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A Study on the Quality Changes of Cultured Gilthead Seabream (*Sparus aurata* L., 1758) and Seabass (*Dicentrarchus labrax* L., 1758) under the Market Conditions*

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Özet: ***Market koşullarındaki kültür çipura (*Sparus aurata*, *L., 1758) ve levrek (*Dicentrarchus labrax*, *L., 1758) balıklarının kalite değişimleri üzerine bir çalışma.*** Türkiye'de taze olarak tüketilen kültür levrek (*Dicentrarchus labrax*, L., 1758) ve çipura (*Sparus aurata*, L., 1758) balıklarının çoğunun Ege Bölgesi ağ kafeslerinden ve haçeri sistemlerinden sağlandığı bilinmektedir. Bu bağlamda; bu çalışmada İzmir bölgesinde balıkçı tezgahlarında, marketlerde ve pazarda satılan kültür levrek ve çipura balıklarının tüketim koşullarındaki pH değeri, toplam uçucu temel azot (TVB-N) mg N/100 g, tiyobarbutirik asit sayısı (TBA) mg malonaldehit/kg, serbest formaldehit (Fa_{ex}) ve serbest ve bağlı formaldehit (Fa_{dest}) mg/kg değişimleri gibi fiziksel ve kimyasal kalite değişimleri araştırılmıştır. Muğla bölgesi ağ kafes işletmesinden strafor kutu içerisinde buzlanarak İzmir'e taşınmış ve restorantta canlı bir vitrinde buzlanmış olarak satışa sunulmuş çipura balıklarında (test materyal A) 1. günde pH değeri 6.35±0.01, TVB-N değeri 23.56±1.63 mgN/100g, TBA sayısı 1.79±1.39 mg malonaldehit/kg, $FA_{(ex)}$ 1.66±0.09 mg/kg, $FA_{(dest)}$ 0.81±0.42 mg/kg olarak tespit edilmiş olup, bu değerler 7. gün sonunda sırasıyla 6.55±0.01, 18.2±0.88 mgN/100g; 1.94±0.51 mg malonaldehit/kg, 1.91±0.32 mg/kg, 1.25±0.28 mg/kg olarak saptanmıştır. İzmir (Çeşme) bölgesi haçeri işletmesinden sağlanmış levrek balıklarının; ev tipi buzdolabı koşullarında depolanmasında (test materyal B_1) 1. günde pH, TVB-N, $FA_{(ex)}$, $FA_{(dest)}$ değerleri sırasıyla 6.45±0.03, 17.5±0.76 mgN/100g, 0.35±0.14 mg malonaldehit/kg, 2.33±0.47 mg/kg, 0.59±0.21 mg/kg olarak tespit edilmiş olup 7. günde bu değerler sırasıyla 6.59±0.02, 20.6±2.17 mgN/100g, 0.19±0.11 mg malonaldehit/kg, 1.72±0.62 mg/kg, 1.87±1.19 mg/kg olarak bulgulanmıştır. Aynı koşullardaki çipura balıklarında (test materyal B_2) depolamanın 1. gününde bu değerler sırasıyla 6.37±0.03, 16.56±1.05 mg/100g, 0.40±0.09 mg malonaldehit/kg, 2.43±1.31 mg/kg, 0.90±0.27 mg/kg olarak tespit edilmiş olup bu değerler 7. gün sırasıyla 6.67±0.12, 26.07±0.67 mgN/100g, 0.73±0.84 mg malonaldehit/kg, 2.08±0.46 mg/kg, 1.03±0.35 mg/kg olarak bulgulanmıştır. İzmir (Çeşme) bölgesi haçeri işletmesinden sağlanmış ve İzmir balıkçı tezgahında satışa sunulmuş çipura balıklarında (test materyal C) 1. günde pH, TVB-N, TBA, $FA_{(ex)}$ ve $FA_{(dest)}$ değerleri 6.45±0.10, 17.15±0.70 mgN/100g, 0.36±0.10 mg malonaldehit/kg, 2.14±0.17 mg/kg, 2.34±0.18 mg/kg olarak tespit edilmiş olup bu değerler 2. günde 6.44±0.05, 15.4±1.14 mgN/100g, 0.51±0.28 mg malonaldehit/kg, 1.07±0.07 mg/kg, 1.07±0.09 mg/kg olarak tespit edilmiştir. Muğla bölgesi ağ kafes işletmelerinden sağlanarak ve İzmir'de bir restorantta camlı bir vitrinde buzlanmış olarak tüketime sunulmuş levrek balıklarında (test materyal D) 3. gün sonunda pH, TVB-N, TBA, $FA_{(ex)}$ ve $FA_{(dest)}$ değerleri 6.58±0.02, 18.20±0.88 mgN/100g, 0.37±0.16 mg malonaldehit/kg, 2.48±0.37 mg/kg, 1.06±0.36 mg/kg olarak bulgulanmıştır. Tüm deneme gruplarında depolama günleri sonunda mikrobiyal gelişimin göstergesi olan pH değerleri ve TVB-N değerleri açısından diğer değerlendirilen analiz kriterlerine oranla daha fazla artış saptanmıştır. Deneme balıklarında yağ miktarı sırasıyla (test materyal A, B_1 ve B_2, C, D)' de% 7.16±1.83,% 4.92±1.38,% 6.82±1.42,% 8.00±0.68,% 4.62±70 olarak tespit edilmiş olup, yağ miktarı bakımından zengin türlerdir. Tüm tüketim koşullarında maksimum 7 günlük depolama süresince balıkların çok iyi veya iyi kalite düzeylerini korudukları tespit edilmiştir.

