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Original article

Mineral Contents and Fatty Acids Compositions of Fillets of Female and Male Pangas (*Pangasius Hypophthalmus*, Sauvage 1878) Cultured in Turkey

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Abstract. Pangas (Pangasius hypophthalmus) is a food resource with great economical importance in Asian countries. This study provides baseline data on some macro and micro minerals and fatty acids composition in fillets of female and male Pangasius hypophthalmus cultured in Turkey. Among the minerals determined in both fillets samples, Na was found to be highest, followed by K, Mg and Ca. The order of average micro minerals concentrations was Fe>Zn>Cu>Mn in both fillet samples. In the research, statistically significant differences were not observed in all determined macro and micro minerals when compared to each other. The major fatty acids detected were C16:0, C18:0, C18:1(n-9) and C18:2 (n-6). The results revealed that fillets of male pangas are a better source of minerals, protein and fatty acids than fillets from female pangas.

Key words: Pangasius hypophthalmus, panga, mineral composition, fatty acid profile, proximate composition

Introduction

Pangasius hypophthalmus is an exotic farmed freshwater fish species which is commonly known as panga fish in Turkey (1, 2, 3). This fish species is also called as Asian catfish, sutchi catfish, striped catfish or tra fish in various countries (4).

Pangas is gaining significance in aquaculture due to its fast-growing and as well as high potential for export in Asian countries such as Vietnam, Bangladesh, Thailand, Malaysia, Indonesia, Laos, Cambodia, Philippines, Singapore, China and India. Among of those, Vietnam is the greatest producing country of Pangas (4, 5). The species has an fundamental importance for consumers in developing countries because of mild flavor and comparatively low prices in supermarkets (6). The consumption of pangas is also growing in other part of world, such as Russia, Spain, France, Italy, Turkey and other European countries and have become highly appreciated by consumers in the United States and Canada. Especially skinless and boneless frozen fillets, thawed fillets and chilled-stored has a rising demand in supermarkets and at fresh seafood markets in Western countries, over the last decade (7, 8).

Fish which are known to have quite a big role in human nutrition are a source of rich amounts of animal protein, minerals and unsaturated fatty acids. Four macro elements (Sodium (Na); Potassium (K); Magnesium (Mg); Calcium (Ca)) and four micro elements (Iron (Fe); Manganese (Mn); Copper (Cu); Zinc (Zn)) constitute important components of hormones, enzymes and enzyme activators. The minerals participate in several biochemical reactions in the human body and it should be consumed within the needs of the organism. The macro elements, Ca and Mg, play a role in bone health; Na is important in nerves and muscles work; K, helps in nerves to function and muscles to contract. Fe is the most abundant essential trace element in the human body among the micro elements, and its deficiency results in anaemia; Zn is the second most abundant transition micro element in organisms after Fe. Zn is responsible for activity regulation

of several enzymes with Mn. It is notified that the recommended daily amount of Zinc is 10-15 mg for men and 7-11 mg for women (9). Cu is the third most abundant trace element and is present in almost every tissue of the body (10, 11, 12 ,13). The daily intake level for copper is reported as 1.5-3 mg for men and women (9). If one of these minerals are not supplied an acceptable extent to the body, primarily by dietary intake, the individual might suffer from mineral deficiency diseases (14).

PUFAs (polyunsaturated fatty acids) are important components that reduce risk for coronary heart diseases. Thus, knowing that the major components of fish oils are PUFAs which have certain pharmacological and physiological effects on human health, has increased interest towards these fatty acids in the recent years (15). Moreover, PUFASs have been reported to have beneficial effects in the treatment of patients with AIDS and diabetic (16). Hence, many researchers have recently studied on minerals and the fatty acid contents in different kind of fish in various parts of the world. Variation in fatty acid contents and minerals would affect the nutritional value as well as texture and the organoleptic qualities of fish (17). Thus, for optimal use, it would be impressive to have information and keep a record on nutritional quality of fillets of *Pangasius hypophthalmus* for healthy consumption. The present work was, therefore, conducted to compare the differences between the minerals, proximate and fatty acid compositions in fillets of female and male pangas (*P. hypophthalmus*) cultured in Turkey.

