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Comparative Analysis of Nutritive Composition, Fatty Acids, Amino Acids and Vitamin Contents of Wild and Cultured Gilthead Seabream (*Sparus aurata* L. 1758)

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Abstract: In this study, nutritional value, fatty acids, vitamin and amino acid contents of cultured and wild gilthead seabream (*Sparus aurata* L. 1758) were comperatively investigated. Fat and moisture contents of the wild type and cultured fish were 69.810±0.040-68.38±0.020 and 8.7±0.030-10.10±0.050%, respectively and the difference was statistically significant ($p<0.05$). However, difference in protein content of both wild and cultured fish (18.880±0.080 and 19.0±0.050%, respectively) was insignificant ($p>0.05$). Aspartic asit, threonin, serine, glutamic asit, valine, methionine, isoleucine, leucine, tyrosine, histidine and arginine content were significantly higher ($p<0.05$) in wild fish, wheras proline, glycine, alanine, phenylalanine and lysine were significantly higher ($p<0.05$) in cultured fish. Vitamin A content was significantly higher in cultured fish ($p>0.05$), however, vitamins E and B_2 were abundant in wild fish as compare to the cultured fish ($p>0.05$). Of monounsaturated fatty acids, oleic and palmiteloic acid contents of both cultured and wild gilthead seabreams were insignificant ($p>0.05$), whereas linoleic acid content was higher in cultured fish ($p<0.05$). As for the polyunsaturated fatty acids, α-linolenic acid and eicosanoic acid contents were insignificant in both cultured and wild fish. However, Docosaheksaenoic (DHA) ve Eicosapentaenoic (EPA) acid contents were significantly higher in cultured gilthead seabreams ($p<0.05$).

Key words: Gilthead seabreams, nutritional value, unsaturated fatty acid, saturated fatty acids, amino acids

INTRODUCTION

Fish is one of the main sources of protein and fat and has become as a healthier alternative to meat for the last 50 years. In addition to protein and fat, fish contain essential amino acids, vitamins and minerals and a larger portion of omega 3 and other unsaturated fatty acids that are healthier than the saturated fat of read meat (Varlik *et al*., 2004).

Fish oil consisted of mostly unsaturated fatty acids is a good source of vitamins A and D, as well as B derivatives. Fish oil is also, the major source of ω-3 fatty acids such as eicosapentaenoic and docosahekzaenoic acids. The ω-3 fatty acids are known to reduce the aterosclerosis risks by lowering the blood cholesterol (LDL) level (Hagstrup, 2001).

In this study, we aimed to compare nutritional value, fatty acids, amino acids and vitamin contents of wild-caught and cultured gilthead seabream.

MATERIALS AND METHODS

Wild-caught and cage cultured gilthead seabream with a mean weight of 329.88±7.11 g were used in the study. The Kjeldahl method was used for protein analysis according to the AOAC (1995) procedure and fat determination was performed in a Soxtec Systems. Moisture analysis was performed using oven drying method, A, E and B_2 vitamins were analyzed in HPLC (Levin, 1997) and fatty acids were analyzed by using the IUPAC gas chromatograph methodology (Frestone and Horwitz, 1979). Amino acid analysis was carried out in an external laboratory (TUBITAK Marmara Research Centre, Gebze) using an Eppendorf Biotronic LC 3000 Amino acid Analyzer. The data were evaluated with anova and t-test.

RESULTS AND DISCUSSION

Fatty acid contents of wild and cultured gilthead seabream were shown in Table 1. Amino acid contents (mg 100 g^{-1}) of wild and cultured gilthead seabream were shown in Table 2. Nutritional value (%), fat, moisture and vitamin contents (mg 100 g^{-1}) of wild and cultured gilthead seabream were shown in Table 3.

