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ANIMAL SCIENCE

Determination of meat quality of sea bass (*Dicentrarchus labrax*) sold at different selling areas

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Abstract

This study was carried out on farmed sea bass which are sold at local market, public market and hypermarket that are in operation throughout the year in centre of Mugla province in Turkey. In the study, microbiological analysis (total aerobic mesophilic bacteria, psychrophilic bacteria, enterobacteriaceae), sensory analysis and chemical analysis (pH, total volatile basic nitrogen (TVB-N), trimethylamine (TMA-N), thiobarbituric acid (TBA), crude oil and crude protein) were performed. When the results of the study was evaluated generally, it was determined that all the sea bass bought from different selling areas were good chemical and sensorial quality and marketable. On the other hand, according to results of microbiological analysis, it was found that total number of aerobic mesophilic and psychrophilic bacteria exceeded the consumable limit values in hypermarket (May), public market (May and October) and outdoor market. It was determined that it reached high values especially in summer months in terms of Enterobacteriaceae. It was observed that sea bass sold in hypermarket were cleaner in winter months (November- December- January) than the ones sold in other selling places. It was ascertained that temperature was more proper for Enterobacteriaceae growth and also fish sold in public market in summer were bad quality.

Key words: Sea bass, *Dicentrarchus labrax*, Local market, Public market, Hypermarket, Quality, Muğla

Introduction

Seafood is very important in human nutrition; but it might be contaminated after catching and/or transporting to the market. When seafood is contaminated, the microorganisms grow, spoilage starts, and consumption became dangerous. Maintenance of the sanitation in fish markets is necessary to prevent contamination (Sikorski et al., 1990; Mol and Tosun, 2011).

Sea bass (*Dicentrarchus labrax*) is an economically important cultured fish species along the Mediterranean coast. The market demand, and as a result the price, for fresh sea bass has increased markedly over the past decade due to its desirable aroma and quality; consequently, farming sea bass is considered to be a profitable business (Alasalvar et al., 2002).

Sea bass is still almost universally sold as whole fish. However, as one moves away from regions bordering the Mediterranean, there is an increasing demand and willingness to pay for value added product forms, including quality assured and branded whole fish. Filleted and gutted products are starting to make an appearance, but are still relatively insignificant in relation to the size of the overall market (EC, 1995). The white flesh, mild flavour and low fat content of sea bass are major attributes sought by the consumer (Kyrana and Lougovois, 2002).

The quality of sea bass, selling in different market (local market, public market, and hypermarket) in Muğla, was studied for investigating the chemical and microbiological quality of sea bass which is consumed locally.

Material and Method

Fish materials

Sea bass samples (at least 2 kg) provide monthly from local market, public market and hypermarket in Muğla during January – December 2010. The length of the sea bass was in the range of 25-30 cm and the weight was 250-300 g. Samples were taken to Seafood Processing Technology

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Laboratory of Muğla Sıtkı Koçman University without breaking cold chain.

Microbiological analysis

The following bogue of microflora were monitored: Total Viable Count (TVC), psychrotrophic bacteria, total coliform bacteria. A sample (10 g) was removed aseptically using a scalpel and forceps from the fillet, transferred to a stomacher bag, containing 90 mL of sterile Peptone Water (PW) solution (0.1%), and homogenized using a stomacher at room temperature. For each sample, appropriate serial decimal dilutions were prepared in PW solution (0.1%). The amount of 1 mL of these serial dilutions of sea bass homogenates were cultured by pour plate method. Total viable counts (TVC) were determined using Plate Count Agar (PCA, Merck code 1.05463, Darmstadt, Germany) after incubation for 2 days at 37ºC; psychrotrophic bacteria were determined after incubation at 7ºC for 10 days with same medium (FDA/BAM, 2001). Total Enterobacteriaceae counts were determined using Violed Red Bile Glucose Agar (Merck) after incubation at 37ºC for 2 days (FAO, 1992).

