

Chemical composition of cultured sea bass (*Dicentrarchus labrax*, Linnaeus 1758) muscle

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Summary

The contents of the constituents in cultured sea bass (*Dicentrarchus labrax*, Linnaeus 1758) were 69.3% moisture, 18.6% protein, 10.7% fat, 1.3% ash, 0.1% saccharides and 715 kJ·kg⁻¹ energy. Main amino acids were aspartic acid and glutamic acid. High contents of essential amino acids, lysine and leucine, were detected. The fatty acid composition was 24.2% saturated (SFA), 41.0% monounsaturated (MUFA) and 33.2% polyunsaturated fatty acids (PUFA). Palmitic acid was the primary saturated fatty acid, contributing approximately by 64% to the total SFA content. Major PUFA were linoleic acid (LA), docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). The cholesterol content of sea bass was 42 mg·kg⁻¹. Ascorbic acid and niacin contents were higher than other water-soluble vitamins. The major macro- and microelements were K, P, Ca and Zn, Mn, respectively. As, Hg, Cd and Pb contents were far below the amount of the maximum allowable levels.

Keywords

sea bass; composition; amino acid; fatty acid; cholesterol; vitamin; mineral

The annual fishery production of Turkey is approximately 623000 t. Aquaculture production is 159000 t, out of which approximately 52.0% is carried out in sea waters. Economically the most important species are rainbow trout (47.7%) in fresh waters and sea bass (29.3%) and sea bream (17.9%) in sea waters. In 2009, 47000 t of sea bass was produced in seas of the country [1]. Cultured sea bass has an important commercial value in terms of consumption in Turkey and export. The market demand of fresh sea bass has increased markedly in recent years due to quality attributes such as the white flesh, low fat content and desirable aroma.

In recent years, production of sea bass has intensively raised in the Black Sea region. Sea bass, which has been intensively produced in the East Black Sea, was tested for the first time also in the Middle Black Sea. The objective of this study was to investigate the composition, amino acid, fatty acid, cholesterol, mineral, heavy metals and vitamin contents of sea bass (*Dicentrarchus labrax*, Linnaeus 1758) cultured in Sinop region of Black Sea.

MATERIALS AND METHODS

Material

Sea bass (*Dicentrarchus labrax*) cultivated in net cages in a fish farm (Kuzey Su Ürünleri, Sinop, Turkey) in the Sinop region of Middle Black Sea was harvested on April 2010. The fish were slaughtered by immersing in ice-cold sea water (hypothermia) and delivered to the processing plant on land. Gutting was carried out manually after cleaning with running tap water. The fish (eviscerated, beheaded and washed) packed in separate insulated polystyrene boxes with ice (fish:ice, 3:1) were transferred to laboratory within 4 h after harvest. The mean weight of the cleaned fish was 226 g ± 1.65 g. For all analyses, twenty fish were used.

Analysis

The whole muscle of sea bass was analysed for approximate chemical composition: protein by Kjeldahl (method 925.52), ash by heating at 550 °C, and moisture by air drying (method 925.10), according to the AOAC procedures [2].

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Total fat by soxtec method [3], amino acids by HPLC pre-column derivatization method after digestion [4], fatty acids by IUPAC IID-19 method [5], cholesterol by a chromatographic method [6], mineral analyses according to the AOAC procedures [3], vitamin E, A, B₁, B₂ and niacin analyses by a HPLC method [7], folic acid and pantothenic acid analyses by ELISA Vita fast method [7], vitamin C by titrimetric method [2] were carried out. Arsenic by AAS hydride system (method 7061A) [8], mercury by AAS hydride system (method 7471) [9], cadmium and lead (method 999.10) according to the AOAC procedures [3] were carried out. Toxic element contents were calculated according to reference coded SRM 7/2007 784. Energy value was calculated by Atwater method [10].

Statistical analysis

The descriptive statistics (mean, standard error) were conducted using MS Office Excel 2007 (Microsoft, Redmond, Washington, USA).

