Turkish Journal of Veterinary and Animal Sciences

http://journals.tubitak.gov.tr/veterinary/

Research Article

Turk J Vet Anim Sci
(2014) 38: 20-25
© TÜBİTAK
doi:10.3906/vet-1304-3

The effect of using different commercial feeds in sea bream (*Sparus aurata* L. 1758) and sea bass (*Dicentrarchus labrax* L. 1758) aquacultured in the Güllük Gulf (Muğla, Türkiye) on fatty acid profile

Hasan ATALAY[1,*], **Tanay BİLAL**[2]
[1]Ministry of Food Agriculture and Livestock, Marmaris, Muğla, Turkey
[2]Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine, İstanbul University, Avcılar, İstanbul, Turkey

Received: 03.04.2013 • **Accepted:** 29.08.2013 • **Published Online:** 18.12.2013 • **Printed:** 20.01.2014

Abstract: The aim of this study was to investigate the effects of using different commercial feeds on growing performance and fatty acid profile of sea bream and sea bass aquacultured in net cages. Four different fish companies (i.e. 4 experimental groups) were given different commercial feeds (extruded fish feed) to be used regularly for 480 days. Omega-3 [eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA)] values of feeds for groups 1, 2, 3, and 4 were 11.81%, 14.23%, 7.69%, and 12.01%, respectively. When compared, omega-3 components in sea bass were higher than in sea bream. EPA and DHA fatty acids were 12.53% in sea bass and 11.06% in sea bream. When fatty acid contents of feeds were compared with fatty acid levels of sea bream and sea bass, it was determined that the total monounsaturated fatty acid (ΣMUFA) level was the highest in sea bass (38.13%) and sea bream fishes (39.12%) in group 3 given fish meal that had the highest ΣMUFA content (38.05%). It was observed that the fatty acid profile of the sea bream and sea bass reflected the fatty acid contents of the feeds used in their feeding.

Key words: Feed, sea bream, sea bass, fatty acid profile

1. Introduction

Today, 1 of every 4 fish consumed in the world is an aquacultured fish and 1 of every 3 shrimp is produced through fish farming. Sea bass (*Dicentrarchus labrax* L. 1758) and sea bream (*Sparus aurata* L. 1758) are the most preferred fishes due to their meat quality, flavoring, and economic value. Since 1984, marine fish farming has developed rapidly in Turkey and sea bream and sea bass farming accounts for the greater part of the production.

In 2011, Turkey's total fish production was 703,545 t with a marine catch total of 514,755 t and production from aquaculture of 188,790 t. Among aquacultured fish, 100,239 t was trout, 47,013 t was sea bass, 32,197 t was sea bream, 207 t was carp, 5 t was mussels, and 1442 t was other fishes (1).

Theoretically, 2–5 kg of natural fish is required for the production of 1 kg of fish from fish farms. To produce fish meal and fish oil, 12%–15% and 10%–12% of marine fish was used, respectively. Annual production of fish oil is approximately 1.2×10^6 t (2,3).

As sea bream (*Sparus aurata* L. 1758) and sea bass (*Dicentrarchus labrax* L. 1758) farming accounts for the greater part of marine fish farming production in Turkey (4), the aim of this study was to investigate the effects of using different commercial feeds on the fatty acid profiles of sea bream and sea bass aquacultured in net cages by private companies located in the Güllük Gulf of Muğla.

2. Materials and methods

This study was carried out among 4 different legally registered fish companies (i.e. 4 experimental groups) located in the Güllük Gulf, Muğla, Turkey. Approximately 365,000–440,000 healthy juvenile (mean body weight: 2–4 g) sea bream (*Sparus aurata* L. 1758) and sea bass (*Dicentrarchus labrax* L. 1758) in these farms were given different commercial feeds (extruded fish feed), used regularly for 480 days. Sea bream and sea bass were grown in the same cages. Fish were fed ad libitum 3 times a day. Ingredients of feeds are as follows: fish flour 30%–70%, soybean meal 10%–40%, fish oil 5%–15%, corn gluten and wheat gluten 10%–30%, and vitamin and mineral premixes.