Material and Methods

Raw Materials

Freshwater pangas (*Pangasius hypophthalmus*) used in this study were obtained from the region of Eegean from Turkey, preserved in crushed ice and transferred to the laboratory, where gutted and filleted manually. All specimens were packed in separate labelled polythene bags and stored at -20°C until process of laboratory analysis. Total twenty fillets samples of male and female *Pangasius hypophthalmus* were used in this research.

Methods

The crude protein analysis of panga fillet samples was performed by Kjeldahl Method (18) and the lipid analysis was carried out according to Bligh and Dyer (19) method.

To estimate the moisture in the fillet samples, the initial weight of the samples and the weight after drying in an oven at 105°C for 12 h was recorded. The average ash quantity in fillets was calculated after samples were treated in a muffle furnace at 550 °C for 6 h (20).

For analysis of total macro and micro elements (Na, Mg, Ca, Mn, Cu, Fe, Zn) in experiment, fillets samples, 0.25g was digested in a microwave oven (Berghoff MWS-4) by using acidic mixture of 65 % HNO_3 then the concentrations were determined by using Inductively coupled plasmaoptical emission spectrometry (Perkin Elmer-NexION 350X).

IUPAC Methods II. D. 19 (21) was used to prepare the methyl esters of fatty acids of panga fillet samples. To determine the fatty acid composition of samples, analyses were done by using a Perkin Elmer Autosystem XL Gas Chromotography and Flame Ionization Detector (FID) equipment and a Supelco 2330 fused silica capillary column (30 mx 0.25 mm x 0.20 μm film thickness).

Lipid Quality Indexes

Following three indices were used to calculate the nutritional quality of the total lipids

Atherogenicity Index (AI) = [(4xC14:0+C16:0+C18:0)] / [(ΣMUFA+Σ*n*-3 +Σ*n*-6)]

Thrombogenicity Index (TI) = [(C14:0+C16:0+C18:0)] / [(0.5xΣMUFA) + (0.5xΣn-6) + (3xΣn-3) + (Σ*n*-3/Σ*n*-6)] (22)

Hypocholesterolemic/Hypercholesterolemic Fatty Acid Ratio (h/H) = [C18:1*n*-9+C18:2*n* 6+C20:4*n*-6+C18:3*n*-3+C20:5n-3+C22:5*n*-3+C22:6*n*-3)]/ C14:0+C16:0) (23)

Statistical Analysis

The data from results of analysis were subjected to independent t-test at alpha level of 0.05 significance

by using the SPSS program version 17.0 for Windows. The mean values were reported as X±SD.

Results and Diıscuiıon

Generally, the protein and lipid contents of cultured fish are variable due to fish feeding and movement of fish muscle (24).

Proximate composition including protein, lipid, moisture and ash of female and male pangas fillets (*Pangasius hypophthalmus*) is shown in Table 1.

Averages sharing the same superscript are not statistically significant (p>0.05)

The results revealed that the protein (13.71%), lipid (1.40%) and ash (0.84%) contents are higher in male pangas fillets whereas moisture contents (83.84%) is slightly higher in female pangas fillets. However a statistical significance was observed only in protein contents when compared to each other (p<0.05). It was reported that based on their fat content, fish are grouped as lean (up to 2% fat), semi-fat fish (2-7% fat), fatty fish (7-15% fat) and very fat (over 15% fat) (25). As can be seen in Table 1, *P. hypophthalmus* is involved in lean fish group with its fat ratio which is less than 2% and might be also characterised by low lipid contents and high percentages of moisture. The results are consistent to those of Orban et al. (26) who reported that moisture is the most abundant component (80–85%) in *P. hypophthalmus* fillets from Vietnamese and marketed in Italy. However same authors also reported the panga fish can be characterized by relatively low protein (12.60–15.60%) and fat (1.10–3.00%) content. In another study on chemical quality of frozen Vietnamese *P. hypophthalmus* fillets protein, lipid, moisture and ash contents were between 12.51–14.52%; 1.09-1.65%; 83.83–85.59% and 0.76–2.38% respectively (4). In the present study, in both fillet samples, the percentage contents of protein, lipid, moisture and ash of *P. hypophthalmus* were within the range for those reported prior research.

