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COMPARISON OF ESSENTIAL TRACE ELEMENT PROFILES OF RAINBOW TROUT FISH (*ONCORHYNCHUS MYKISS*) MEAT AND EGG

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Abstract

Many mineral compounds, present in fish meat, are essential for human life at low concentrations. Humans need a steady supply of at least minerals to maintain health and optimal performance. The elements such as Fe, Cu, Mn and Zn are essential elements because of their crucial role in biological systems. In this study, essential element profiles of rainbow trout meat and its egg were investigated and compared each other. Higher concentrations of essential trace elements (Fe, Cu, Mn and Zn) were found in egg of rainbow trout compared to its meat. Highest Zn (140.28±4.24 µg/g) content was determined in trout egg samples compared to other trace elements. Fe (48.17±1.61 µg/g) was the most abundant trace elements found in trout meat, whereas Mn (1.24±0.04 µg/g) was the least.

Key words*: Rainbow trout egg, fish meat, Oncorhynchus mykiss, essential trace elements.*

INTRODUCTION

Seafood is widely consumed in all over the world because of its high protein, lipid (Omega-3 fatty acids) and mineral content. Aquatic foods are very rich sources of macro and trace elements known as minerals. The total mineral content of aquatic foods is in the range of 0.6–1.5% wet weight (Erkan and Özden, 2007). Five macro (sodium, Na; potassium, K; magnesium, Mg, calcium, Ca; phosphorus, P) and four trace elements (iron, Fe; manganese, Mn; copper, Cu; zinc, Zn) are essential for regulation of healthy functions in the human body. The major minerals, Ca, P and Mg, are involved in bone health. Fe is the most abundant trace element in the human body and its insufficient daily intake results in anaemia. Mg, Mn and Zn are responsible for activity regulation of several enzymes (Taskaya et al., 2009).

Rainbow trout (*Oncorhynchus mykiss*) is a member of the Pacific trout and belongs to the Salmonidae family. They survive in cold, clear and well-oxygenated lakes, rivers and streams with the ideal temperature, ranging between 13°C and 15.5°C (Fallah et al., 2011). Rainbow trout is widely cultured, appreciated and consumed fish species. Fish flesh and egg are known nutritive seafood products because of their lipid, protein and mineral content. Fish eggs are rich source of vitamins and minerals (Fe, Mg, Mn, P, K, Cu and Zn) (Bledsoe et al., 2003).

Referring to existing scientific literature, few studies have found regarding essential elements composition of rainbow trout. In addition, no studies have been carried to determine and compare differences between trout meat and egg in terms of essential trace element contents. Thus, objective of this study was to determine and compare of essential trace elements in edible flesh and egg of farmed rainbow trout for the first time.

MATERIALS AND METHODS

Materials

The farmed rainbow trout (*Oncorhynchus mykiss*) fish was provided from the seafood market (Metro gross market, Antalya, Turkey) in January 2017. 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 eviscerated manually to obtain fillets. The samples were packed in polyethylene pouches and stored at -80 °C prior to analysis.

Analytical procedures

The meat and egg samples were dried in laboratory oven at 90°C for 24 hours until a constant weight was obtained, allowed cooling. Then samples were ground in a household grinder. Digestion of the samples was performed by using microwave, pressure digestion system (Berghof Speedwave, Eningen Germany). A sample (0.20 g) was mixed with 6 ml of nitric acid in a container. The system was heated up to 190°C for 20 min. After cooling to ambient temperature, the solution was filtered through a 0.45 µm nitrocellulose membrane filter, followed by transfer to an acid-washed volumetric flask and made up to volume with double deionized water. Blank digest was also carried out in the same way. Analysis of the elements (Fe, Cu, Mn and Zn) was carried out by inductively coupled plasma-optical emission spectrophotometer (ELAN DRC-E ICP-MS, Perkin Elmer, USA) equipped with a Scott spray chamber (Norwalk, C, USA). Details of the instrumental operating conditions are depicted in Table 1.

Table 1. ICP-OES instrumental operating conditions

Parameters*	Responses
RF generator power (W)	1000
Plasma gas flow rate (l/min)	19
Auxiliary gas flow rate (l/min)	1.2
Nebulization gas flow rate (l/min)	0.81
Sample uptake rate (ml/min)	1
Type of detector	Solid state
Type of spray chamber	Cyclonic
Injector tube diameter (mm)	0.3
Measurement replicates	3
Element (λ/nm)	Fe: 259.939; Cu: 324.754; Mn: 257.610; Zn: 213.856;

Statistical analysis

All experiments were conducted in duplicate, and all analyses were done at least in duplicate. The data were recorded as mean ± standard deviation (SD) for measurements. Statistical analysis was conducted according to the statistical analysis software of SAS institute (Statistical Analysis System, Cary, NC, USA). Differences among the mean value of samples were tested by Duncan's Multiple Range Test and significance was defined at $P<0.05$.

RESULTS AND DISCUSSION

Essential trace element concentrations in rainbow trout meat and egg

Table 2 shows the mean concentrations of the essential trace elements in egg and meat of rainbow trout fish.