Chemical Analyses

The fish samples were analysed in triplicate for lipid content of fishes by the Bligh and Dyer (1959) method, total crude protein by Kjeldhal method (AOAC, 1984). The pH values were recorded by using a InoLab model digital pH meter (InoLab, WTW, Germany) after homogenization of each 10 g fish muscle sample in 100 ml distilled water (Manthey et al., 1988). Total volatile basic nitrogen (TVB-N) was determined according to the method used by Antonacopoulos and Vyncke (1989). The TVB-N values were expressed as milligrams per 100 g of muscle. Thiobarbituric acid (TBA) reactive substances were determined according to Tarladgis et al. (1960) to evaluate the oxidation stability during chilled storage and the results expressed as TBA value, milligrams of malonaldehyde per kg flesh. The Trimethyl Amine Nitrojen (TMA-N) content of sample was determined according to the method of AOAC (1998) and expressed as mg TMA-N per 100 g fish muscle.

Sensory analysis

Triplicate samples from each of analysis period were taken at regular intervals. Sensory analysis were performed monthly with the panel consisted of six regular assessors, each trained in fish quality assessment before the experiment. Panellists gave points to fish samples with reference to Aubourg (2001). Samples are presented in three portions to panelists. According to sensory scale fish which got between 4 – 3 point were "best quality", between 2,9 – 2 point "quality", 1,9 – 1 point "acceptable quality", under 1 point "unacceptable".

Statistical Analysis

Experiments were performed in triplicate (n=3) and a completely randomised design (CRD) was used. Data were presented as means±standard deviation and a probability value of >0.05 was considered significant. Analysis of variance (ANOVA) was performed and the mean comparisons were done by Duncan's multiple range tests. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS for Windows, SPSS Inc., Chicago, IL, USA).

Results and Discussion

Microbiological analysis results

Total Mesophilic Bacteria

Total mesophilic counts for sea bass sold at different selling areas are given in Figure 1. The lowest mesophilic counts (2.7 log10 cfu/g) were determined for sea bass samples sold at local market (on September) while the sea bass samples sold at public market reached the highest value (7.6 log10 cfu/g) on September. According to the results obtained, total aerobic mesophilic counts increase during the summer season. Total aerobic mesophilic counts exceeded the upper limit of 7 log10 cfu/g for sea bass sold at local public market (on September) and at hypermarket (on May). Mol and Tosun (2011) reported that total mesophilic bacteria counts for sea bass sold at markets in Istanbul exceeded the limit values especially between June and August.

Psychrophilic bacteria counts

Total psychrophilic counts for sea bass sold at different selling areas are given in Figure 2. The lowest psychrophilic counts (4.3 log10 cfu/g) were determined for sea bass samples sold at local market (on January) while the sea bass samples sold at public market reached the highest value (7.72 log10 cfu/g) on November. According to the results obtained, total aerobic psychrophilic counts decrease during the summer season. Total psychrophilic counts exceeded the upper limit of 7 log10 cfu/g for sea bass sold at public market (on November) and at both public and local market (on May). Koutsoumanis and Nychas (1999) reported that the microbial population of fish stored aerobically consists almost exclusively of Gram-negative psychrotrophic bacteria, *Pseudomonas spp*. and H_2S-producing bacteria.