For the analysis, 5 sea bream and 5 sea bass were randomly selected from each company and sent to the laboratory in cold chain storage. Muscle samples were separated from each fish and stored at −18 °C. Analysis

* Correspondence: hasanatalay33@hotmail.com

of the nutrient contents of feeds and muscle samples were done according to AOAC standards (5) in the laboratory of the Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine, İstanbul University, and analysis of fatty acid profiles in muscle samples and feeds were done at the Scientific and Technological Research Council of Turkey (TÜBİTAK) Marmara Research Center Food Institute according to the IUPAC (6) method using PerkinElmer AutoSystem XL gas chromatography equipment. Chemical and microbiological analysis of sea water samples were taken from the net cages of the fish farms 6 times every 3 months. Chemical and microbiological analyses of sea water samples were performed at the Republic of Turkey Ministry of Agriculture and Rural Affairs Directorate of Muğla Province Control Laboratory.

All statistical analyses were performed using SPSS 16.0. One-way analysis of variance (ANOVA) was used for each experiment and mean differences were determined by Duncan's multiple range test.

3. Results

The results of the chemical analysis of the feeds used in the study are presented in Table 1. Chemical and microbiological analysis results of sea water samples taken from net cages from fish farms 6 times every 3 months are given in Table 2. Table 3 presents the nutrient compositions of muscle meat of sea bream (*Sparus aurata* L. 1758) and sea bass (*Dicentrarchus labrax* L. 1758). Study results revealed that dry matter, crude protein, ash, and ether extract values did not differ significantly between groups. There was no statistically significant difference between groups with respect to liver ether extract rates (Table 4).

Dominant essential fatty acids of fish feeds were myristic acid (C14:0), palmitic acid (C16:0), stearic acid (C18:0), palmitoleic acid (C16:1), oleic acid (C18:1ω9), linoleic acid (C18:2ω6), linolenic acid (C18:3ω3), eicosanoic acid (C20:1ω9), eicosapentaenoic acid (EPA, C20:5ω3), and docosahexaenoic acid (DHA, C20:6ω3). Fatty acid composition of fish feed is presented in Table 5 (in raw %).

Dominant essential fatty acids of sea bream were myristic acid (C14:0), palmitic acid (C16:0), stearic acid (C18:0), palmitoleic acid (C16:1), oleic acid (C18:1ω9), linoleic acid (C18:2ω6), linolenic acid (C18:3ω3), eicosanoic acid (C20:1ω9), EPA (C20:5ω3), and DHA (C20:6ω3). Fatty acid composition of sea bream is presented in Table 6 (in the raw %).

Table 1. Chemical analysis results of fish feeds.

Sea bream and sea bass	Group 1	Group 2	Group 3	Group 4
Dry matter (%)	90.57	92.23	89.76	92.86
Crude protein (%)	44.74	46.34	41.93	47.29
Ash (%)	7.98	8.28	8.21	9.89
Ether extract (%)	18.05	20.42	11.60	16.26

Table 2. Chemical and microbiological analysis results of water samples.

Analysis	Group 1	Group	Group 3	Group 4
Coliform (CFU/100 mL)	347	958	12	434
Fecal coliform (CFU/100 mL)	106	820	7	96
E. coli (CFU/100 mL)	102	55	1	14
pH	8.27	8.77	7.74	8.07
Nitrite (mg/L)	0.066	0.43	0.07	-
Nitrate (mg/L)	3.10	9.53	6.87	3.24
Ammonium ion (mg/L)	2.54	2.56	2.29	7.74
Phosphate (mg/L)	0.21	0.14	0.23	0.05
Sulfate (mg/L)	1184.67	1475.50	5370	5800
Copper (mg/L)	0.06	0.02	0.07	0.02
Iron (mg/L)	0.10	0.05	0.17	0.02
Zinc (mg/L)	-	-	-	0.01
Potassium (mg/L)	73.47	29.5	36.42	169.73

Table 3. The nutrient compositions of muscle samples of sea bream and sea bass.

	Group 1	Group 2	Group 3	Group 4
Sea bream				
Dry matter (%)	26.37 ± 0.25	28.06 ± 0.32	26.49 ± 0.31	29.40 ± 0.43
Crude protein (%)	21.51 ± 0.31	22.69 ± 0.30	21.02 ± 0.22	23.10 ± 0.25
Ash (%)	1.50 ± 0.05	1.63 ± 0.08	1.37 ± 0.05	1.51 ± 0.09
Ether extract (%)	5.31 ± 0.15	4.55 ± 0.11	4.05 ± 0.13	4.27 ± 0.21
Sea bass				
Dry matter (%)	25.14 ± 0.22	24.54 ± 0.32	24.73 ± 0.37	23.69 ± 0.45
Crude protein (%)	23.38 ± 0.25	22.78 ± 0.35	21.46 ± 0.32	16.86 ± 0.23
Ash (%)	1.49 ± 0.10	1.54 ± 0.02	1.30 ± 0.08	1.56 ± 0.01
Ether extract (%)	4.69 ± 0.16	5.71 ± 0.14	5.02 ± 0.15	4.42 ± 0.12

Table 4. The ether extract rates of liver (%).