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Anahtar Kelimeler: Çipura, levrek, kalite, TVB-N, TBA

Abstract: It is known that most of the Seabass (*Dicentrarchus labrax*, L., 1758) and Seabream (*Sparus aurata*, L., 1758) that are freshly consumed in Turkey are obtained from the netcages in Ege region and from hatchery systems. In this study, with this fact tken into consideration, physical and chemical quality controls such as pH value, total volatile base nitrogen (TVB-N) mgN/100g, thiobarbyturic acid count (TBA) mg malonadehyde/kg, free Formaldehyde (FAex) and free and linked Formaldehyde (FAdest) mg/kg researched of the Seabream and Seabass under consumption conditions that are sold in fish markets at Izmir region. The established values of Seabream that were frozen in straphor boxes at the net cage foundation of Mugla district before being carried to Izmir and displayed for sale behind a glass window in frozen conditions are as follows : on the first day; the pH value 6.35±0.01, TVB-N value 23.56±1.63 mgN/100g, TBA count 1.79±1.39 mg malonaldehyde/kg, $FA_{(ex)}$ 1.66±0.09 mg/kg, $FA_{(dest)}$ 0.81±0.42 mg/kg. At the and of the seventh day, the values are 6.55±0.01, 18.2±0.88 mgN/100g; 1.94±0.51 mg malonaldehyde/kg, 1.91±0.32 mg/kg, 1.25±0.28 mg/kg respectively (test material A). The established values of seabass that were obtained from hatchery foundations in Izmir (Cesme) district and were stored in the same conditions as the house refrigerator are as follows : (test material B1) On the first day pH, TVB-N, FA(ex), FA(dest) respectively; 6.45±0.03, 17.5±0.76 mgN/100g, 0.35±0.14 mg malonaldehyde/kg, 2.33±0.47 mg/kg, 0.59±0.21 mg/kg. At the and of the seventh day the values are respectively; 6.59±0.02, 20.6±2.17 mgN/100g, 0.19±0.11 mg malonaldehyde/kg, 1.72±0.62 mg/kg, 1.87±1.19 mg/kg. The values for Seabream that were stored under the same conditions are (test material B_2) respectively; on the first day, 6.37±0.03, 16.56±1.05 mg/100g, 0.40±0.09 mg malonaldehyde/kg, 2.43±1.31 mg/kg, 0.90±0.27 mg/kg. At the end of the seventh day, the values are respectively; 6.67±0.12, 26.07±0.67 mgN/100g, 0.73±0.84 mg malonaldehyde/kg, 2.08±0.46 mg/kg, 1.03±0.35 mg/kg. The established values for seabream that were obtained from hatchery foundations in Izmir (Cesme) district and were sold at fish markets in Izmir are as follows: (test material C) On the first day, pH TVB-N, TBA, Fa(ex) and FA(dest) values are respectively; 6.45±0.10, 17.15±0.70 mgN/100g, 0.36±0.10 mg malonaldehyde/kg, 2.14±0.17 mg/kg, 2.34±0.18 mg/kg. At the second day the values are respectively; 6.44±0.05, 15.4±1.14 mgN/100g, 0.51±0.28 mg malonaldehyde/kg, 1.07±0.07 mg/kg, 1.07±0.09 mg/kg The established values for Seabass that were obtained from net cage foundation of Mugla district and were displayed for sale behind a glass window in frozen conditions are as follows :(test material D) At the end of the third day pH, TVB-N, TBA, $FA_{(ex)}$ and $FA_{(dest)}$ values are respectively; 6.58±0.02, 18.20±0.88 mgN/100g, 0.37±0.16 mg malonaldehyde/kg, 2.48±0.37 mg/kg, 1.06±0.36 mg/kg. At the end of the days of storage, in control groups, a higher amount of rise in the pH values and TVB-N values that show the microbic formations, then the other analysed criteria was observed. The recorded oil amounts in control fish were respectively; (test material A, B_1, B_2, C, D) 7.16±1.83%. 4.92±1.38%, 6.82±1.42%, 8.00±0.68, 4.62±70%. The species are all rich in fat amounts. It is recorded that all fish maintain their good or excellent conditions in a maximum of 7 days storage under all consumption conditions.