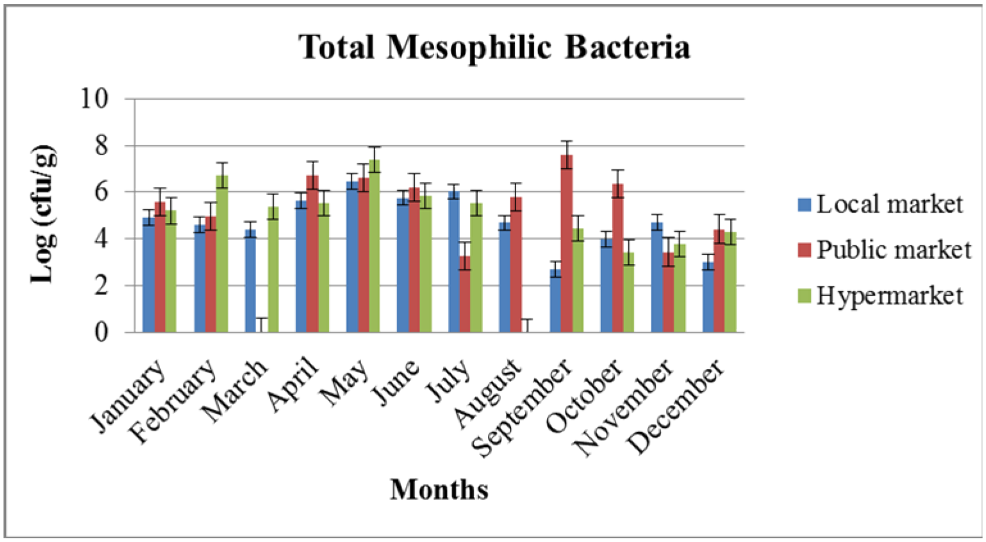

Figure 1. Monthly results of total mesophilic bacteria counts for sea bass sold at different selling areas.

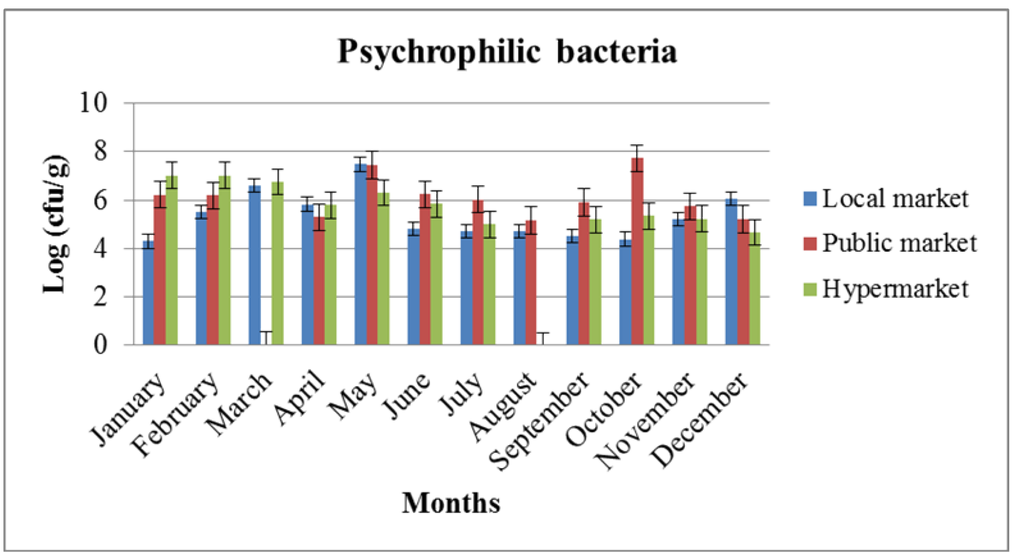

Figure 2. Monthly results of total psychrophilic bacteria counts for sea bass sold at different selling areas.

Total Enterobacteriaceae counts

Total Enterobacteriaceae counts for sea bass sold at different selling areas are given in Figure 3. The lowest Enterobacteriaceae counts (2.17 log10 cfu/g) were determined for sea bass samples sold at hypermarket market (on November) while the sea bass samples sold at local market reached the highest value (7 log10 cfu/g) on July. Total Enterobacteriaceae counts detected on summer season (May, June and July) were found to be higher than other months. Sea bass that are sold in winter season are suggested to be safe in terms of Enterobacteriaceae counts. The largest summer/winter discrepancy regarding bacterial counts was recorded for Enterobacteriaceae, where especially fresh fish yielded unacceptable levels in summer (Popovic et al., 2010).