Ether extract	Group 1	Group 2	Group 3	Group 4
Sea bream	10.98 ± 0.15	11.56 ± 0.45	11.08 ± 0.23	10.98 ± 0,40
Sea bass	10.03 ± 0.27	10.23 ± 0.19	9.20 ± 0.32	11.08 ± 0.28

Dominant essential fatty acids of sea bass were myristic acid (C14:0), palmitic acid (C16:0), stearic acid (C18:0), palmitoleic acid (C16:1), oleic acid (C18:1ω9), linoleic acid (C18:2ω6), linolenic acid (C18:3ω3), eicosanoic acid (C20:1ω9), EPA (C20:5ω3), and DHA (C20:6ω3). Fatty acid composition of sea bass is given in Table 7 (in raw %).

4. Discussion

No statistically significant difference was observed among the groups with respect to total weight of the fishes fed with fish meal from different companies. The best performance for sea bream (*Sparus aurata* L. 1758) and sea bass (*Dicentrarchus labrax* L. 1758) was in group 2, while the lowest was in group 4. Study results revealed that feed conversion ratio did not differ among groups. In parallel with this study, other studies on fish feeding have reported that different fish feeds do not make significant differences in fish growth performance.

Fatty acid composition of sea bass and sea bream fish feeds ranged from 19.37% to 34.18% for saturated fatty acids, 33.78% to 38.10% for monounsaturated fatty acid, and 20.86% to 33.90% for polyunsaturated fatty acids. Fatty acid composition of sea bream ranged from 20.13% to 22.93%, 31.2% to 39.12%, and 27.00% to 38.06% for saturated, monounsaturated, and polyunsaturated fatty acids respectively. Fatty acid composition of sea bass ranged from 21.07% to 22.70%, 34.672% to 38.13%, and 29.39% to 34.57% for saturated, monounsaturated and polyunsaturated fatty acids, respectively.

It was reported in a study conducted by Fair et al. (7) that different omega-3 levels constituted by adding herring oil at different rates (0%, 4%, 8%, 12%) in striped bass hybrids' rations reflected the ration profile of fatty acid composition in tissues and that the level of essential fatty acid in the groups receiving 8% and 12% herring oil was high. Previous studies (8,9) also analyzed body fatty acid composition of sea bass fingerlings. According to the body fatty acid analysis results, EPA and DHA levels were the highest in the groups that were fed with fish oil. Linolenic acid and linoleic acid values were the highest in the soybean oil-fed group, whereas oleic acid levels were the highest in the olive oil-fed group. The results obtained in this study are consistent with those of Izquierdo et al. (10), who investigated sea bream fingerlings fed with a vegetable oil mixture. Other studies (11,12) examined the effect of protein and fat rate used in sea bream feed on growth and revealed that feed conversion ratio increases in parallel with the increase of protein level. Similarly, it was determined that soybean, sunflower, and fish oil added to fish feed of sea bass at different rates did not have a significant impact on growth performance (13,14).

In conclusion, it was observed that omega-3 fatty acids components (EPA and DHA), which are important for health, were greater in sea bass (*Dicentrarchus labrax* L.

Table 5. The composition of fatty acids in feeds.

