.(.): ..-.. (20..) DOI: 10.3153/jfscom.2011002

Journal of FisheriesSciences.com

E-ISSN 1307-234X

© 2010 www.fisheriessciences.com

RESEARCH ARTICLE ARAŞTIRMA MAKALESİ

THE QUALITY OF FISH FROM RETAIL MARKETS IN ISTANBUL, TURKEY

Suhendan Mol*, Ş. Yasemin Tosun

Istanbul University, Fisheries Faculty, Istanbul, Turkey

Abstract: The quality of fish (anchovy, horse mackerel, whiting, sea bass and sea bream), selling in Istanbul market, were studied. Samples were obtained from the retail fish markets located in three main regions (Region I= Kadikoy, Region II=Besiktas and Region III= Kumkapi) of Istanbul. According to the results of sensory, chemical and microbiological analysis; quality of the samples was lower (P<0.05) in summer then the other seasons due to the high ambient temperatures (32 ±2ºC), and samples obtained from Region III (Kumkapi) was generally better (P<0.05) than the others. Istanbul wholesale fish market, the seafood supplier of the retailers, is also located in Kumkapi. Therefore transport of fish from wholesale market to the retailers in Region III is easy and fast. However, wholesale fish market is far from the local markets in Region I and II. Thus, it was concluded that unsuitable transport conditions of fish from whole sale market to the retailers are the main reasons of poor quality. Vehicles must be equipped with a cooling system, and retailers should properly refrigerate seafood especially in summer season. It is mandatory to apply Turkish legislation of 2002, which is on the regulation of seafood market conditions and harmonious with EC (European Commission) criteria.

Keywords: Seafood, Fish quality, Fish markets, Retail market

Özet: **İstanbul'da Sabit Pazarlarda Satılan Balıkların Kalitesi**

Bu çalışmanın amacı, İstanbul'da sabit pazarlarda satılan balıkların (hamsi, mezgit, istavrit, çipura ve levrek) kalite düzeylerinin belirlenmesidir. Çalışmada, İstanbul'un üç farklı bölgesinden (Kadıköy= I. bölge, Beşiktaş= II. bölge, Kumkapı= III. bölge) balık örnekleri temin edilmiştir. Balıkların kalitelerini belirlemek için, duyusal, kimyasal ve mikrobiyolojik analizler yapılmıştır. Duyusal, mikrobiyolojik ve kimyasal analiz sonuçlarına göre yaz sezonu boyunca temin edilen örneklerin kalitesi yüksek ortam sıcaklığından (32 ±2ºC) dolayı düşük (P<0.05), III. bölgede satışa sunulan balıkların kalitesi I ve II. bölgelerde satılanlara göre genellikle iyi (P<0.05) bulunmuştur. İstanbul semt pazarlarının ana tedarikçisi olan İstanbul Büyükşehir Belediyesi Balık Hali Kumkapı semtinde bulunmakta olduğundan buradan Kumkapı semtindeki perakendecilere balığın kolay ve hızlı şekilde ulaştırılması mümkün olmaktadır. Balık hali II. ve III. bölgelerdeki satıcılara uzak olduğundan balığın taşınması sıtasındaki uygun olmayan koşulların düşük ürün kalitesine yol açtığı sonucuna varılmaktadır. Taşımada kullanılan araçların soğutma sistemi ile donatılması, perakendecilerde ise özellikle yaz aylarında soğutma koşullarının oluşturulması gereklidir. Avrupa Birliği kriterleri ile uyumlu olan Su ürünleri toptan ve perakende satış yönetmeliği (2002)'nin uygulanması satışa sunulan balıkların kalitesinin korunması için şarttır.

Anahtar Kelimeler: Su Ürünleri, Balık kalitesi, Balık marketleri, Perakende

* **Correspondence to:** Sühendan MOL, Istanbul University, Fisheries Faculty, Ordu Caddesi No:200 Laleli Istanbul-TURKEY
Tel: (+90 212) 455 57 00-16437, Fax: (+90 212) 514 03 79
E-mail: suhendan@istanbul.edu.tr

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).