RESULTS AND DISCUSSION

Approximate composition

The results on approximate analysis of sea bass are shown in Tab.1. The contents of the constituents in sea bass used in this experiment show 69.3% moisture, 18.6% protein, 10.7% fat, 1.3% ash, 0.1% saccharides and 716 kJ·kg⁻¹ energy. Approximate chemical composition values for cultured sea bass from Greece were reported by ALASALVAR et al. [11]: 72.2% moisture, 20.7% protein, 5.2% fat and 1.5% ash. The authors reported that the cultured sea bass possessed a considerably higher fat and lower moisture content than the wild sea bass, probably due to high dietary fat level in the feed (20%) and reduced activity of the cultured fish. Approximate composition values

were reported for sea bass cultured in Greece also by GRIGORAKIS et al. [12]: 75.2–74.4% moisture, 18.6–20.3% protein, 4.5–3.9% fat and 1.3–1.3% ash for winter and summer samples, respectively. ÖZYURT and POLAT [13] found spring samples of wild sea bass captured in the Iskenderun bay, on the North-Eastern Mediterranean to contain 70.8% moisture, 21.4% protein, 6.1% fat and 1.3% ash. ÖZDEN and ERKAN [14] reported that the approximate chemical composition of cultured sea bass from Aegean Sea was 69.7% moisture, 21.7% protein, 6.5% fat, 2.0% ash and 0.2% saccharides. MENDES and GONÇALVES [15] determined 64% moisture, 23.9% protein, 10.7% fat and 1.2% ash in cultured sea bass from Tavira, Portugal. FUENTES et al. [16] found no differences between fish farmed in Greece and in Spain. In addition, the authors indicated that moisture and protein contents were higher in wild sea bass, while both farmed groups showed a higher fat content.

Amino acid composition

The amino acid composition of sea bass is shown in Tab.2. Results showed that the main amino acids of sea bass were aspartic acid and glutamic acid. Aspartic acid and glutamic acid play important roles as general amino acids in enzyme active centres, as well as in maintaining the solubility and ionic character of proteins. The essential amino acids of sea bass constituted approximately 49% of total amino acids. In the present study, the ratio of essential/non-essential amino acids (E/NE) was observed to be 0.98. The ratio of E/NE was determined as 0.76 for wild sea bass in autumn, 0.75 for wild sea bass in winter, and 0.77 for wild sea bass in spring and summer by ÖZYURT et al. [13]. Arginine, lysine and leucine were the major essential amino acids. High levels of lysine and leucine were determined in sea bass flesh. A deficiency in lysine can result in a deficiency in niacin, vitamin B, causing the disease pellagra. Lysine can also be used as a nutritional supplement to help against herpes. Fish are quite rich in lysine [14]. Several researchers reported that the main amino acids in wild sea bass were aspartic acid, glutamic acid and lysine [13, 14]. According to results of this research, 200g of sea bass meat may supply the daily human requirement of essential amino acids except for tryptophan.

Fatty acid content

The main components of all fats are the fatty acids, which may be saturated, monounsaturated or polyunsaturated. Saturated and monounsaturated fats are not necessary in the diet as they can be synthesized by the human body. Two polyun-

Tab. 1. Approximate chemical composition of sea bass muscle.

| Constituent | Content |
|-------------------------------|-------------|
| Moisture [%] | 69.3 ± 0.20 |
| Protein [%] | 18.6 ± 0.00 |
| Fat [%] | 10.7 ± 0.20 |
| Ash [%] | 1.3 ± 0.01 |
| Saccharides [%] | 0.1 ± 0.02 |
| Energy [kJ·kg ⁻¹] | 716 ± 2.00 |

Values are mean ± standard error from duplicate determinations.

Tab. 2. Amino acid composition of sea bass muscle.

| Amino acids | [mg·kg ⁻¹] |
|--|------------------------|
| Aspartic acid | 20100 ± 2300 |
| Glutamic acid | 29900 ± 3100 |
| Asparagin | < 170 ± 0.00 |
| Serine | 8600 ± 600 |
| Histidine* | 5700 ± 400 |
| Glycine | 9200 ± 100 |
| Threonine* | 9400 ± 900 |
| Citrulline | < 180 ± 0.00 |
| Arginine* | 11800 ± 800 |
| Alanine | 12100 ± 1200 |
| Tyrosine | 7400 ± 200 |
| Cysteine | 1000 ± 100 |
| Valine* | 10000 ± 900 |
| Methionine* | 6100 ± 700 |
| Tryptophan* | < 200 ± 0.00 |
| Phenylalanine* | 9400 ± 400 |
| Isoleucine* | 9300 ± 600 |
| Ornithine | < 300 ± 0.00 |
| Leucine* | 15800 ± 1600 |
| Lysine* | 18100 ± 3800 |
| Hydroxyproline | < 2600 ± 0.00 |
| Sarcosine | < 220 ± 0.00 |
| Proline | 9200 ± 2300 |
| Total amino acids | 192900 ± 18300 |
| Total essential amino acids | 95400 ± 8700 |
| Total non-essential amino acids | 97500 ± 9500 |
| Ratio of essential/non-essential amino acids | 0.98 ± 0.01 |

Values are mean ± standard error from duplicate determinations.