Table 2. Essential trace element concentrations in meat and egg of rainbow trout fish*

Element	Meat (µg/g)	Egg (µg/g)
Fe**	48.17 ± 1.61^{B}	98.16 ± 2.97^{A}
Zn**	12.56 ± 0.42^{B}	140.28 ± 4.24^{A}
Mn**	1.24 ± 0.04^{B}	18.46 ± 0.26^{A}
Cu**	3.33 ± 0.11^{B}	8.15 ± 0.25^{A}

* In dry matter; **Essential elements

Our study showed that essential trace element concentrations of egg samples were significantly higher ($P<0.05$) than meat samples. Fe and Cu were predominant in trout egg. Fe, Cu, Mn and Zn are essential for growth, reproduction and energy metabolism in all living organisms (Fallah et al., 2011; Verep et al., 2007). Iron (Fe) deficiency is one of the most widely known nutritional disorders that affect an estimated two billion people worldwide (Pretorius et al., 2016). Pregnant women, infants, young children and adolescents have higher iron requirements and are at greater risk of developing iron deficiency (Zimmerman and Hurrell, 2007). Fe concentration (98.16 µg/g) of egg samples was twofold higher than meat (48.17 µg/g) samples. Fig. 1 shows Fe and Zn contents of rainbow trout meat and egg. Our results were significantly higher than results of Fallah et al. (2011). The researchers found that wild and farmed rainbow trout meat contains 32.46 and 15.47 µg/g Fe, respectively. Fe content (98.16 µg/g) of rainbow trout egg was found higher than those of skipjack (70.22 µg/g) and tongol (55.24 µg/g) fish eggs but lower than those of defatted bonito fish egg (122.17 µg/g) (Intarasirisawat et al., 2011). Higher Zn concentration was observed in egg samples

(140.28 µg/g) compared to meat samples (12.56 µg/g). Lower Zn concentrations have been reported for wild (46.74 µg/g) and farmed (20.97 µg/g) trout meat by (Fallah et al., 2011).
Manganese (Mn) is an essential trace metal for human and animals, since it is involved in many physiological processes. Particularly it plays an important role in the metabolism of proteins, carbohydrates, lipids and in the production of steroids sexual hormones, moreover is the cofactor of enzymes such as RNA synthetase, glutamine synthetase, pyruvate decarboxylase, Mnsuperoxido desmutase and arginase (Wedler, 1993).

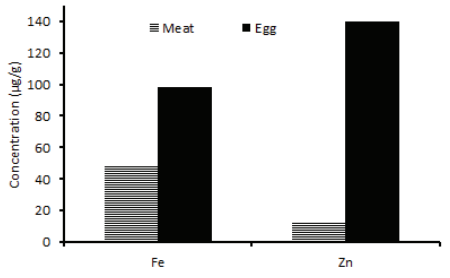

Figure 1. Iron (Fe) and zinc (Zn) concentrations in rainbow trout meat and egg

Figure 2 shows Mn and Cu contents of rainbow trout meat and egg. Mn concentration of egg samples was significantly (P<0.05) higher than concentration of meat samples.

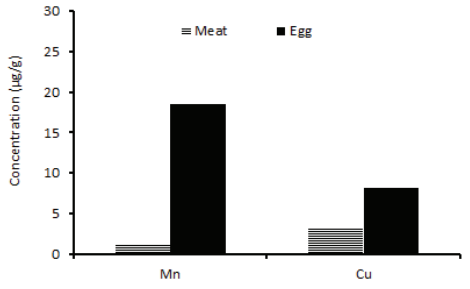

Figure 2. Manganese (Mn) and copper (Cu) concentrations in rainbow trout meat and egg

Egg samples contain 18.46 µg/g Mn, whereas Mn content of meat samples was 1.24 µg/g. Higher Mn concentrations have been reported for wild (13.93 µg/g) and farmed (6.26 µg/g) trout meat by Fallah et al. (2011). Mn content of trout egg was higher than those of skipjack (0.34 µg/g), tongol (0.80 µg/g) and defatted bonito (0.78 µg/g) fish eggs (Intarasirisawat et al., 2011).
Copper (Cu) is required for iron utilization, and as a cofactor for enzymes involved in glucose metabolism and the synthesis of hemoglobin, connective tissue and phospholipids (Celik and Oehlenschlager, 2004). Cu content of rainbow trout egg (8.15 µg/g) was significantly (P<0.05) higher than those of trout meat (3.33 µg/g). Higher Cu contents were found for wild (8.40 µg/g) and farmed (21.81 µg/g) rainbow trout meats (Fallah et al., 2011). Cu content of egg samples (8.40 µg/g) was lower than those of skipjack (12.72 µg/g), tongol (12.48 µg/g) and defatted bonito (34.35 µg/g) fish eggs (Intarasirisawat et al., 2011).

CONCLUSIONS

This study gives valuable information on the essential trace element contents in meat and egg of farmed rainbow trout. Essential trace elements (Fe, Zn, Mn and Cu) content of rainbow trout egg was significantly (P<0.05) higher than those rainbow trout meats. It could be stemmed from owing to the fact that essential trace nutrients such as elements are necessary for growing. Thus rainbow trout eggs could be serve as a good source of essential minerals for human and animals.

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