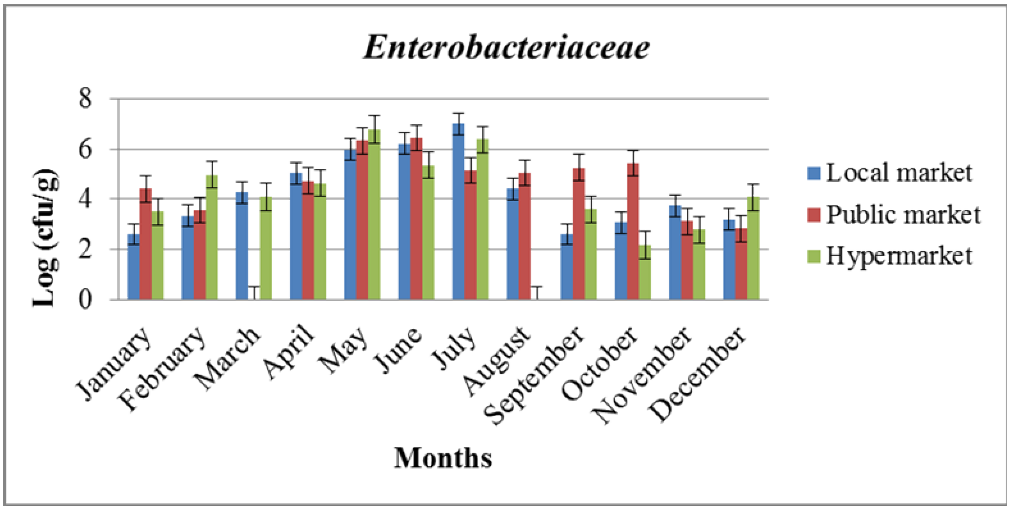

Figure 3. Monthly results of total Enterobacteriaceae counts for sea bass sold at different selling areas.

Chemical analysis results

Chemical analysis results of sea bass samples sold at different selling areas are given in Table 1, depending on the months.

pH analysis results

It is generally known that the limit value for the consumption of pH in fish is 6.80–7.00 (Berik and Varlik, 1999; Özyurt et al., 2007). Lowest pH value (6.29) were detected for sea bass samples sold at hypermarket (on June) and at local market (on November) while the highest value (6.97) were detected for sea bass samples sold at hypermarket (on January). The increase in the pH value occurs owing to the effects of ammonia and other similar volatile base compounds as a result of the decomposition. The pH value in culture sea bass found by Periago et al. (2005) and Orban et al. (2003) were 6.44 and 6.27 respectively. In our study, pH values were lower than 7.00 for all samples and they were in acceptable quality.

TVB-N analysis results

Lowest TVB-N value (17.43 mg/100g) were detected for sea bass samples sold at hypermarket (on May) while the highest value (28.69 mg/100g) were detected for sea bass samples sold at public market (on June). Fish and fish products were accepted as "very good" when they contain 25.00 mg/100g or lower TVB-N values; "good" when contain 30.00 mg/100g TVB-N; "marketable' when contain 35.00 mg/100g TVB-N and "spoiled" over 35.00 mg/100g TVB-N values (Kietzman et al., 1969; Mol and Tosun, 2011). TVB-N values were found to be below the consumable limits for the sea bass samples sold at different selling areas and so they have marketability with good quality.

TMA-N analysis results

TMA is produced by the decomposition of TMAO caused by bacterial spoilage and enzymatic activity (Papadopoulos et al., 2003). Fish and other seafoods were accepted as "good" when they contain 4.00 mg/100g TMA-N; "marketable" when they contain 10.00 mg/100g TMA-N, and they accepted as "spoiled" when they contain 12.00 mg/100g TMA-N (Connell, 1980). Lowest TMA-N value (0.25 mg/100g) were detected for sea bass samples sold at public market (on August) while the highest value (7.72 mg/100g) were detected for the same group on June. TMA-N values were found to be below the consumable limits for the sea bass samples sold at different selling areas and so they have marketability with good quality.

TBA analysis results

TBA is a widely used indicator for assessing the degree of lipid oxidation (Nishimoto et al., 1985). Lowest TBA value (0.41 mg malonaldehyde/kg) were detected for sea bass samples sold at public market (on April) while the highest value (1.67 mg malonaldehyde/kg) were detected for sea bass samples sold at hypermarket (on December). TBA values were found to be below the consumable limits for the sea bass samples sold at different selling areas. Cakli et al., (2007) reported that the initial TBA value as 0.259 mg malonaldehyde/kg muscle of fish for sea bass stored in ice. Ersoy et al. (2008) found that the initial TBA value as 1.10 mg malonaldehyde/kg flesh of fish. Our results were similar to the results of their study.