Moisture contents in wild and cultured gilthead seabream detected ranged from 69.81-68.38%. Since, wild fish has more moisture content than cultured counterparts and because of reciprocal relationship between fat

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Table 1: Fatty acid contents of wild and cultured gilthead seabream (%)

Fatty acids	Wild	Cultured
Lauric (C12:0)	0.0485±0.001[a]	0.0485±0.001[a]
Myristic (C14:0)	3.2805±0.017[a]	3.6405±0.011[b]
Pentadecanoic (C15:0)	0.4705±0.06[a]	0.4760±0.002[a]
Palmitic (C16:0)	15.881±0.114[a]	15.858±0.068[a]
Heptadecanoic (C17:0)	0.634±0.006[a]	0.636±0.004[a]
Stearic (C18:0)	4.4425±0.011[b]	4.164±0.006[a]
Oleic (C18:1n)	26.310±0.256[a]	25.981±0.022[a]
Linoleic (C18:2n)	14.619±0.045[b]	12.357±0.012[a]
Arachidic (C20:0)	0.352±0.022[a]	0.366±0.004[a]
Eicosanoic (C20:1n)	1.105±0.031[a]	1.309±0.005[a]
Eicosadienoic (C20:2)	0.470±0.045[a]	0.479±0.034[a]
Behenic (C20:0)	0.198±0.002[b]	0.158±0.002[a]
Docosadioneic (C22:2)	0.626±0.004[a]	0.618±0.005[a]
Tricosanoic (C23:0)	0.039±0.001[a]	0.046±0.003[a]
Lignoceric (C24:0)	0.0125±0.004[a]	0.116±0.002[a]
Docosaheksaenoic (C22:6n)	9.693±0.011[a]	10.178±0.04[b]
Tridecanoic (C13:0)	0.025±0.002[a]	0.027±0.001[a]
Myrristoleic (C14:1)	0.017±0.001[a]	0.017±0.002[a]
Pentadecanoic (C15:1)	0.098±0.004[a]	0.104±0.001[a]
Palmiteloic (C16:1)	5.437±0.034[a]	5.914±0.031[a]
Heptadecanoic (C17:1)	0.676±0.011[a]	0.730±0.008[a]
Elaidic (C18:1n)	0.218±0.004[a]	0.192±0.002[a]
Linoleaidic (C18:2n)	0.450±0.001[b]	0.424±0.002[a]
g-linolenic (C18:3n6)	0.203±0.03[a]	0.216±0.004[a]
α-linolenic (C18:3n3)	1.689±0.028[a]	1.524±0.002[a]
Henicosanaic (C21:0)	0.085±0.017[a]	0.107±0.002[a]
Eicosatri (C20:3n)	0.201±0.004[a]	0.198±0.002[a]
Erucic (C22:1n)	0.256±0.005[a]	0.327±0.003[b]
Nervonic (C24:1n)	0.323±0.004[a]	0.371±0.006[a]
Eicosapentaenoic (C20:5n)	3.398±0.059[a]	3.656±0.024[b]

Table 2: Amino acid contents of wild and cultured gilthead seabream (%)

Amino acid	Wild	Cultured
Aspartic	1705.00±1.000[b]	1591.00±95.00[a]
Threonine	760.50±25.00[b]	675.00±18.00[a]
Serine	713.00±49.00[b]	451.00±7.500[a]
Glutamic acid	2277.00±82.00[b]	2017.50±76.50[a]
Proline	225.00±2.000[a]	346.50±25.50[b]
Glycine	2016.00±1.000[a]	2437.00±187.00[a]
Alanine	973.00±6.000[a]	1095.50±50.50[b]
Valine	836.00±50.00[b]	767.00±24.00[a]
Methionine	466.50±29.50[b]	446.00±9.00[a]
Isoleucine	766.00±41.00[b]	729.00±31.00[a]
Leucine	1229.50±58.50[b]	1140.00±39.00[a]
Tyrosine	606.00±4.000[b]	588.50±21.50[a]
Phenylalanine	736.00±2.000[a]	738.00±38.00[b]
Histidine	625.00±4.000[b]	606.50±41.50[a]
Lysine	1626.50±99.50[a]	1707.00±30.00[b]
Arginine	1037.00±3.000[b]	942.50±17.50[a]

Table 3: Nutritional value (%) and vitamin contents (mg $100g^{-1}$) of wild and cultured gilthead seabream