Key Words: Seabass, seabream, quality, TVB-N, TBA

Introduction

Aquaculture is developed in Turkey as fresh water fish until 1980 and after eighties salt water fish cultivation gained acceleration to proceed development. Seawater fish food especially for Seabass is intensive at South Aegean Region. Produced cultivation fish is estimated as 16.000 tons per year in 1994, 43.60% is trout, 38% is gilthead seabream, 13.90% is seabream, 2.70% is salmon and 1.80% is carp (1). Choise of fish consumers are concentrated on fresh consumption. During the period of 1970–1980, fresh consumption share was generally 87% of total consumption however during the period of 1980–1990; this ratio is decreased to roughly 70%. It is estimated this ratio is about 79% (1). Quality criteria studies on cultured fish in Turkey is new (2, 3, 4). However, there are many studies

at all over the world (5, 6, 7, 8, 9, 10) Christopherson *et al*., (1992) (11) studied how light and packaging conditions affect carotenoid and lipid oxidation during the storage of cultured rainbow trout (*Onchorynchus mykiss*) nourished with ration containing astaxanthine. Results of this study showed that light and packaging conditions during storage of fish culture nourish with ration containing astaxanthine have effect on carotenoid and lipid oxidation. Kalakoswka *et al*. (1992) (12), studied on quality changes such as histamine total volatile base nitrogen, lipid oxidation, volatile compounds and test evaluation during ice storage of Baltic herring caughtat different season. They informed that shelf life of fish depended on seasonal change, post spawning feeding, spawning, pre spawning relations with fall and winter conditions.

It is known that most of cultured fish such as seabass and gilthead seabream in Turkey consumed as fresh are supplied from Aegean region net cage and hatchery exploitations, departing from this point, in this study, physical and chemical changes as pH, TVB-N, TBA, FA $_{(ex)}$ and FA$_{(dest)}$ were searched for the storage days of the cultured seabream (*S. aurata*) and seabass (*D. labrax*) present for consume at restaurant, fishermen and home type refrigerator (+2–+4ºC) in Izmir region.

Materials and Methods

In this study gilthead seabream (*S. aurata*) and seabass (*D. labrax*) fish taken from Cesme hatchery at Izmir region and net cage exploitations at Mugla region were used as test material. The weight varies between 300 and 350 gr for these fish. Test fishs were transported to Izmir by frigorific vehicle in straphor boxes from Izmir and Mugla region and stored known restaurant, fishermen and home type refrigerator (+2–+4°C) (Table 1). For each period of all groups, parallel analyses were done at 5 fishs.