Protein and lipid content of sea bass samples (at least 2 kg,) provided from local market, public market and hypermarket are given in Figure 4-5. Lowest protein contents depending on the months were detected as 18.21% (July), 17.97% (June) and 17.76% (September) and highest protein contents were detected as 20.25% (August), 20.65% (August) and 20.53% (June) for sea bass samples provided from local market, public market and hypermarket, respectively. Lowest lipid contents depending on the months were detected as 2.66% (January), 2.54% (May) and 2.98% (January) and highest lipid contents were detected as 7.57% (September), 9.07% (April) and 8.41% (March) for sea bass samples provided from local market, public market and hypermarket, respectively. Protein contents were not significantly different among all selling areas ($p>0.05$). Lipid content of sea bass provided from local market and public market were higher than those sold in hypermarket ($p>0.05$). Dinçer et al. (2009) determined % crude protein and % crude lipid value of cultured fresh sea bass in Aegean Sea as 19.38±0.47% and 7.84±0.20%. Grigorakis et al., (2004) found summer samples of sea bass 20.39% protein, 3.90% lipid. Similar proximate compositions (19.43% protein, 4.81% fat) have been reported by Kyrana and Lougovois (2002) for sea bass. It is known that variations in the chemical composition of marine fishes is closely related to nutrition, living area, fish size, catching season, seasonal and sexual variations as well as other environmental conditions (Özden and Erkan, 2009).

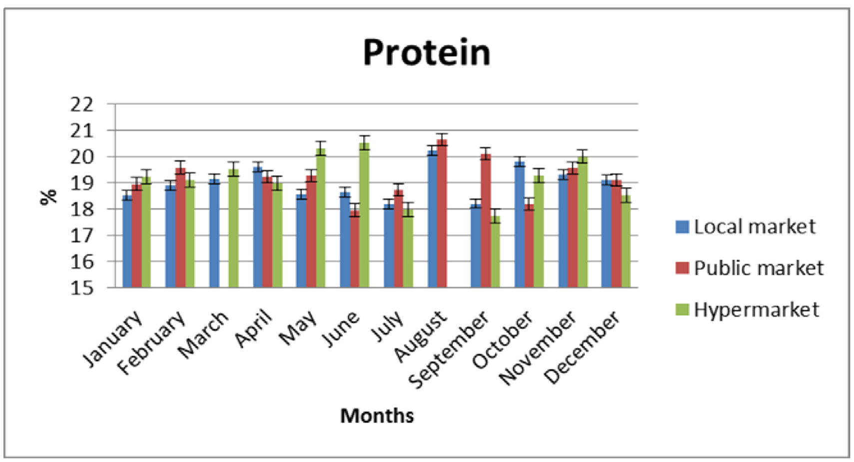

Figure 4. Monthly changes in protein contents of sea bass sold at different selling areas.

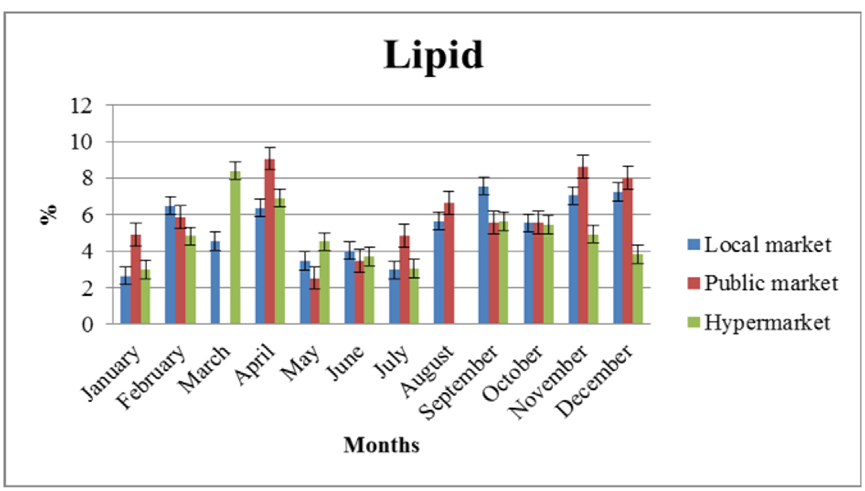

Figure 5. Monthly changes in lipid contents of sea bass sold at different selling areas.

