6n3) in a multistage chain elongation and desaturation process (Schuchardt et al., 2016). However, this process is slow and inefficient in human body. The conversion rate from ALA to EPA (~5%) and especially to DHA is low (~1%) (Plourde and Cunnane, 2007).

Therefore, it is essential to supply PUFA from food. Marine derived food contains a high proportion of long chain PUFA. Aquaculture is one of the fastest growing food sectors in the world.

The most common type of breeding is rainbow trout in Turkey and even in the world. Rainbow trout is a species with large eggs and these eggs are affected from dietary components as diverse as fatty acids, vitamins pigments and proteins (Fontagne-Dicharry et al., 2017).

Fish egg contains 11% albumin, 75 ovoglobulin and 13% collagen (Sikorski, 1994). Fish egg has a high content of nutritive lipids, particularly phospholipids and long chain unsaturated fatty acids (Mahmoud et al., 2008). Fish eggs are commonly consumed due to its high amount of protein, lipids, vitamins and minerals.

The objectives of this study were; (i) determine the fatty acid profile of rainbow trout meat and its egg, (ii) compare the PUFA contents of the supplies and (iii) reveal their relation with health.

MATERIALS AND METHODS

Materials

Farmed rainbow trout (*Oncorhynchus mykiss*) was purchased from the seafood market in Antalya, Turkey and fresh milked rainbow trout eggs were obtained from the fish farm located in Akçay creek (Finike-Antalya, Turkey). Fishes and fish eggs were transferred to laboratory in polystrene boxes with in an hour. The fishes were beheaded and gutted at once. The samples were packed in polyethylene pouches and stored at -80 °C prior to analysis.

Analytical procedures

FAME Analysis: Fatty Acid Esterification

A lipid sample of 10 mg dissolved in 2-mL n-heptane was mixed with 4-mL 2-M methanolic KOH and centrifuged at 4,000 rpm for 10 min (Ozogul et al., 2007). The upper layer was injected into a gas chromatograph (GC; Clarus 500, Perkin Elmer, Waltham, MA, USA).

FAME Analysis: Gas Chromatographic Conditions

A GC instrument with BPX70 fused silica column (50 m × 0.22 mm, film thickness 0.25 µm; SGE Inc., Victoria, Australia) and equipped with a flame ionization detector was used. The oven temperature was held at 140°C for 5 min, and then raised to 200°C at 4°C/min and without holding, raised to 220°C at 1°C/min. T

he injection temperature was set at 220°C. Helium was the carrier with 1.0 mL/min flow rate. The detector temperature was set at 280°C.

The split used was 1:50. Fatty acids were identified by comparison with the retention times of standard fatty acid methyl esters (FAME Mix, C4-C24 Unsaturates, Supelco, Bellefonte, PA, USA). The results were expressed as a percentage of the total of the identifiable fatty acids.

Health lipid indices

From the data of fatty acid profile, the atherogenicity (AI, showing the inhibition of the aggregation of plaque and diminishing the levels of esterified FA, cholesterol, and phospholipids, thereby preventing the appearance of micro- and macro-coronary diseases) and thrombogenicity (TI, showing the tendency to form clots in the blood vessels) were calculated as follows (Ulbritcth and Southgate, 1991).

$$AI = [12:0 + (4x14:0) + (16:0)] / (\Sigma MUFA + \Sigma PUFA\ n\text{-}6 + \Sigma PUFA\ n\text{-}3)$$

$$TI = (14:0+16:0+18:0) / [(0.5 \times \Sigma MUFA) + (0.5 \times \Sigma PUFA\ n\text{-}6 + (3x\ \Sigma PUFA\ n\text{-}3) + (n\text{-}3 /(n\text{-}6)]$$

Statistical analysis

Homogenized samples were prepared as two parallels and two recurrences. Test plan was defined and analyses of variance (ANOVA) carried out. Different results are used for multiple comparison tests. Statistical analysis was performed using SAS program (Statistical Analytical Systems, Cary, NC) (Duzgunes et al., 1987).

RESULTS AND DISCUSSIONS

The lipid contents of rainbow trout and its egg were 5.66±0.04 g and 10.34±0.84 in wet weight, respectively.