Table 1. Cultured Gilthead Seabream (*Sparus aurata* L., 1758) and Seabass (*Dicentrarchus labrax* L., 1758) fish used as test material.

Test Material	Specifications
A	The seabream which has been iced box, transported with cold chain vans from Mugla net cage facility that served as alive in fish restaurant in Izmir.
B_1 and B_2	The seabass and seabream stored in refrigeration conditions (2–4°C) which is harvested from hatchery facility in Cesme–Izmir.
C	The seabream which has been sold on traditional fishery workbench in Izmir was supplied from hatchery facility in Cesme – Izmir.
D	The seabass which has been iced in box transported with cold chain vans from Mugla net cage facility that served as alive in fish restaurant in Izmir.

Methods

FA was determined by the spectrophotometric method of Nash (1953) (13) in an aqueous extract of the muscle. This extract was obtained by steam distillation of the muscle in the presence of 6% perchloric acid (14).

PH value (15), TVB-N mg/100g. value (16) and TBA mg malonaldehyde/kg (17) were measured.

Total lipid was extracted from the mixed fish samples with a mixture of chloroform and methanol (18).

Result and Discussion

PH, total volatile base nitrogen (TVB–N), thiobarbyturic acid (TBA), free formaldehyde (FA_{ex}) and bound and free

formaldehyde (FA_{dest}) and crude lipid values were given for cultured gilthead seabream fish supplied from Mugla net cage exploitation and given to sell within ice box with window at Izmir during storage periods of one, three, five and seven days at Table 2 (Test material A).

Table 2. Pysical and chemical analysis values (test material a) of Gilthead Seabream.

Test Material A		pH	TVB–N mgN/100g	TBA mg malonaldehyde/kg	FA_{ex} mg/kg	FA_{dest} destilation with antonna apparatus
1. DAY	Min.	6.33	21.00	0.85	1.54	0.37
	Max.	6.36	25.20	4.15	1.83	1.50
	stdev	0.01	1.63	1.39	0.09	0.42
	x	6.35	23.56	1.79	1.66	0.81
3. DAY	Min.	6.38	15.40	1.02	1.54	0.56
	Max.	6.42	25.20	2.23	2.78	2.25
	stdev	0.01	3.50	0.42	6.36	0.64
	x	6.40	18.66	0.48	1.91	1.28
5. DAY	Min.	6.35	18.20	1.24	1.69	0.37
	Max.	6.46	25.20	1.93	2.86	0.93
	stdev	0.04	3.11	0.21	0.41	0.28
	x	6.40	22.66	1.63	2.09	0.68
7. DAY	Min.	6.53	16.80	1.06	1.47	0.93
	Max.	6.57	19.60	2.57	2.35	1.68
	Stdev	0.01	0.88	0.51	0.32	0.28
	X	6.55	18.20	1.94	1.91	1.25

** Total Lipid (%): Min: 4.94, Max: 9.47, Stdev: 1.83 x: 7.16.*

At first day of storage pH value at muscle was 6.35 and this showed gradual increase and reached to 6.55 at 7th day. During storage quality of fish taste which is explained by TVB–N, nitrogen value is found 23.56 mgN/100g. This high value is indication of microbial development in fish (19, 20). Oxidation of flesh which is expressed by malonaldehyde was 1.79 mg malonaldehyde/kg on 1th day. TBA value which was found high at initial time suggests that these fish have high fat content 7.16%. Nunes et al. (1992) (20) stated that both TBA and peroxide values showed higher development rate for sardines (*Sardina pilchardus*) during storage period these group of fish have free FA content varying between 1.66–1.91 and total FA content varying between 0.81–1.25. These results give low FA values for these products (21).

Seabass and gilthead seabream fish supplied from Cesme hatchery at Izmir region and stored (+2, +4°C) in house type refrigerator at Izmir and their physical and chemical quality criteria values shown at Table 3 and Table 4 (Test material B_1 and B_2).