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Table 1. Chemical analysis results of sea bass sold at different selling areas

Mon**th**s	Local market				Public market				Hypermarket			
	pH	TVB-N	TBA	TMA-N	pH	TVB-N	TBA	TMA-N	pH	TVB-N	TBA	TMA-N
January	6.76±0.01^{aA}	21.16±1.49^{aA}	0.61±0.05^{aA}	4.50±0.42^{aA}	6.38±0.01^{aB}	25.84±1.47^{aB}	0.57±0.03^{aA}	3.18±0.27^{aB}	6.97±0.02^{aA}	22.49±1.80^{aA}	0.70±0.06^{aB}	3.55±0.12^{aB}
February	6.34±0.03^{bA}	24.90±0.84^{bA}	0.67±0.03^{aA}	4.24±0.13^{aA}	6.39±0.02^{aA}	28.13±1.47^{bB}	0.73±0.03^{bB}	4.24±0.76^{bA}	6.50±0.01^{bB}	27.99±0.76^{bB}	0.56±0.02^{bC}	4.39±0.15^{bA}
March	6.44±0.01^{bA}	20.02±0.21^{aA}	0.54±0.11^{bA}	3.21±0.41^{bA}	*	*	*	*	6.40±0.01^{bA}	23.07±0.43^{aB}	0.79±0.02^{aB}	5.48±0.07^{cB}
April	6.49±0.04^{bA}	20.52±1.38^{aA}	0.52±0.02^{bA}	1.52±0.38^{cA}	6.68±0.01^{bB}	22.51±1.09^{cB}	0.41±0.02^{aB}	2.07±0.60^{cB}	6.56±0.03^{bC}	21.48±0.45^{aA}	0.49±0.01^{cA}	1.69±0.32^{dA}
May	6.69±0.02^{aA}	25.82±2.38^{bA}	0.46±0.01^{bA}	4.64±0.26^{aA}	6.62±0.05^{bA}	20.34±0.10^{cB}	0.54±0.01^{aB}	2.24±0.44^{cB}	6.39±0.06^{bB}	17.43±0.42^{cC}	0.50±0.01^{cA}	1.27±0.38^{dC}
June	6.35±0.01^{bA}	20.52±0.20^{aA}	0.54±0.04^{bA}	1.05±0.07^{cA}	6.62±0.01^{bB}	28.69±1.58^{bB}	0.56±0.02^{aA}	7.72±1.41^{dB}	6.29±0.01^{bcA}	19.64±0.49^{cA}	0.48±0.03^{cB}	1.10±0.15^{dA}
July	6.46±0.02^{bA}	19.48±0.58^{aA}	0.49±0.01^{bA}	2.57±0.41^{bcA}	6.42±0.03^{aA}	20.40±0.90^{cA}	0.55±0.04^{aB}	0.93±0.07^{eB}	6.32±0.02^{bcB}	21.03±0.57^{aB}	1.06±0.05^{dC}	1.05±0.15^{dB}
August	6.53±0.01^{cA}	21.60±0.97^{aA}	0.60±0.02^{aA}	0.76±0.25^{dA}	6.56±0.02^{bA}	22.10±1.19^{cA}	0.55±0.01^{aA}	0.25±0.25^{eB}	*	*	*	*
Semtember	6.50±0.03^{cA}	24.10±1.10^{bA}	0.72±0.02^{cA}	1.73±0.72^{cA}	6.38±0.02^{aB}	23.72±1.28^{acA}	0.59±0.03^{aB}	0.89±0.13^{eB}	6.52±0.03^{bA}	23.9±1.27^{aA}	0.56±0.02^{bB}	0.93±0.19^{dB}
October	6.35±0.01^{bA}	23.13±0.46^{bA}	0.55±0.02^{bA}	1.69±0.39^{cA}	6.62±0.04^{bB}	24.23±0.78^{acA}	0.55±0.01^{aA}	3.08±0.32^{aB}	6.50±0.03^{bC}	25.46±0.72^{bdB}	0.76±0.06^{aB}	1.35±0.19^{dC}
November	6.29±0.01^{bA}	22.15±0.49^{abA}	1.04±0.04^{dA}	1.14±0.26^{cA}	6.46±0.01^{aB}	24.68±0.47^{acB}	1.66±0.10^{cB}	2.01±1.46^{cB}	6.53±0.04^{bC}	27.49±0.91^{bC}	1.27±0.02^{dC}	3.67±0.38^{aC}
December	6.63±0.02^{cA}	24.73±0.36^{bA}	1.66±0.07^{eA}	1.52±0.25^{cA}	6.42±0.02^{aB}	23.23±0.38^{acA}	0.85±0.03^{bB}	2.78±0.34^{acB}	6.38±0.01^{bB}	28.23±1.14^{bB}	1.67±0.04^{eA}	3.04±0.25^{aC}