Fatty acids	Group 1	Group 2	Group 3	Group 4
C12:0	-	0.10	-	-
C14:0	3.71	7.69	2.62	3.44
C15:0	0.24	1.00	0.18	0.22
C16:0	11.86	20.77	13.37	12.13
C17:0	0.33	1.15	0.26	0.33
C18:0	2.69	2.69	3.69	2.93
C20:0	0.24	0.60	0.30	0.28
C21:0	0.30	–	0.19	0.26
C22:0	–	0.18	–	–
ΣSFA	19.37	34.18	20.61	19.59
C14:1	-	0.22	-	-
C16:1	4.09	6.89	3.35	3.61
C18:1ω9	28.50	15.48	31.38	25.81
C20.1ω9	4.34	5.44	2.54	3.27
C22:1ω9	0.39	6.72	0.26	0.35
C24:1	0.78	1.57	0.52	0.74
ΣMUFA	38.10	36.32	38.05	33.78
C18:2ω6	11.65	4.44	19.77	16.72
C20:2	0.67	0.27	0.58	0.57
C18:3ω6	0.10	0.11	0.10	0.10
C18:3ω3	3.57	1.67	3.89	4.08
C20:3ω3	0.17	-	0.15	0.15
C20.4ω6	0.25	0.14	0.26	0.27
C20:5ω3	5.30	5.66	3.37	5.72
C22:6ω3	6.51	8.57	4.32	6.29
ΣPUFA	28.22	20.86	32.44	33.90
DHA + EPA	11.81	14.23	7.69	12.1
Undefined %	14.31	8.64	8.90	12.73

Table 6. The fatty acid compositions of muscle samples of sea bream.

Fatty acids	Group 1	Group 2	Group 3	Group 4
C14:0	3.31	3.32	3.43	3.37
C15:0	0.35	0.27	0.24	0.24
C16:0	14.15	13.16	13.92	14.47
C17:0	0.50	0.42	0.36	0.39
C18:0	3.19	2.50	2.88	3.99
C20:0	0.29	0.20	0.21	0.27
C21:0	0.13	0.26	0.24	0.20
ΣSFA	21.92	20.13	21.28	22.93
C14:1	0.08	-	-	-
C16:1	4.87	4.70	5.26	5.12
C18:1ω9	23.81	26.38	29.21	27.67
C20.1ω9	1.34	2.77	3.18	2.41
C22:1ω9	0.27	0.52	0.61	0.49
C24:1	0.65	0.78	0.95	0.83
ΣMUFA	31.02	35.15	39.21	36.52
C18:2ω6	22.14	16.69	12.27	15.22
C20:2	0.61	0.68	0.68	0.75
C18:3ω6	0.18	0.11	0.13	0.14
C18:3ω3	2.98	3.46	2.55	2.41
C20:3ω3	0.20	0.21	0.25	0.23
C20.4ω6	0.23	0.29	0.27	0.20
C20:5ω3	3.61	3.67	3.31	3.22
C22:6ω3	8.11	7.20	7.54	7.59
ΣPUFA	38.06	32.31	27.00	29.76
DHA + EPA	11.72	10.87	10.85	10.81
Undefined %	9.00	12.41	12.51	10.79

Table 7. The fatty acid composition of muscle samples of sea bass.

Fatty acids	Group 1	Group 2	Group 3	Group 4
C14:0	2.95	2.96	3.22	2.85
C15:0	0.29	0.29	0.28	0.24
C16:0	14.69	14.27	14.17	15.54
C17:0	0.48	0.48	0.45	0.44
C18:0	03.12	3.15	2.57	3.25
C20:0	0.23	0.23	0.20	0.20
C21:0	0.16	0.15	0.18	0.18
ΣSFA	21.92	21.53	21.07	22.70
C16:1	3.98	3.89	3.93	3.94
C18:1ω9	26.52	26.74	28.98	27.81
C20.1ω9	3.23	3.00	4.18	2.85
C22:1ω9	0.33	0.32	0.35	0.32
C24:1	0.61	0.57	0.69	0.61
ΣMUFA	34.67	34.52	38.13	35.53
C18:2ω6	16.83	17.37	12.62	14.61
C20:2	0.87	0.90	0.68	0.96
C18:3ω6	0.17	0.16	0.13	0.16
C18:3ω3	3.17	3.29	3.27	3.09
C20:3ω3	0.13	0.13	0.11	0.12
C20.4ω6	0.24	0.20	0.14	0.20
C20:5ω3	4.24	4.37	4.65	4.66
C22:6ω3	8.07	8.15	7.79	8.21
ΣPUFA	33.72	34.57	29.39	32.01
DHA + EPA	12.31	12.52	12.44	12.87
Undefined %	9.69	9.38	11.41	9.76

1758) fed with different commercial fish meals than in sea bream (*Sparus aurata* L. 1758). In terms of fatty acids profiles, fatty acid contents of sea bass and sea bream reflected the fatty acid contents of the feeds. New and useful scientific information is needed in every production stage of sea bream and sea bass, which are intensively produced in Turkey. In this context, it would be useful to reveal the effects of feed used in the process from feeding to harvest.