Fatty acid profile of rainbow trout meat and egg revealed that these foods are good sources of PUFA (Figure 1). Total PUFA contents in rainbow trout meat were 40.76% and 43.01% in egg. Mono-unsaturated fatty acids (MUFA) content ranged between 34.26 and 36.66%. Both sources had low saturated fatty acids (SFA) content.

It is recommended that a diet must be composed of high concentrations of PUFA. The ratio of n6/n3 should be less than 4, n3/n6 should be more than 6 and PUFA/SFA should be more than 0.4 (Wood et al., 2003). PUFA/SFA ration in trout meat is 1.64, meanwhile this ratio is 2.23 in trout egg.

The higher values are preferred in both PUFA/SFA and n3/n6 ratios which are satisfied with rainbow trout egg due to prevention of coronary hearth diseases, plasma lipid levels and cancer risks (Simat et al., 2015).

As can be seen from Figure 2, EPA+DHA content of the eggs are (23.23) higher than fish flesh (14.01).

Long-chain PUFA especially EPA and DHA are reported to have cardio-protective effects. Simopoulos (1999) reported that daily

consumption of EPA+DHA should not be less than 0.22 g.
The consumption of rainbow trout meat and egg meets this requirement.

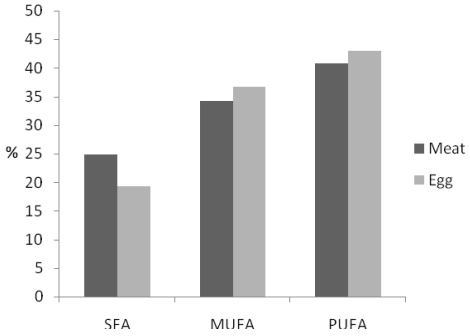

Figure 1. SFA, MUFA and PUFA contents of rainbow trout meat and egg

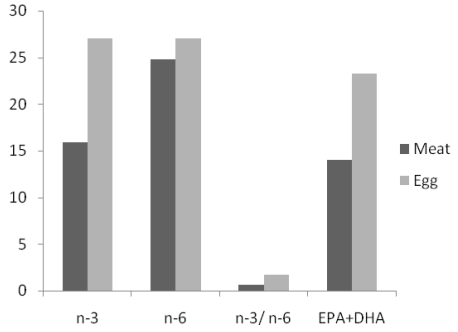

Figure 2. n-3, n-6, n3/n6 and EPA+DHA contents of rainbow trout meat and egg

Atherogenicity and thrombogenicity indexes are related with both coronary heart diseases and nutritional quality of fatty acids (Figure 3).
The recommended level is 0.4-0.5 which is considered beneficial for humans (FAO/WHO, 1994).
Both fatty acids supplies have values close to the recommended levels.
Higher levels of plant-originating C18:2n-6 presents in manufactured feeds affect the n-3/n-6 ratio in the edible part of the fish, thus reducing the nutritional quality of lipids Grigorakis, 2007).
The broodstock diets such as certain nutrients and antioxidants have direct effect on egg quality (Sawanboonchun et al., 2008).

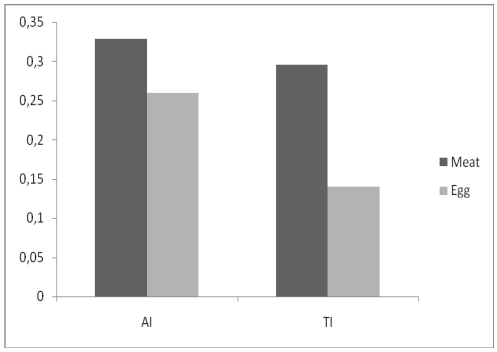

Figure 3. AI and TI values of rainbow trout meat and egg

CONCLUSIONS

A comparison of PUFA content between fish species and its egg has not been examined before. It was revealed that rainbow trout egg has higher PUFA content than fish meat. Moreover, the eggs of rainbow trout meet the recommended values for PUFA/SFA, n3/n6 ratios and EPA+DHA content. Both rainbow trout meat and egg can be consumed as good sources of healthy fatty acids.

ACKNOWLEDGEMENTS

This study was a part of project which was supported by the Scientific and Technological Research Council of Turkey (TUBİTAK, grant no: 115O691).

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