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PROOF

Comparison of Food, Amino Acid and Fatty Acid Compositions of Wild and Cultivated Sea Bass (*Dicentrarchus labrax* L.,1758)

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Abstract

In this research biochemical, amino acid and fatty acid compositions of wild and cultured sea bass (*Dicentrarchus labrax*) were compared.Crude protein (CP), crude fat (CF) and moist contents were 19.13% and 18.0%; 8.90% and 10.30%; 68.37% and 68.83% for wild and cultured sea bass, respectively. Essential amino acid (EAA) were 6921±11 and 7360.5±266.5 mg/100g in wild and cultured sea bass, respectively and the differences between them were insignificant (P>0.05). Saturated fatty acid (ΣSFA) were 26.50±0.06% and 25.11±0.01% in wild and cultured sea bass, respectively, and the differences between them was significant (P<0.05). Mono unsaturated fatty acids (ΣMUFA) were 27.55±0.22% and 30.14±0.02% andpoly unsaturated fatty acids (ΣPUFA) were 35.06±0.02% and 33.82±0.12% in wild and cultured sea bass respectively and the results between them were found insignificant (P>0.05).n3/n6rates were 2.02±0.01 and 1.02±0.06 inwild and cultured sea bass, respectively (P<0.05).It was found that C18:2n6c linoleic acid, C18:3n3a-linolenic acid and C22:1n9 erucic acid values in cultured sea bass and C20:5n3 EPA and C22:6n3 DHA in wild sea bass values were high.

Keywords: Seabass, *Dicentrarchus labrax*, biochemical composition, amino acid composition, fatty acid composition.

Doğal ve Yetiştiricilik Yoluyla Elde Edilen Levrek Balıklarının (*Dicentrarchus labrax*, L., 1758) Besin, Amino Asit ve Yağ Asitleri Kompozisyonlarının Karşılaştırılması

Özet

Bu çalışmada doğal ve kültür levrek balıklarının (*Dicentrarchus labrax*) besin, aminoasit ve yağ asitleri kompozisyonları karşılaştırılmıştır. Doğal ve kültür levrek balıklarında sırasıyla ham protein (HP) değerleri %19.13 ve %18.0; ham yağ (HY) değerleri %8,90 ve %10,3; nem oranları %68,37 ve %68,83 olarak bulunmuştur. Esansiyel amino asit (EAA) değerleri doğal ve kültür levrek balıklarında sırasıyla 6921±11 mg/100g, 7360,5±266,5 mg/100g tespit edilmiş ve fark önemsiz bulunmuştur (P>0,05). Doymuş yağ asit (ΣSFA) değerleri doğal ve kültür levrek balıklarında sırasıyla %26,498±0.059, %25,102±0,012 olarak tespit edilmiş ve fark önemli bulunmuştur (P<0,05). Doğal ve kültür levrek balıklarında sırasıyla tekli doymamış yağ asit (ΣMUFA) değerleri %27,553±0,22, %30,136±0,019; çoklu doymamış yağ asit (ΣPUFA) değerleri %35,063±0.023, %33,820±0,12 olarak tespit edilmiş, farkın önemsiz olduğu belirlenmiştir (P>0,05). Doğal ve kültür levrek balıklarında n3/n6 oranları 2,021±0,005 ve 1,024±0,059 olarak bulunmuştur (P<0,05). C18:2n6c Linoleic Acid, C18:3n3a-Linolenik Asit ve C22:1n9 Erusik asit değerleri kültür levrek balıklarında, C20:5n3 EPA ve C22:6n3 DHA değerleri doğal levrek balıklarında yüksek bulunmuştur.

Anahtar Kelimeler: Deniz levreği, *Dicentrarchus labrax*, Besin kompozisyonu, Amino asit kompozisyonu, Yağ asitleri kompozisyonu

Introduction

Aquaculture cage systems are a sector which has been growing very rapidly particularly in recent years and responding the increasing food demand in parallel to increasing rapid population (Jiang *et. al.,* 2013). Sea bass (*Dicentrarchus labrax*) is a species distributed broadly in the Mediterranean and Atlantic seas and havea commercial significance for this reason (Ayala *et. al.,* 2010). Competitions including decreasing market prices or increasing meat quality are experienced among the sea bass producing countries particularly in the Mediterranean (Costa *et al.,* 2011).

Sea bass is also one of the primarily and commonly consumed and cultured fish species in

Turkey. .Many researches specified that in addition to its economical characteristics, sea bass makes positive contributions to human health in terms of food composition.(Leitzman *et al.,* 2004; Mozaffarian *et al.,* 2006; Reader *et al.,* 2007).