Tab. 3. Fatty acid composition of sea bass muscle.

| Fatty acid | [%] |
|------------------------------------|--------------|
| Myristic acid | 3.01 ± 0.02 |
| Pentadecanoic acid | 0.38 ± 0.01 |
| Palmitic acid | 15.43 ± 0.00 |
| Heptadecanoic acid | 0.59 ± 0.01 |
| Stearic acid | 3.50 ± 0.03 |
| Arachidic acid | 0.22 ± 0.01 |
| Heneicosanoic acid | 0.56 ± 0.01 |
| Tricosylic acid | 0.52 ± 0.02 |
| Sum of saturated fatty acids | 24.21 ± 0.03 |
| Palmitoleic acid | 4.95 ± 0.02 |
| Heptadecenoic acid | 0.74 ± 0.04 |
| Oleic acid | 31.59 ± 0.06 |
| Eicosenoic acid | 3.12 ± 0.02 |
| Nervonic acid | 0.56 ± 0.01 |
| Sum of monounsaturated fatty acids | 40.96 ± 0.03 |
| Linoleic acid | 13.02 ± 0.01 |
| Linoelaidic acid | 0.16 ± 0.00 |
| Linolenic acid | 2.11 ± 0.01 |
| Eicosapentaenoic acid (EPA) | 4.63 ± 0.04 |
| Docosahexaenoic acid (DHA) | 10.59 ± 0.00 |
| Eicosadienoic acid | 0.73 ± 0.07 |
| Arachidonic acid | 2.00 ± 0.05 |
| Sum of polyunsaturated fatty acids | 33.24 ± 0.08 |
| Undetermined | 1.59 ± 0.02 |
| ω-3 | 17.33 ± 0.05 |
| ω-6 | 15.91 ± 0.13 |
| ω-3 / ω-6 | 1.09 ± 0.01 |

Values are mean ± standard error from duplicate determinations.

saturated fatty acids that cannot be synthesized by the body are linoleic acid and linolenic acid. These must be provided by diet and are known as essential fatty acids. Docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) are important high unsaturated fatty acids (HUFA). The fatty acid composition of sea bass is presented in Tab. 3.

The fatty acid composition of sea bass was 24.2% saturated (SFA), 41.0% monounsaturated (MUFA) and 33.2% polyunsaturated (PUFA). The highest percentage of SFA in cultured (29.2%) and wild sea bass (33.4%) was reported by ALASALVAR et al. [11]. SFA for cultured sea bass was reported by ÖZDEN and ERKAN to constitute 28.0% [14]. Palmitic acid was SFA present at highest levels, contributing approximately by 64% to

the total SFA content of fat. Similar results were reported for cultured and wild sea bass by ALASALVAR et al. [11]; ÖZYURT and POLAT [13]; ÖZDEN and ERKAN [14] and FUENTES et al. [16]. Monounsaturated and oleic acid contents were higher in this study than those reported by other researchers [11, 13, 14, 16].

In this research, major PUFA were linoleic acid, DHA and EPA. Similar results for sea bass were reported by other researchers [11, 13, 14, 16]. The ratio of ω-3 to ω-6 fatty acids was (1.09), which is similar to those previously reported (1.80–1.83) for cultured sea bass in Greece and Spain by FUENTES et al. [16]. The ratio of ω-3 to ω-6 fatty acids for cultured and wild sea bass were recently reported as 2.88 and 3.02, respectively,

by ALASALVAR et al. [11]. The ratio of ω -3 to ω -6 fatty acids in these reports were higher than in our study. The data suggest that the marine and aquaculture environment effect the amount of ω -3 fatty acids in fish. An adequate daily intake (about 1 g) of EPA and DHA is essential to maintain a healthy heart [17]. According to this, daily consumption of 100 g sea bass exceedingly meets this requirement.