Acknowledgments
This study was summarized from a PhD thesis titled "The Effect of the Use of Different Commercial Feeds on Growth Performance and Fatty Acid Profile in Sea Bream and Sea Bass Fish Aquacultured in the Region of Muğla" by the first author.

References

1. Tarım İl Müdürlüğü ve İl Kontrol Laboratuar Müdürlüğü. Aylık Analiz ve İstatiksel Veriler. Muğla, Turkey: Tarım İl Müdürlüğü ve İl Kontrol Laboratuar Müdürlüğü, 2011 (report in Turkish).
2. Haliloğlu Hİ. Farklı işletmelerde yetiştirilen Gökkuşağı Alabalığı (*Oncorhynehus mykiss)*`nın kas ve adipoz dokuları ile karaciğer ve gonadlarındaki yağ asidi profilinin belirlenmesi. PhD, Atatürk University, Erzurum, Turkey, 2001 (in Turkish).
3. Kol M. Farklı oranlarda soya unu içeren yemlerle beslenen Levreklerde (*Dicentrarchus labrax L. 1758)* büyüme, gelişme ve protein sindirilebilirliği. MSc, Ege University, İzmir, Turkey, 2002 (in Turkish).
4. Akbulut B. Karadeniz'de Levrek (*Dicentrarchus labrax* L. 1758) yetiştiriciliği. Trabzon, Turkey: T.C. Tarım ve Köyişleri Bakanlığı, Tarımsal Araştırmalar Genel Müdürlüğü, Su Ürünleri Merkez Araştırma Enstitüsü Müdürlüğü, 1999 (report in Turkish).

5. AOAC. Official Methods of Analysis, 16th ed. Vols. I and II, revision. Gaithersburg, MD, USA: AOAC, 1998.

6. IUPAC. Standard Methods for the Analysis of Oils, Fats and Derivatives, 6th ed. Oxford, UK: Pergamon Press, 1980.

7. Fair PH, Williams WP, Smith IJ. Effect of dietary menhaden oil on growth and muscle fatty acid composition of hybrid striped bass, *Morone chrysops* × *M. saxatilis*. Aquaculture 1993; 116: 171–189.

8. Yıldız M, Şener E. Farklı bitkisel yağlar ilave edilen diyetlerin Levrek (*Dicentrarchus labrax* L. 1758) yavrularında büyüme performansı ve vücut kompozisyonuna etkileri. İstanbul Üniv Vet Fak Derg 2004; 30: 75–88 (article in Turkish).

9. Özlüer Hunt A. İki farklı yağ kaynağının (balık yağı ve soya yağı) Deniz Levreği (*Dicentrarchus Labrax* L.)'nın gelişme performansı ve vücut yağ asitleri kompozisyonuna etkileri. PhD, Çukurova University, Adana, Turkey, 2003 (in Turkish).

10. Izquierdo MS, Montero D, Robaina L, Caballero MJ, Rosenlund G, Gines R. Alterations in filet fatty acid profile and flesh quality in gilthead sea bream (*Sparus aurata*) fed vegetable oils for a long term period. Recovery of fatty acid profiles by fish oil feeding. Aquaculture 2005; 250: 431–444.

11. Santinha PJM, Medale F, Corraze G, Gomes EFS. Effects of the dietary protein/lipid ratio on growth and nutrients utilization in gilthead sea bream (*Sparus aurata* L.). Aquacult Nutr. 1999; 5: 147–156.

12. Gültepe N. Çipura (*Sparus aurata* L. 1758) beslemede alternatif yem katkı maddesi kullanımı üzerine araştırmalar. PhD, Ege University, İzmir, Turkey, 2007 (in Turkish).

13. Yıldız M, Şener E. The effects of dietary oils of vegetable origin on the performance, body composition and fatty acid profiles of sea bass (*Dicentrarchus labrax* L. 1758) juveniles. Turk J Vet Anim Sci 2004; 28: 553–562.

14. Güzel Ö. Çipura (*Sparus aurata* L. 1758) ve Levrek (*Dicentrarchus labrax* L. 1758) beslenmesinde yağ asitlerinin büyüme ezerine etkileri. MSc, Ege University, İzmir, Turkey, 2008 (in Turkish).