There are many studies on the estimation of the safety and quality of seafoods from different regions of the world and these studies are very important to know health risks. Quality of smoked fish in Newfoundland-Canada (Dillon et al., 1994), retail fresh fish fillets in Netherlands (Broek et al., 1984), raw seafood products in Tokyo- Japan (Handa et al., 2005), fresh and cured fish in Cochin –India (Lalitha and Surendran, 2002), fish and crustaceans in Coimbatore-India (Hatha and Lakshmanaperumalsamy, 1997; Vivekanandhan, et al., 2005), smoked fish and fish pate in Spain (Dominguez et al., 2001), and retail fish products in Southern Finland (Johansson et al., 1999) were studied and health risks were evaluated.

Turkey is a peninsula and has many inland water resources. According to the official data; total amount of the marine and inland products are 582 376 tons. This country imports 44230 tons, and exports 14533 tons of seafood per year (Anon 2000). Istanbul is the major seafood supplier of Turkey, and also the main gate to export seafoods to Europe. However, there is a lack of information on the quality of commercial seafoods in Istanbul. Therefore, the aim of this study is to provide the basic information about the quality and safety of them.

Materials and Methods

Anchovy (*Engraulis encrasicolus)*, horse mackerel (*Trachurus trachurus),* whiting (*Merlangius merlangus*), sea bass (*Dicentrarchus labrax*) and sea bream (*Spraus aurata*), were obtained from the retail markets located in three main regions (Region I=Kadikoy, Region II =Besiktas and Region III= Kumkapi) of Istanbul. These regions were presented in Figure 1. It is possible to find horse mackerel and whiting in local markets during all year (whiting was not found in Region III retail market in October).

However catching of anchovy, the most popular fish in Turkey, is prohibited by the government in summer. Due to this prohibition; consumption of sea bream and sea bass is very common in summer since they are intensively cultured species. Therefore; quality levels of sea bream and sea bass were studied in summer when it was not possible to study with anchovies. For each species of fish 2 kg of sample were analyzed per month.

They were iced in styrofoam boxes and transferred to Istanbul University, Faculty of Fisheries, Seafood Processing and Quality Control Laboratory in 30 minutes. Sensory, chemical (pH, TVB-N (Total volatile basic nitrogen) and TMA-N (Trimethylaminenitrogen)) and microbiological (total mesophilic aerobic bacteria, total coliform, fecal coliform and *Salmonella sp.*) analysis were carried out in order to the determination of the quality levels of fish.

Sensory analysis: Sensory properties were assessed by five judges. Firmness and smell of the flesh; and appearance of the skin, gills, eyes, flesh, and color of fish were regarded (Anon 1996). Three was the highest quality and the samples lower than 1.0 were considered spoiled.

pH analysis: Fish were homogenized and WTW InoLab pH meter (Germany) was used for the pH measurements (Manthey et al., 1988).

Biochemical analysis: The method of Schormüller (1968) was used for TVB-N and TMA-N estimations. The sample was boiled and the vapor components held with 0.1N Hydrochloric acid was titrated with 0.1N sodium hydroxide and the TVB-N was expressed as mg/100g fish. For the estimation of TMA-N content of fish, samples were mixed with 10% trichloracetic acid solution and filtrated. Filtrate was well mixed with potassium hydroxide (50%), formaldehyde (20%) and toluene. Upper layer was separated, mixed with picric acid (0.2%) and measured by spectrophotometer at 450 nm (Shimatzu UV visible 1601, Japan). Results were compared with the standard curve and trimethylamine content of the sample was expressed as mg/100g fish.