Cholesterol content

The cholesterol content of sea bass was 42 mg·kg⁻¹. DABROWSKI et al. [18] indicated that marine fish contain an insignificant quantity of cholesterol and fatty fish, when compared with lean ones, contain lower quantities of cholesterol and unsaponifiable substances. IMRE and SAĞLIK [19] reported a content of 42.9 mg·kg⁻¹ cholesterol in common bass (*Dicentrarchus labrax*) at a lipid content 23×10^3 mg·kg⁻¹. Ninety-seven samples of fish and 17 samples of shellfish from tropical waters were analysed for cholesterol content by MATHEW et al. [20]. They found that in fish, the cholesterol content ranged from 22.2 mg·kg⁻¹ (*Perca pulchella*) to 148 mg·kg⁻¹ (*Lethrinus cinerius*). OSMAN et al. [21] reported that cholesterol content of 10 marine fish most preferred for daily consumption in Malaysia varied from 37.1 mg·kg⁻¹ to 49.1 mg·kg⁻¹. The cholesterol content determined in this study was lower than those reported for rainbow trout (55 mg·kg⁻¹), perch (68–76 mg·kg⁻¹) or eel (142 mg·kg⁻¹), but higher than for salmon (35 mg·kg⁻¹) [22]. The cholesterol content of some fish was reported as 41 mg·kg⁻¹ for halibut, 50 mg·kg⁻¹ for northern pike, 55 mg·kg⁻¹ for coho salmon, 54 mg·kg⁻¹ for ocean perch, 55 mg·kg⁻¹ for cod, 69 mg·kg⁻¹ for rainbow trout, 72 mg·kg⁻¹ for channel catfish, 74 mg·kg⁻¹ for haddock, 110 mg·kg⁻¹ for walleye and 142 mg·kg⁻¹ for sardines by SHEESHKA and MURKIN [23].

Vitamin content

Seafood is known to contain vitamins A, D, thiamine, riboflavin, niacin, B₆, pantothenic acid, B₁₂ and ascorbic acid. Fish oil is also an important carrier of fat-soluble vitamins A and D. Ascorbic acid and niacin contents of sea bass were higher than other water-soluble vitamins (Tab. 4).

High niacin is thought to be due to the high amount of fat content in fish flesh. GÖKOĞLU [22] reported that niacin content of oily fish was higher than that of lean meat. Species with a high niacin content in the flesh are Japanese mackerel, skipjack and frigate mackerel. The Atlantic mackerel is also rich in this vitamin [24].

Vitamin E content of sea bass was determined as 6.9 mg·kg⁻¹ (Tab. 4).

Pantothenic acid has been recognized as participating in the basic biochemical reactions of animal cells, constituting a part of coenzyme A. Pantothenic acid occurs in largest amount in the ovaries, generally followed by dark meat and the liver. It is scarce in white flesh [24]. Pantothenic acid content in sea bass flesh was 3.2 mg·kg⁻¹.

Thiamine and riboflavin contents were 0.46 mg·kg⁻¹ and 0.16 mg·kg⁻¹, respectively. The thiamine content of fish meat varies a little between or within species within a range of 0.1–1.48 mg·kg⁻¹ [24]. Thiaminase enzyme activity is a specific problem in oily fish. The presence of thiaminase, an enzyme capable of rendering thiamine inactive, was discovered in clams, fresh-water fish and some marine fish by several researchers [24]. The low thiamine content of sea bass may be due to this enzyme. Sea bass is an oily fish, its fat content being found in this study at 10.72 mg·kg⁻¹.

The riboflavin content of the flesh of pelagic fish is in most cases 20 mg·kg⁻¹, or nearly ten to twenty times higher than that of neritic species [24]. The level of this vitamin is highest in metabolically active tissues, in particular in fish-eye retina, melanin in the skin, dark meat and pelagic species [22].

In the flesh of sea bass, vitamin A was not detected. This may be due to the fact that vitamin A is more abundant in fish oil and liver. In mature fish, about 90% or more of the total vitamin A in the body is usually stored in the liver [24].

As shown in Tab. 4, content of folic acid was very low in sea bass flesh (0.06 mg·kg⁻¹). Body organs of fish such as the liver, kidney and spleen contain more folic acid than both white and dark meat. The vitamin content of fish varies with species, age, season and fishing localities [24]. The vitamin content in cultured fish varies with feed.