*Samples not found. All values are the Mean±SD (n =3). Different small letters indicate significant difference among means in the same column ($p<0.05$).Different small letters indicate significant
difference among means in the same line ($p<0.05$).

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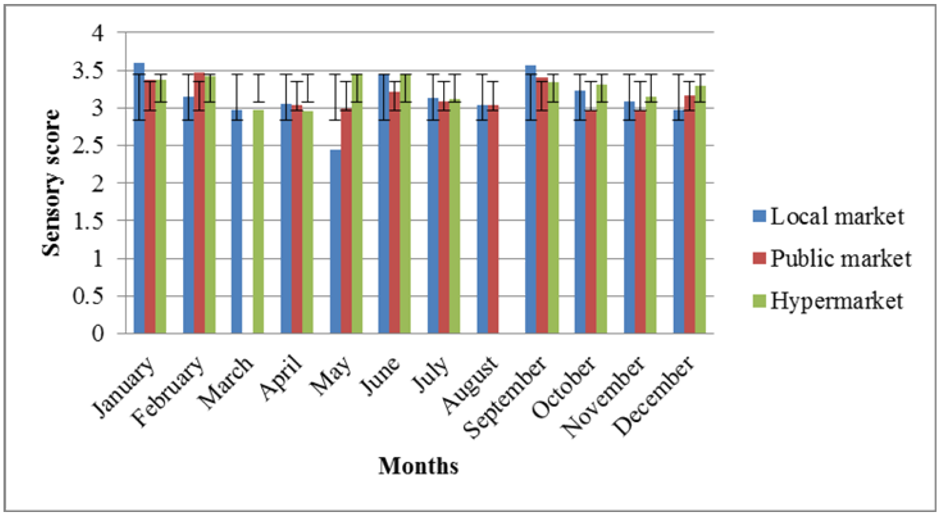

Figure 6. Monthly changes in sensory analysis results of sea bass sold at different selling areas.

Sensory analysis results

Sensory analysis results of sea bass samples sold at different selling areas are given in Figure 6, depending on the months. According to the overall evaluation of the sensory analysis scores, pannelists found the sea bass to have sensorily good quality ($p>0.05$).

Conclusion

When the results of the study was evaluated generally, it was determined that all the sea bass bought from different selling areas were good chemical and sensorial quality and marketable. On the other hand, according to results of microbiological analysis, it was found that total number of aerobic, mesophilic and psycrophilic bacteria exceeded the consumable limit values in hypermarket (May), public market (May and October) and outdoor market. It was determined that it reached high values especially in summer months in terms of Enterobacteriaceae. It was observed that sea bass sold in hypermarket were cleaner in winter months (November- December- January) than the ones sold in other selling places. It was ascertained that temperature was more proper for Enterobacteriaceae growth and also fish sold in public market in summer were bad quality. It was determined that necessary hygiene conditions were not provided in the outdoor market and public market, terms of cold chain were broken and their microorganism load was high due to the fact that they were sold in open-air spaces. According to sensorial analysis results, seabass have a good quality. pH, TVB-N, TMA-N and TBA values were found to be below the consumable limits for the sea bass samples sold at different selling areas and so they have marketability with good quality. Fishermen, who sell fish, should be informed about this subject and they should be told the importance of public health. Besides these, it is needed to take precautions for them to show required attention.

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