Components	Wild	Cultured
Protein	vcvc18.880±0.080[a]	19.00±0.050[a]
Fat	8.700±0.030[a]	10.10±0.050[b]
Moisture	69.810±0.040[b]	68.38±0.020[a]
Vitamin A	0.027±0.002[a]	0.030±0.001[a]
Vitamin E	0.967±0.001[b]	0.198±0.001[a]
Vitamin B_2	0.110±0.020[a]	0.070±0.010[a]

Common superscripts in the same line signify means which are not significantly different (p>0.05)

content and moisture, fat content of cultured gilthead seabream is expected to be higher as reported by Cakli (1994). Similarly, Khalil *et al.* (1986) reported a significant difference in moisture contents of wild (74.8-75.7%) and cultured (69.1-74.5%) squire fish (*Chrysophrys auretus*).

Funuyama *et al.* (1991) reported moisture content variation in wild and cultured striped jack (*P. dentex*) as 58.0-67.2 and 45.2- 64.9%, respectively.

Fat contents detected in wild and cultured gilthead seabream were 8.7 and 10.10%, respectively. Cakli (1994) claimed that fat content of cultured gilthead seabream is 2-3 fold those of wild type. Aoki *et al.* (1991) showed significantly higher lipid content in cultured red seabream (*Pagrus major*) compared to wild type counterparts. Similarly, Funuyama *et al.* (1991) reported 12.4-40.7% fat content in cultured striped jack (*Pseudocaranx dentex*) as oppose to 7.9-22.2% in wild type. Nakagawa *et al.* (1991) compared amount of fatty acids in ayu (*Plecoglossus altivelis altivelis*) obtained from nine different region of Japan. They detected more than twice as much fat (8.2±2.5%) in cultured ayu than its wild types (3.4±1.7%). In addition, Hatae *et al.* (1989) reported higher fat contents in both cultured pory (*Pagellus erythrinus*) and Japanese amber jack *(Seriola quinqueradiata)* than their wild types, but not between cultured and wild type flounder (*Platichthys flesus*).

In this study, protein contents of wild type (18.88%) and cultured gilthead seabream (19.0%) were comparable. Similar results have been reported by other groups, for a number of fish. Cakli (1994) reported seasonal variations in protein contents of both wild type and cultured gilthead seabream. This variations were insignificant between two groups. Several investigators reported similar observations with Red sea bream, Japanese amberjack and Bastard halibut (Aoki *et al*., 1991; Iwamoto *et al*., 1990), pergy, Japanese amber jack, flounder (Hatae *et al*., 1989), striped jack (Funuyama *et al*., 1991) and Japanase jack mackerel (Kunisaki *et al*., 1986).

Dikel (1999) compared dry matter and protein contents of young trout (*Oncorhyncus mykiss*) grown in fresh and salt water. Protein contents of fish grown in fresh water (19.11%) and salt water (18.46%) were very similar, wheras lipid contents were higher in fish grown in salt water (1.45%) than in fresh water (0.96%). Dry matter values were insignificant (21.67 and 21.5%, respectively) between wild and cultured trout. Kunisaki *et al.* (1986) showed 10-20 fold higher fat content and low moisture in cultured horse macjerel than wild type. But protein and mineral contents were similar in both types.

According to Funuyama *et al.* (1991), cultured striped jack had higher percentage of lipid and protein content. In addition, wild type striped Jack contained 7 fold more thiamine, whereas cultured fish had 1.5 times more α-tocopherol than wild type. Autors also, observed higher riboflavin, vitamins E and B_2 contents but lesser moisture and vitamion A content in wild type fish.

Aoki *et al.* (1991) reported 2-4 fold higher lipid contents in 6 different Red sea bream. Although, moisture contents of all tested species were lower in wild type fish, protein contents were similar in both groups. Amino acids contents including taurine, histidine, lysine, arginine, glycine, alanine and glutamin varied among species.

In our study, we detected higher contents of aspartic asit, threonine, serine, glutamic acid, valine, methionine, isoleucine, leucine, tyrosine, histidine, arginine in wild type and higher proline, glycine, alanine, phenylalanine and lysine in cultured gilthead seabream.