Tab. 4. Vitamin content of sea bass muscle.

| Vitamin | [mg·kg ⁻¹] |
|------------------|------------------------|
| Thiamine | 0.46 ± 0.02 |
| Riboflavin | 0.16 ± 0.01 |
| Folic acid | 0.06 ± 0.00 |
| Niacin | 12.00 ± 0.00 |
| Ascorbic acid | 12.95 ± 0.05 |
| Pantothenic acid | 3.20 ± 0.00 |
| Vitamin E | 6.90 ± 0.10 |
| Vitamin A | Undetermined |

Values are mean ± standard error from duplicate determinations.

Mineral content

In Tab. 5, the mineral content of sea bass is presented. Major macro elements in sea bass flesh were potassium, phosphorus and calcium. Potassium is an electrolyte that interacts with sodium to conduct nerve impulses and many other functions in the cells. It is worth noting that the recommended dietary allowance (RDA) of this mineral is 3500mg. Phosphorus is found in many foods, so most people have a sufficient intake of this mineral. Most calcium in the body is contained in the bones, but about 1% is used for nerve impulses and muscle contractions (including heart, kidney and other organs) that sustain life and provide movement. Calcium participates in the protein structuring of RNA and DNA, so it affects the genetic structure and genetic mutations in the body's constant cellular replacement programme. RDA of calcium is 1200mg [25]. In this research, contents of potassium, phosphorus and calcium in sea bass flesh were 6287.5 mg·kg⁻¹, 3443.9 mg·kg⁻¹ and 1102.0 mg·kg⁻¹, respectively. Potassium, phosphorus and calcium levels of cultured sea bass from Aegean Sea, harvested in September, were reported as 4601.03 mg·kg⁻¹, 3749.80 mg·kg⁻¹ and 616.50 mg·kg⁻¹, respectively by ÖZDEN and ERKAN [14]. The values of these minerals reported by FUENTES et al. for farmed in Greece and Spain, and for wild sea bass [16] were lower.

Magnesium participates in more than 300 enzymatic reactions. Magnesium is essential for the conversion of vitamin D to its biologically active form that then helps the body to absorb and utilize calcium. RDA of this important mineral is 350mg. The highest magnesium content is found in the tissues that are most metabolically active including the brain, heart, liver and kidney. Sodium is one of the three main electrolytes in the body. Without electrolytes, the body would completely stop working. Daily consumption of salty foods provides more than enough dietary intake. RDA for sodium is 500mg [25]. Magnesium and sodium levels of sea bass were 380.5 mg·kg⁻¹ and 366.0mg·kg⁻¹, respectively. ÖZDEN and ERKAN [14] found 325.773 mg·kg⁻¹ Mg and 775.26 mg·kg⁻¹ Na in cultured sea bass harvested in September from Aegean Sea. Mg and Na contents were reported at 110 mg·kg⁻¹ and 250 mg·kg⁻¹ for sea bass farmed in Greece, 80 mg·kg⁻¹ and 280 mg·kg⁻¹ for sea bass farmed in Spain, and 120 mg·kg⁻¹ and 290 mg·kg⁻¹ for wild sea bass captured in Spain, respectively, by FUENTES et al. [16].

The microelements of sea bass were Zn (8.4 mg·kg⁻¹) and Mn (2.4 mg·kg⁻¹). RDA for these elements is 15–19 mg and 2–5 mg, respectively. Manganese plays an essential part of proper bone

Tab. 5. Mineral content of sea bass muscle.

| Macroelements | [mg·kg ⁻¹] |
|---------------|------------------------|
| Sodium | 366.0 ± 20.00 |
| Magnesium | 380.5 ± 8.50 |
| Calcium | 1102.0 ± 1.00 |
| Potassium | 6287.5 ± 8.65 |
| Phosphorus | 3443.9 ± 54.05 |
| Microelements | [mg·kg ⁻¹] |
| Iron | < 0.38 ± 0.00 |
| Copper | < 0.106 ± 0.00 |
| Chromium | < 1.00 ± 0.00 |
| Manganese | 2.4 ± 0.09 |
| Zinc | 8.4 ± 0.00 |
| Cobalt | < 1.00 ± 0.00 |
| Nickel | < 0.50 ± 0.00 |
| Selenium | 0.18 ± 0.00 |

Values are mean ± standard error from duplicate determinations.