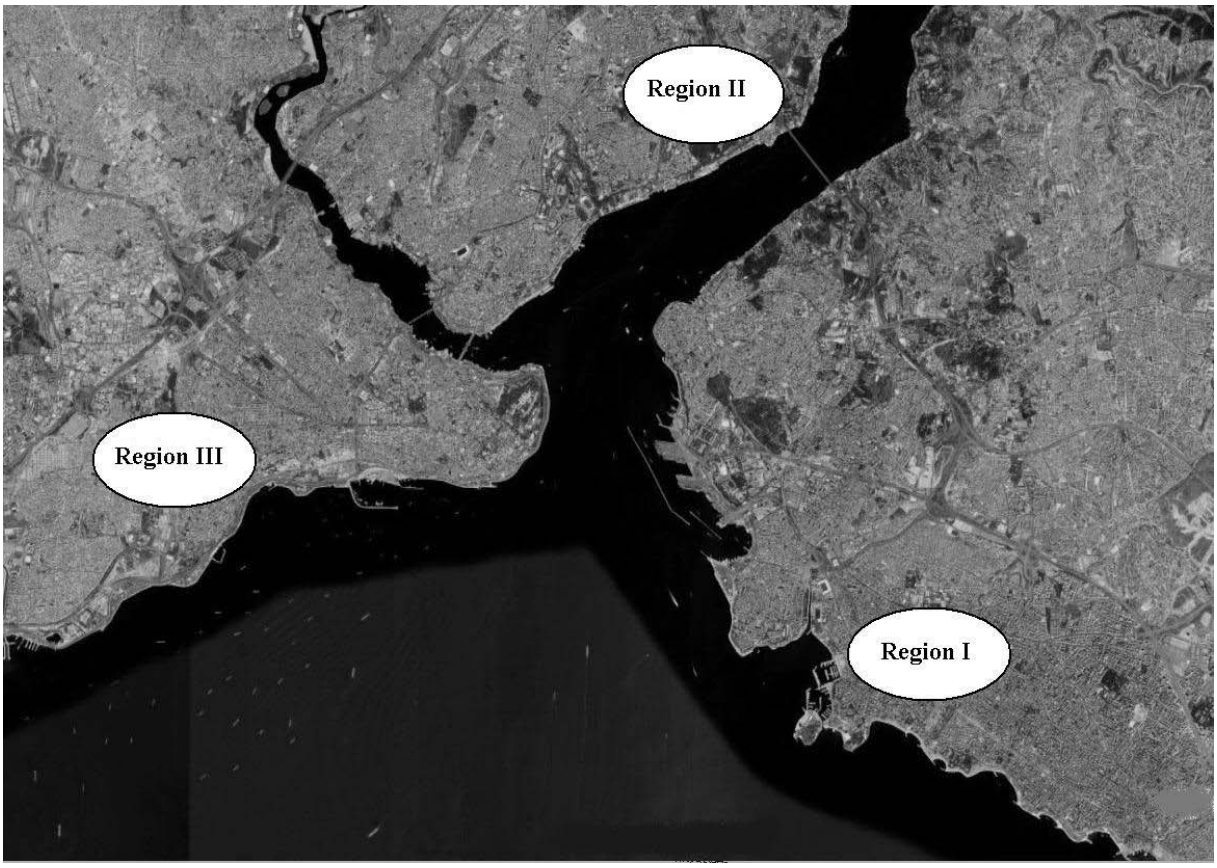

Figure 1. During the year of 2004 whole fish samples were obtained from the retail markets located in three main regions (Region I=Kadıköy, Region II =Beşiktaş and Region III= Kumkapı) of Istanbul, Turkey (googleearth, 2009).

Microbiological analysis: 10 g of the sample was mixed with 90 ml of peptone water, homogenized in a stomacher (IUL Instrument, Spain) and diluted with peptone water. Total mesophilic aerobic bacteria were determined using Plate Count Agar and plates were incubated for 24 hours at 35 °C (FDA 1984). Lauryl Sulfate Tryptose Broth tubes were inoculated and incubated 24-48 h at 37 °C to estimate the coliform bacteria. After that Brilliant Green %2 broth was used for the total coliform validity test. EC (*Escherichia coli*) Broth tubes were incubated at 44.5°C for 24 h for fecal coliform estimation. Gas producing tubes were evaluated according to MPN (most probable number) table (Baumgard, J. 1986).

In a sterilized jar, a tampon solution (225ml) was prepared with Phosphate Buffered Saline Tablets; samples (25g) were mixed in this solution and incubated 16-20 h. at 37 °C to estimate *Salmonella*. Selenite Cysteine Broth and Tetrathionate Broth were inoculated and incubated at 35-37 °C for 24 h and 18-24 h respectively for the selective enrichment. Bismuth Sulfite Agar and Xylose Lysine Desoxycholate Agar were inoculated and incubated 24-48 h at 37 °C as selective agar. Two different slant agars (Triple Sugar Iron Agar and Lysin Iron Agar) were used for identification and *Salmonella sp.* was evaluated as negative or positive (Andrews, 1992).