PH values of cultured giltead seabream and seabass fish during 1. 3 and 7 days storage were determined as changing between 6.37–6.67 and 6.45–6.59 respectively. It was found that TBA values were varying between 0.40–0.73 and 0.35–0.19. Free FA values were altering between 2.43–2.08 and 2.33–1.72 and total FA values were 0.90–1.03 and 0.59–1.87. Fat content of gilthead seabream fish for company B were 6.82% and seabass values 4.92%. For company B_2 fish, TVB–N values were determined that at seven days exceeding good quality limits. TBA values for cultured gilthead seabream being a little higher than cultured seabass suggests that it is directly related to the fat content of fish flesh.

Physical and chemical quality values of gilthead seabream fish taken from Izmir

region hatchery (Cesme) and sold at looms of fisherman in Izmir are presented at Table 5 for company C.

Table 3. Physical and chemical analysis values (test material B_1) of Seabass (*Dicentrarchus labrax* L., 1758).

Test Material B_1		pH	TVB–N mgN/100g	TBA mg malonaldehyde/kg	FA_{ex} mg/kg	FA_{dest} destilation with antonna apparatus
1. DAY	Min.	6.38	16.8	0.20	1.69	0.37
	Max.	6.50	18.2	0.49	2.71	1.93
	stdev	0.03	0.76	0.14	0.47	0.21
	x	6.45	17.5	0.35	2.33	0.59
3. DAY	Min.	6.55	14.0	0.15	1.32	0.56
	Max.	6.63	18.2	0.49	1.98	2.81
	stdev	0.03	1.44	0.15	0.34	0.98
	x	6.60	16.33	0.32	1.73	1.46
7. DAY	Min.	6.57	16.8	0.07	1.10	0.37
	Max.	6.61	22.6	0.39	2.49	3.37
	stdev	0.02	2.17	0.11	0.62	1.19
	x	6.59	20.6	0.19	1.72	1.87

Total Lipid (%): Min: 2.87, Max: 5.75, Stdev: 11.388 x: 4.92 Table 3

Table 4. Physical and Chemical Analysis Values (Test material B_2) of Seabream (*Sparus aurata* L., 1758).

Test Material B_2		pH	TVB–N mgN/100g	TBA mg malonaldehyde/kg	FA_{ex} mg/kg	FA_{dest} destilation with antonna apparatus
1. DAY	Min.	6.33	15.4	0.30	1.32	0.56
	Max.	6.42	18.2	0.53	4.04	1.31
	stdev	0.03	1.05	0.09	1.31	0.27
	x	6.37	16.56	0.40	2.43	0.90
3. DAY	Min.	6.38	16.8	0.79	1.32	0.37
	Max.	6.50	19.2	1.93	1.54	1.12
	stdev	0.04	1.05	0.37	0.16	0.34
	x	6.44	17.96	1.23	1.54	0.59
7. DAY	Min.	6.51	25.2	0.10	1.61	0.56
	Max.	6.80	26.6	2.08	2.71	1.50
	stdev	0.12	0.67	0.84	0.46	0.35
	x	6.67	26.7	0.73	2.08	1.03

Total Lipid (%): Min: 5.14, Max: 8.71, Stdev: 1.42 x: 6.82

Table 5. Physical and chemical analysis values (test material C) of Seabream (*Sparus aurata* L., 1758).

Test Material C		pH	TVB–N mgN/100g	TBA mg malonaldehyde/kg	FA_{ex} mg/kg	FA_{dest} destilation with antonna apparatus
1. DAY	Min.	6.35	16.8	0.24	1.91	2.25
	Max.	6.55	18.2	0.51	2.35	2.62
	stdev	0.10	0.70	0.10	0.17	0.18
	x	6.45	17.15	0.36	2.14	2.34
2. DAY	Min.	6.39	14.0	0.24	0.95	0.93
	Max.	6.50	16.8	0.92	1.17	1.12
	stdev	0.05	1.14	0.28	0.07	0.09
	x	6.44	15.4	0.51	1.07	1.07