Table 1. Proximate composition (%) in fillets of Panga (*P. hypophthalmus*)

Parameters (%)	Female Pangas	Male Pangas
Protein	13.00±0.11[a]	13.71±0.13[b]
Lipid	1.33±0.04[a]	1.40±0.03[a]
Moisture	83.84±0.44[a]	83.03±0.42[a]
Ash	0.82±0.01[a]	0.84±0.01[a]

Table 2. Macro elements in fillets of Panga (*P. hypophthalmus*)

Parameters (g kg^{-1})	Female Panga	Male Panga
Na	6.261±0.03[a]	7.013±0.04[b]
Mg	0.277±0.01[a]	0.311±0.02[a]
Ca	0.104±0.01[a]	0.108±0.01[a]
K	2.376±0.02[a]	2.636±0.01[b]

Table 3. Micro elements in fillets of Pangas (*P. hypophthalmus*)

Parameters (µg g^{-1})	Female Panga	Male Panga
Cu	0.44±0.01[a]	0.64±0.01[b]
Fe	5.60±0.02[a]	9.35±0.03[b]
Zn	2.97±0.02[a]	3.57±0.02[b]
Mn	0.18±0.01[a]	0.22±0.01[a]

In Table 2 and Table 3, the macro and micro element contents in fillets of Pangas are presented.

Averages sharing the same letters are not statistically significant (p>0.05)

The order of average macro elements concentrations detected in P. *hypophthalmus* fillets samples was Na>K>Mg>Ca and the micro elements order was Fe>Zn>Cu>Mn, for both fillet samples (Table 2 and Table 3).

Averages sharing the same letters are not statistically significant (p>0.05)

According to table 2 and table 3, the average quantity of macro and micro elements in male pangas fillets were higher than those determined in female panga fillets. However, in our study significant differences were observed only for Na, K, Cu, Fe, Zn (p<0.05). From this point of view it can be said that fillets of male panga are more significant source of Na, K, Cu, Fe, Zn than female pangas.

The Na, K, Mg and Ca contents of pangas were reported within the same order by Orban et al. (26) who study nutritional quality of *P. hypophthalmus* fillets from Vietnamese available on the Italian markets as 3.875 g kg^{-1}, 3.356 g kg^{-1} 0.1208 g kg^{-1} and 0.0803 g kg^{-1} repectively. In another study on mineral profile in Vietnamese panga fish (*P. hypophthalmus*), the

levels of Na, K, Mg and Ca were reported as 6 g kg^{-1}, 1.8 g kg^{-1}; 0.173 g kg^{-1} and 0.08 g kg^{-1} respectively (27). Cenzano et al. (27) reported the values of Cu, Fe, Zn and Mn as 0.1 µg g^{-1}; 1.6 µg g^{-1}; 2.44 µg g^{-1};< 0.1 µg g^{-1} respectively. The values obtained present study are slightly higher than those reported by Orban et al. (26) and Cenzano et al. (27) for Vietnamese panga fish. This difference is thought to be related to fish feeding system and different types of diet composition.

The results presented in this study also show that fillets of pangas cultured in Turkey are rich in minerals and the average micro elements levels in fillest (for both samples) are lower than the maximum permitted levels proposed by WHO and FAO (28). The fatty acid profile of male and female species are displayed on Table 4.

Averages sharing the same letters are not statistically significant (p>0.05) nd: Not detected

As can be seen in Table 4, sixteen fatty acids in lipids of pangas fillets were evaluated and arranged in classes as saturated fatty acids (SFAs), monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs). It was found that SFAs constitute the largest amount of total fatty acids followed by PUFAs and MUFAs in fillets of female and male pangas.

Table 4. Fatty acid profiles in fillets of Panga (*P. hypophthalmus*)