Fish are known to be rich in terms of amino acid and fatty acid. Lipids are stored by the fish and used as energy source. Fatty acids also are part of complex lipids and sources for energy. Fatty acids are divided into two groups as saturated and unsaturated fatty acids. Oleic acid constituting the major part of unsaturated fatty acids is important for the livings health. It has quite significant roles in histogenesis, circulatory system and usage as an energy source (Alphonse, 2012). Furthermore, marine fish are rich in terms ofeicosapentaenoicacid (EPA) and docosahexaenoicacid (DHA). While marine fish species use fatty acids such as EPA and DHA for better growth rate and feed efficiency; they provide significant savings in protein in feed (Sargent *et al.*, 1999; Erdem *et al*., 2009).It is well known that EPA and DHA fatty acids in fish have an important place in health protection of human (Combe, 2004). Studies showed that these fatty acids has remarkable effects for protection such as heart, cardiac-vascular, depression, headache like migraine, articular rheumatism, diabetes, high cholesterol and tension, some allergic and cancer diseases (Nettleton, 2000).

Fish are rich food sources for humans in terms of amino acid. Amino acid amounts in fish vary according to the species, age, season and nutrition habits (Erdem, 2006). Furthermore, according to Messina *et al*. (2009),lipids and fatty acid profiles of fish are influenced by nutrients and environmental factors and they are also reflected in biochemical composition and sensorial quality of fish.

In this study, the comparison of food, amino acid and fatty acid compositions of wild and cultured seabass were aimed.

Materials and Method

A total of100 cultured seabass with an average weight of 258.55±3.81 g obtained from Muğla (Milas-Boğaziçi Village, Western Turkey) region and 40 naturally fished sea bass with an average weight of 406.80±8.61g were used.

Cultured sea bass were fed with an extruder sea bass growing feed with 48% protein and 18% fat contents. The content of the feed include amino acids consisting of lysine, cystine and methionin as additives to the raw materials.

Protein, fatty acid and moisture analyses of fish meats were performed according to Kjeldal method, Hydrolyze Soxtec System method and the method of drying in the drying oven (AOAC, 1995), respectively. Vitamin E, B_2 and Aanalyses were performed according to HPLC method (Food and Chemistry, 1984; Manz *et al.*, 1988).

Amino acid analysis was performed according to Hydrolyze method. Eppendorf LC 3000 was performed using Amino acid analyzer manual and fatty acid analysis was performed according to IUPAC gaschromatograph method (Frestone and Horwitz, 1979). All analyses were done in TUBITAK Marmara Research Center, Food Institute, Gebze, Turkey.

The results of the analysis were tested by one-way ANOVA in MS Excel© program, difference among groups was detected by applying t-test.

Results and Discussion

The food, amino acid [Essential amino acid (EAA), Non-essential amino acid(NEAA)] and fatty acid compositions [Saturated Fatty Acid (SFA), Mono Unsaturated Fatty Acids(MUFA), Poly Unsaturated Fatty Acids (PUFA),Omega-3 Fatty Acid (Ω-3) and Omega-6 Fatty Acid (Ω-6)] of cultured and wild sea bass are indicated in Tables 1, 2 and 3, respectively.

Meat quality varies depending on many factors including species, the culture environment, region of fishing, season and nutrition habits. In the present study, protein rate of wild sea bass was 6.27% and more than cultured sea bass. The results showed similarity with the results of the studies conducted by Erdem (2006) in brook trout and by Orban *et al*. (2003) in gilt-head breams and sea bass but showed differences with the results of the study of Yıldız *et al*. (2007) in sea bass. This difference might arise from the fish size, environment and the feed content.

Moist content of wild sea bass was 0.67% and less than from that of cultured sea bass. Fat rate of cultured and wild sea basswere10.30% and 8.90%, respectively and the 15.73% fat differences could be directly correlated to the given food to the cultured fish. This can be explained by that the cultured sea bass uses protein in the feed not only in meat efficiency but also in energy metabolism and thus fat taken from the feed is stored in the body.

The results of the present study indicated similarities with the results of the studies performed by Kaba *et al.* (2009) in gilt-head bream, by Yıldız *et. al.* (2007), Alasalvar (2002) and Orban *et al*. (2003) in sea bass, by Erdem (2006) in brook trout and by Nowosad *et al*. (2015) in European eel.