Total Lipid (%): Min: 7.01, Max: 8.06, Stdev: 0.68 x: 8.00

PH values for first and second day were 6.45–6.44, TVB–N values were 17.15–15.4 mgN/100g, TBA values were 0.36–0.51 mg malonaldehyde/kg, FA_{ex} were 2.14–1.07 and FA_{dest} were 2.34–1.07 range. These values were at range of good quality values and these group fish have fat content as 8.00%. Seabass fish supplied from net cage at Mugla region and sold at a restaurant in Izmir have pH value= 6.58, TVB–N value= 18.20 mgN/100g, TBA value= 0.37 mg malonaldehyde/kg, FA_{ex}= 2.48 and FA_{dest} = 1.06 (Table 6). These fish were in very good quality limits with respect to these criteria and their fat content were 4.62%. Result of this study showed that cultured gilthead seabream fish have more fat content than seabass fish and fish belonging to this group lose their good quality properties aftes seven days during their storage with ice.

Table 6. Physical and chemical analysis values (test material D) of Seabass (*Dicentrarchus labrax* L., 1758)

Test Material D		pH	TVB–N mgN/100g	TBA mg malonaldehyde/kg	FA_{ex} Mg/kg	FA_{dest} destilation with antonna apparatus
3. DAY	Min.	6.55	16.8	0.19	2.13	0.56
	Max.	6.61	19.6	1.57	3.01	1.50
	stdev	0.02	0.88	0.16	0.37	0.36
	x	6.58	18.2	0.37	2.48	1.06

Total Lipid (%): Min: 3.95, Max: 5.65, Stdev: 0.70 x: 4.62

Conclusion

In this study, physical and chemical changes as pH value, TVB–N (mgN/100g), TBA (mg malonaldehyde/kg), FA_{ex} and FA_{dest} (mg/kg) were searched for the cultured seabream (*S. aurata*) and seabass (*D. labrax*) present for consume at restaurant, fishermen and home type refrigerator (+2–+4ºC) in Izmir region.

According to the results, pH and TVB–N values were found as the most quick advanced quality criterias for cultured seabream and seabass stored at different consume conditions. PH and TVB–N values were increased depending on the storage days for all groups. Fennema *et al.*, (1973) (22) to attribute Berg, informed that pH value was increased quantity of 0.3 for fish, chicken and beef steak muscles stored at 0–(-5)ºC. Same investigors informed that storage heat, salt composition, physiologic state, capasity of proteins and activity of enzyme were effective for increasing of myosystems pH values while the storage. TVB–N, an important quality criteria for determining the freshness of fish and fish products, estimate as marketable between 30–35 mg/100g and estimate as spoilt more than 35 mg/100g (23).

TVB–N values have determined in acceptable limits as very good class for all groups. TBA quantities are in acceptable consuming limits in all fish which have been analysed. Tarladgis *et al.*, (1966) (17) reported that rancidity starts when the rancidity index exceeds 4 mg malonaldehyde/kg.

FA_{dest} values have note gone up to the 10mg/kg, therefore any quality lost (max. 7 days) were not detected in aquacultured seabream and seabass (14). FA is a reaction product that associated extractable protein losts. FA_{ex} can be extracted with perchloric acid from muscle, max. 7 days bonded FA can not be extracted and measured on the contarary (24).

It was stated that cultured fish have more fat content than natural types (25, 10, 2). The critical factor limiting the

storage life of fat fish such as gilthead seabream and seabass is the oxidation of lipids stored in muscle tissue. This oxidation results with flesh rancidity and makes the marketing of fish unsatisfactory. Lipid oxidation and lipids hydrolysis accomplishes a decrease in percentage of polyunsaturated lipids including w-3 fat acids which are important for its nourishment. Malonaldehyde (MA) for food is generally considered together with oxidative angle formation. Although the importance of any part of MA concentrations stated at flesh products is not unknown; reports (26) concerning on this material being mutagenic and carciogenic amphazises the necessity of MA should be at lowest level during storage and marketing. In order to guard the marketability at the storage of cultured fish, remedy should be found againist the destructive effect of lipid oxidation. Fish flesh is an extremely complex system and more work needs to be done on the lipid oxidation process as it occurs in biological tissue.

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