Fatty Acid Profiles	**Female Pangas (%)**	**Male Pangas (%)**
C14:0 (Myristic acid)	1.0993±0.01[a]	0.7131±0.01[b]
C16:0 (Palmitic acid)	26.9197±0.06[a]	23.1547±0.05[b]
C18:0 (Stearic acid)	26.7781±0.05[a]	20.9294±0.04[b]
C20:0 (Arachidic acid)	0.4047±0.01[a]	0.2287±0.01[b]
C22:0 (Behenic acid)	1.8940±0.02[a]	2.7509±0.02[b]
∑ SFA	***57.0958*±0.15**[a]	***47.7768±0.13***[b]
C16:1 (Palmitoleic acid)	nd[a]	0.4745±0.01[b]
C18:1 (*n*-9) (Oleic acid)	20.7842±0.03[a]	21.3802±0.02[b]
C20:1 (Eicosenoic acid)	nd[a]	0.3055±0.01[b]
∑ MUFA	***20.7842±0.03***[a]	***22.1602±0.04***[b]
C18:2 (n-6) (Linoleic acid)	8.1761±0.02[a]	9.2101±0.02[b]
C18:3 (*n*-3) Alpha-linolenic acid ALA)	nd	0.2691±0.01[b]
C18:3 (*n*-6) (Gama-linoleic acit, GLA)	0.9262±0.02[a]	1.1208±0.02[b]
C20:2 (*n*-6) (Eicosadienoic acid)	0.6844±0.01[a]	1.0392±0.03[b]
C20:4 (*n*-6) (Arachidonic acid)	5.5973±0.01[a]	8.4777±0.02[b]
C20:5 (*n*-3) (Eicosapentaenoic acid, EPA)	nd	0.3010±0.01[b]
C22:5 (*n*-3) (Docosapenthonoic acid)	3.1319±0.01[a]	3.7087±0.01[b]
C22:6 (*n*-3) (Docosahexaenoic acid, DHA)	2.6039±0.03[a]	4.9365±0.02[b]
Σ PUFA	***21.1198±0.09***[a]	***29.0631±0.14***[b]
Σ *n*-3 PUFA	**5.7358**	**9.2153**
Σ *n*-6 PUFA	**15.384**	**19.8478**
***n*-3/*n*-6 PUFA**	**0.372**	**0.464**
PUFA/SFA	0.370	0.608
AI	1.387	0.916
TI	1.536	0.9121
h/H	1.4379	2.0235

Among these the highest concentrations of SFAs (57.09%) were identified in female fillets while the highest concentrations of PUFAs (29.06%) and MUFAs (22.16%) were identified in male fillets. The difference between the contents of SFA, PUFA and MUFA were statistically significant ($p<0.05$) for both fillets. Dominated SFAs detected in fillets were C16:0 and C18:0. These results agree with studies on fatty acid profile of *P. hypophthalmus* reported by Thammapat et al. (4), Ho & Paul (29), Karl et al. (30), Sokamte et al. (31). In the present study, the total PUFA constituted about 21.11% of total fatty acids in female panga fillets, while it was higher in male fillets with 29.06%. The major contributors to PUFAs was C18:2 (n-6) (Linoleic acid) in both group. The ratios of the n3/n6 and the total PUFA/SFA were found to be higher in fillets of male pangas as 0.464 and 0.608 respectively, whereas, it was found as 0.372 and 0.370 respectively, in female pangas fillets.

The ratio of n3/n6 is widely reported to range from 0.24 to 4.1 for different fish species and used as an index for assessing the nutritional quality of fisheries products (10, 32, 33). In the current study, for female panga fillets, the total n-3/n-6 ratio were within the range reported for some different fish species while the ratio was slightly higher in male fillets. The ratio of total PUFA/SFA is proposed to be above 0.45 in human diets to decrease the risk of cardiovascular and some chronic diseases such as cancer. In other word, foods with total PUFA/SFA coefficient below 0.45 have been considered undesired for human nutrition because of their potential to induce cholesterol increase in the blood (34). In the current study, in female fillets, the total PUFA/SFA ratio was found lower (0.370) than recommended level (0.45) for human diets while the ratio was higher than 0.45 in male fillets.

The h/H ratio and the indexes of AI, TI indicate the nutritional quality of food according to fatty acids fractions and their potential effect on the development of cardiovascular disease (16, 35). There is no recommended maximum or minimum amount considered to be favorable for human health. But from nutritional point of view, it was reported that high h/H ratio and AI and TI indexes lower than one are desirable in lipids for prevention of cardiovascular disorders (32, 35). The results presented in this work show that, AI and TI indexes had higher values, 1.387 and 1.536, respectively, for female panga fillets while h/H ratio was higher in fillets from male panga (2.023).

Conclusions

In view of the results obtained by this study on pangas cultured in Turkey, it can be said that the both of panfagas fillet samples are rich in minerals and are groupped as lean fish because of their low lipid contents. However, regarding the lower AI and TI index, total proteins, minerals and percentages of PUFAs, male pangas is more desirable item for the human diet.

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