Table 1. Food and vitamin contents of cultured and wild sea bass

	CP (g/100g)	CF (g/100g)	Moisture (g/100g)	Vitamin A (mg/100g)	Vitamin E (mg/100g)	Vitamin B2 (mg/100g)
Wild	19.13	8.90	68.37	0.07	1.85	0.14
Cultured	18.00	10.30	68.83	0.10	2.30	0.15

Table 2. Amino acid values of wild and cultured sea bass

Amino Acid (mg/100g)	Wild	Cultivation
AsparticAcid	1374.00 ± 90.50[a]	1482.00± 8.01[a]
Threonine	550.50 ± 18.50[a]	680.00 ± 8.01[b]
Serine	368.50 ± 8.51[a]	375.50 ± 1.51[a]
GlutamicAcid	1475.00 ± 44.00[a]	2369.00 ±22.00[b]
Proline	733.50 ±2 1.50[a]	583.50 ± 14.50[b]
Glycine	528.00 ± 8.00[a]	633.00 ± 0[b]
Alanine	752.50 ± 7.50[a]	728.00 ± 0[a]
Valine	681.50 ±3 3.50[a]	708.50 ± 35.50[a]
Methionine	385.00 ± 2.00[a]	364.00 ± 34.00[a]
İsoleucin	590.00 ± 60.00[a]	685.00 ± 0[a]
Leucine	1040.50 ± 27.50[a]	1101.5 ± 90.50[a]
Tyrosine	544.00 ±1 4.00[a]	544.00 ± 14.00[a]
Phenylalanine	738.00 ± 1.00[a]	752.00 ± 36.00[a]
Histidine	621.50 ± 21.50[a]	563.00 ± 22.00[a]
Lysin	1431.00 ± 48.00[a]	1583.50 ± 18.50[b]
Arginine	883.00 ± 23.00[a]	923.00 ± 22.00[a]
EAA	6921.00 ± 11.00[a]	7360.50 ± 266.50[a]
NEAA	5776.00 ± 3.00[a]	6715.00 ± 3.00[b]
EAA/NEAA	1.198 ± 0.01[a]	1.096 ± 0.03[a]

The values expressed in the same line with exponential letters are statistically different from each other (P<0.05)

Table 3. Fatty acids composition of wild and cultured sea bass

Fatty acids (%)	Wild	Cultured
C12:0 Lauricacid	0.046 ± 0.002[a]	0.045± 0.0005[a]
C13:0 Tridecanoicacid	0.028 ± 0.001[a]	0.020 ± 0.001[b]
C14:0 MyristicAcid	3.897 ± 0.034[a]	3.532 ± 0.001[b]
C14:1 MyristoleicAcid	0.018 ± 0.0005[a]	0.016 ± 0.00[a]
C15:0 PentadecanoicAcid	0.586 ± 0.011[a]	0.417 ± 0.003[b]
C15:1 cis-10 Pentadecanoicacid	0.122 ± 0.001[a]	0.087 ± 0.001[b]
C16:0 Palmitik Acid	16.998 ± 0.008[a]	16.348 ± 0.005[b]
C16:1 Palmiteloicacid	5.278 ± 0.027[a]	4.926 ± 0.001[b]
C17:0 HeptadecanoicAcid	0.881 ± 0.002[a]	0.662 ± 0.002[b]
C17:1 cis-10HeptadecanoicAcid	0.666 ± 0.144[a]	0.366 ± 0.001[b]
C18:0 StearicAcid	3.395 ± 0.006[a]	3.529 ± 0.002[b]
C18:1n9t ElaoidicAcid	0.182 ± 0.006[a]	0.075 ± 0.006[b]
C18:1n9c OleicAcid	19.154 ± 0.091[a]	18.970 ± 0.022[a]
C18:2n6t LinoleaidicAcid	0.453 ± 0.01[a]	0.305 ± 0.007[b]
C18:2n6c LinoleicAcid	10.457 ± 0.023[a]	15.130 ± 0.01[b]
C18:3n6 g-LinolenicAcid	0.189 ± 0.023[a]	0.153 ± 0.001[a]
C20:0 ArachidicAcid	0.315 ± 0.016[a]	0.244 ± 0.001[b]
C18:3n3 a-LinolenicAcid	1.616 ± 0.024[a]	1.914 ± 0.0005[b]
C20:1n9 EicosanoicAcid	1.401 ± 0.033[a]	3.401 ± 0.0005[b]
C21:0 HenicosanoicAcid	0.08 ± 0.021[a]	0.082 ± 0.001[a]
C20:2 cis- EicosadinoicAcid	0.648 ± 0.044[a]	0.786 ± 0.0005[b]
C20:2 cisEicosatriAcid	0.082 ± 0[a]	0.076 ± 0.001[b]
C22:0 BehenicAcid	0.085 ± 0.001[a]	0.116 ± 0.008[a]
C20:4n6 ArachidonicAcid	0.027 ± 0.002	0
C22:2 DocosadienoicAcid	0.802 ± 0.004[a]	0.665 ± 0.019[b]
C22:1n9 ErucicAcid	0.389 ± 0.005[a]	1.956 ± 0.012[b]
C23:0 TricosanoicAcid	0.052 ± 0.001[a]	0.04 ± 0.001[b]
C20:5n3 EPA	6.777 ± 0.035[a]	5.527 ±0.001[b]
C24:0 LingocericAcid	0.074 ± 0.001[a]	0.066 ± 0.003[a]
C24:1n9 NervonicAcid	0.321 ± 0.0005[a]	0.337 ± 0.003[b]
C22: 6n3 DHA	14.010 ± 0.017[a]	9.417 ± 0.042[b]
∑ SFA	26.498 ± 0.059[a]	25.102 ± 0.012[b]
∑ MUFA	27.553 ± 0.22[a]	30.136 ± 0.019[b]
∑ PUFA	35.063 ± 0.023[a]	33.820 ± 0.12[b]
Unidentifiable	10.653 ± 0.606[a]	10.941 ± 0.119[a]
Ω-3	22.488 ±0.03[a]	15.978 ± 0.91[b]
Ω-6	11.126 ± 0.011[a]	15.589 ± 0.007[b]
Ω-3/Ω-6	2.021 ± 0.005[a]	1.024 ± 0.059[b]