and cartilage formation, and in glucose metabolism. Zinc is a part of every cell in the body and forms a part of over 200 enzymes that have functions ranging from proper action of body hormones to cell growth. Because the body readily uses zinc for many different functions, it constantly needs to be replaced. Sufficient levels of zinc are very important for the body's immunity and strength [25]. GÜNER et al. [26] reported that the most abundant microelements in fish were Zn and Fe followed by Cu. PÉREZ CID et al. [27] reported that Zn was the most abundant element in *Anguilla anguilla*, *Mullus surmuletus*, *Trigla lucerna*, *Mugil cephalus*, *Chelon labrosus*, *Liza aurata* and *Dicentrarchus labrax*, with a content around 20 mg·kg⁻¹ (wet weight) in the *Anguilla anguilla* samples, and with values between 4.7 mg·kg⁻¹ and 12 mg·kg⁻¹ in the rest of the species studied. ALASALVAR et al. [11] found that Fe and Zn were the dominant elements among 14 minerals and constituted 78.2% and 81.6% of the total trace mineral contents in cultured and wild sea bass, respectively. Cu and Zn contents of sea bass from Güllük Bay were reported as < 0.01 mg·kg⁻¹ and < 0.5 mg·kg⁻¹ (dry weight), respectively by DALMAN et al. [28]. Zn and Fe levels of sea bass harvested in September were reported as 2.89 mg·kg⁻¹ and 25.77 mg·kg⁻¹, respectively [14]. FUENTES et al. [16] also found that Zn and Fe were major microminerals in farmed and wild sea bass. CUSTÓDIO et al. [29] found that the essential elements K, Ca, Fe, Cu, Zn, Se, Rb and Sr were equivalent in farmed fish

and wild fish. The variation in the mineral composition of marine foods is closely related to seasonal and biological differences (species, size, dark/white muscle, age, sex and sexual maturity), area of catch, processing method, food source and environmental conditions (water chemistry, salinity, temperature and concentration of contaminants) [11, 26].

Toxic elements

Metals are being widely used in industries and agriculture. Heavy metals, such as mercury, cadmium, lead, constitute a significant potential threat to human health because they are associated with many adverse effects on health. The consumption of fish is recommended because it is a good source of omega-3 fatty acids, which have been associated with health benefits due to its cardio-protective effects. The risk assessment evaluation is necessary and it depends on the fish species and the level of its consumption [30]. The toxic element contents of sea bass are presented in Tab. 6.

The maximum allowed levels in muscle meat of fish for Hg, Cd and Pb are 0.5 mg·kg⁻¹, 0.05 mg·kg⁻¹ and 0.3 mg·kg⁻¹ (fresh weight), respectively. As shown in Tab. 6, As and Hg contents in sea bass were negligible. Also, Cd and Pb were far below the maximum allowable levels. PÉREZ CID et al. [27] determined 6.19×10^{-3} mg·kg⁻¹ (wet weight) Cd and 3.8×10^{-2} mg·kg⁻¹ (wet weight) Pb for sea bass from Ria. They reported that the metal contents in the samples studied depended on the analysed type, the sampling station and the period of sampling. ALASALVAR et al. [11] reported that Pb and Cd contents were 1.03 mg·kg⁻¹ and 0.27 mg·kg⁻¹ for cultured sea bass, and 0.84 mg·kg⁻¹ and 0.17 mg·kg⁻¹ for wild sea bass, respectively. DALMAN et al. [28] reported < 0.01 mg·kg⁻¹ Cd and < 0.02 mg·kg⁻¹ Pb (dry weight) for sea bass from Güllük Bay. CUSTÓDIO et al. [29] determined that the toxic elements such as Cd, Hg and Pb of wild sea bass were higher than the values of cultured sea bass, nevertheless, never exceeding maximum

recommended values. They indicated that such fact was due to the fast growth, controlled water quality, diets and feeding regimes.

CONCLUSIONS

Cultured sea bass is a good alternative source of proteins, fat and minerals for humans. Cultured sea bass is a good source of PUFA, mainly of the ω -3 series. It is a valuable food in terms of containing the majority of essential amino acids (in particular lysine and leucine), minerals (in particular potassium, phosphorus, calcium, magnesium and zinc), and vitamins (in particular ascorbic acid and niacin), at a comparatively low content of cholesterol.

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Tab. 6. Toxic element contents of sea bass muscle.

| Toxic element | [mg·kg ⁻¹] |
|---------------|------------------------|
| Arsenic | < 0.0006 ± 0.00 |
| Mercury | < 0.001 ± 0.00 |
| Cadmium | 0.002 ± 0.00 |
| Lead | 0.035 ± 0.00 |

Values are mean ± standard error from duplicate determinations.

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