Celik (1999) compared protein, lipid and dry matter of wild and cultured gilthead seabream. He reported 20.76 and 21.84% protein, 1.7 and 4.58% lipid and 23.68 and 27.89% dry matter in wild type cultured fish, respectively. Alasalvar *et al.* (2002) reporeted higher fat contents in cultured sea bass (*Dicentrarchus labrax*) with reduced moisture. It concluded that the lower moisture content was due to high-fat feeding and lack of activity. They found similar protein contents in both wild and cultured sea bass. Similarly, Nettleton and Exler (1992) reported 2.5 and 5 fold higher fat content in cultured coho salmon (*Oncorhyncus kisutch*) and cultured catfish (*Ictalurus punctatus*), respectively, than their wild type counterpars.

In this study, we observed similar palmitic acid content for wild (15.881%) and cultered gilthead seabream (15.858%), respectively (Table 1). However, stearic and myristic acid contents were significantly higher in cultured gilthead seabream than wild fish. While, oleic acid content was not different between wild and cultured gilthead seabream, linoleic and palmiteloic acid concentrations were significantly higher in cultured fish. Likewise, among the polyunsaturated fatty acids, α-linolenic and eicosatri acid contents were similar, wheras docosaheksaenoic and eicosapentaenoic acids were significantly higher in cultured gilthead seabream.

In a study by Cakli (1994), the average annual palmitic acid values in gilthead seabream were reported as 23.39 and 20.96% for wild type and cultured fish, respectively. Stearic acid contents were also higher in wild type (7.26%) than cultured gilthead seabream (5.11%). Average percent values of myrictic, oleic, palmiteloic and docosaheksaenoic acids were found to be higher in cultured fish. On the other hand, eicosapentaenoic acid level remained same in wild type and gilthead seabream. Higher linoleic and lower docosaheksaenoic acid levels were also reported by Wassef and Shehata (1991) in cultured red snapper. The eicosapentaenoic acid levels were similar in both wild and cultured fish. Lower stearic and palmitic acid levels in wild type Red sea bream, ayu, Japanese sea perch, Japanese jack mackerel, striped jack and Bestard halibut and higher eicosapentaenoic and palmiteloic acid contents were also reported by other researchers (Aoki *et al*., 1991).

Chanmugam *et al.* (1986) reported much higher n-3 fatty acid presence in cultured catfish. Various muscle fat contents were also investigated by Cakli and Celik (1995) in wild and cultured gilthead seabream. Two to three times higher fat presence in dark muscle of cultured fish than their wild type counterparts. Also, they observed higher eicosapentaenoic and docosaheksaenoic acid deposition in the muscles around linea laterale in wild and dorsal region muscles in cultured fish.

Nettleton *et al.* (1994) also reported 5 fold higher fatty acid consisting mostly of monounsaturated fatty acid (mostly 18: 1) levels in cultured catfish. Similar results were also reported in Red sea bream by Navarro *et al.* (1990). Nettleton and Exler (1992) reported very similar concentration variations in ascorbic, pantothenic, folic, thiamine, riboflavin, niasin, pridoksin, vitamin B_{12}, vitamin A and beta karoten levels in channel catfish, coho salmon and rainbow trout. Similar observations were reported by Kunisaki *et al.* (1986) in horse mackerelin. Other autors reported, higher linoleic acid levels in cultured carps and rainbow trout (Suzuki *et al*., 1986) and seven fold higher thiamine in wild and 1.5 times α-tocopherol in cultured striped Jack (Funuyama *et al*., 1991).

Celik and Gokce (2003) showed significant amount of ω-3 ve ω-6 fatty acids in wild cought tilapia. Rueda *et al.* (1997) showed higher unsaturated fatty acid presence in wild and high monounsaturated fatty acids in artificially fed red porgy. In a similar study, Alasalvar *et al.* (2002) reported significantly higher saturated and polyenoic fatty acids but lower monoenoic acid levels in wild sea bass.

CONCLUSION

Although, we found oleic, a-linolenic, eicosatri and linoleic acid levels higher in wild gilthead seabream than cultured ones, only linoleic acid levels were significant. DHA and EPA levels were significantly higher in cultured gilthead seabream. In addition to its economic importance, cultured fish provide a nutricious source of protein, particularly overpopulated areas. With the advances in fish culturing technologies and breeding, a high food value and textured fish meat production will be possible.

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