The values expressed in the same line with exponential letters are statistically different from each other (P<0.05).

Protein quality is determined by the quantity of essential amino acids in protein. Essential amino acid (EAA) values of wild and cultured sea bass were insignificant (P>0.05). The difference of 6.35% could be arisen from amino acid sources added to the fish feed.

Palmitic acid was the highest saturated fat acid and oleic acid is the highest unsaturated fatty acid. Values of ∑SFA were %26.50±0.06 and%25.10±0.01 in wild and cultured sea bass, respectively, and the difference between them was significant (P<0.05). The results were parallel to those findings of the studies conducted by Orban *et al.* (2003) in gilt-head breams and sea bass; by Erdem (2006) in brook trout. Hunt *et al.* (2011) detected 35.71% ∑SFA rate in young sea bass and perches. It is considered that the different results might caused by the difference in the fish size.

While ∑MUFA values were %30.14±0.02 and %27.55±0.22, ∑PUFA values were %33.82±0.12 and %35.06±0.02 in cultured and wild sea bass, respectively and there were significant differences between cultured and wild sea bass in terms of ∑MUFA and ∑PUFA (P<0.05). It was considered that the higher ∑MUFA value in cultured sea bass could becaused by the existence of herbal origin of raw materials in the feed. Orban *et al.* (2003) and Hunt *et al*. (2011) reported similar results in sea bass.

Although EPA and DHA, two significant fatty acids of PUFAs, existed in higher quantities in wild seabass, similar results were obtained in cultured sea bass. It was reported that the sum of EPA and DHA fatty acid values formed 60% of PUFA in marine fish and 30-40% in freshwater fish (Kinsella *et al*.,1977 cited in Erdem, 2006). This values were 59.28% and 44.19% in wild and cultured sea bass. PUFA was 25.75% in sea bass (Hunt *et al.*, 2011). While Kaba *et al.* (2009) reported higher EPA and DHA in cultured gilt-head breams, Erdem (2006) found higher EPA in wild and higher DHA in cultured brook trout. Similarly Orban *et al.*, (2003) reported higher EPA in cultured gilt-head breams and bass and higher DHA in wild sea bass and cultured gilt-head breams.

Rates of Ω-3/Ω-6 were 2.02±0.01 and 1.02±0.056 in wild and cultured bass, respectively, and the difference between them were significant (P<0.05). Rates of Ω-3/Ω-6being greater than 1 is the indicator of the fact that the product in question is better and have higher quality in terms of nutrition. Erdem (2006) in brook troutand by Orban *et. al.* (2003) in gilt-head breams and sea basses reported similar results.

Conclusion

Sea bass has high nutrition value in terms of meat quality. Furthermore, as a result of the study, it could be suggested that food composition of cultured sea bass had high quality. Thus, this result could be useful for eliminating the prejudice toward the fish production through cultivation. The study showed that cultured sea bass is similar to wild sea bass in terms of amino acid, fatty acid and food composition values and even better in terms of certain values of cultured sea bass. As a result, it is possible to say that commonly cultured sea bass is a product with similar quality and high nutritive value as wild sea bass.

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