Statistical analysis: Statistical differences were studied on the probability $P<0.05$, ANOVA was performed to compare the means (Sümbüloğlu and Sümbüloğlu,. 2002) and Excel 1997 was used.

Results and Discussion

Sensory, chemical and microbiological analysis of fish (anchovy, horse mackerel, whiting, sea bass and sea bream), obtained form the retail markets located in three main regions of Istanbul, were presented in table 1, 2 and 3.

Sensory analyses give the most reliable results for the determination of quality of fish and fish products (Lang, 1979; 1983). The fish is accepted as "very good" when it's sensory score is higher than 2.70; "good" when its sensory score is between 2.70 – 2.00; "marketable" when it is between 2.00 – 1.00 and "spoiled" when their sensory score is lower than 1.00 (Huss, 1988). In this study the average sensory scores of the anchovy samples obtained from Region I, Region II and Region III were 1.57, 1.76 and 2.04, respectively. Sensory quality of anchovy obtained from Region I was significantly lower (P<0.05) than the others regarding the average scores. Whiting samples were marketable in all markets. Sensory quality of horse mackerels obtained from Regions II and III were significantly higher (P<0.05) in respect to the samples from Region I. Quality of sea bass obtained from Region III was "good"; but "marketable" for the others (P<0.05). Sensory quality of sea bream was determined as "good" and there were not significant differences (P>0.05) among the various regions.

In this study the average pH values of the anchovies obtained from Region I, Region II, and Region III were 6.06, 6.00 and 5.87 respectively. Baygar and Özden (2004) reported pH value for anchovies as 6.21. In another study the average pH values of anchovies were regarded as 6.08 in fall, 6.15 in winter, and 6.20 in spring (Türker et al., 1999). The results are similar to that of ours study. The average pH value of horse mackerels obtained from Region I was 6.24, and it was 6.19 for the samples obtained from the other regions of Istanbul. Özden and Baygar (2003) obtained horse mackerels from the markets in Istanbul and reported the pH the value as 6.04. In another study, the pH value of *Trachurus murphy* selling in Valdivia, Chile was 6.29 (Schoebitz et al., 1985). It was mentioned that, pH values of the fresh fish are between 6.00 and 6.50, the limit of acceptability is between 6.80-7.00 (Baygar, et al., 2002; Connell, 1980; İnal, 1992). In our study pH values were lower than 7.00 for all samples and they were in acceptable quality.

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). In this study, the average TVB-N values of whiting samples were higher (P<0.05) than other species in all sampling regions and the other species were in "very good" quality according to the mean TVB-N values of catching season. In various studies total volatile basic nitrogen content of anchovies obtained from the retailers in Istanbul was not reported higher than 20 mg/100g. (Özden, and Baygar, 2003; Perk, 1995; Varlık et al., 2000) and they were regarded as fresh. In this study it was determined that TVB-N values of anchovies higher (P<0.05) in may, and fall due to the high ambient temperature (32 ±2°C) Similarly, Turker et al. (1999) (Türker et al.,1999) reported TVB-N values of anchovies as 17.82 mg/100g, 13.24 mg/100g and 13.09 mg/100g in fall, winter and spring seasons respectively. It was determined that, the average TVB-N values of anchovy and whiting from Region I was significantly higher (P<0.05) then the others. Even if the TVB-N content of the sea bass obtained from Region I was significantly higher (P<0.05) in July (30.50 mg/100g), sea bass samples were acceptable during the study. European Union (1995), accepted the TVB-N limit for sea bream as 25.00 mg/100g. Therefore it is clear that sea breams were acceptable during the study.

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). In this study, the average TMA-N values were lower than 10.00 mg/100g for all samples. However; TMA-N content of whiting which were obtained from Region I was over 12.00 mg/100g in May; and these samples were "unmarketable". For whiting samples which were taken from Region II, TMA-N value was very high in July and they were also "unmarketable". Trimethylamine nitrogen values of the samples obtained from Region III showed that, whiting samples were unmarketable in June and horse mackerels in July. These values were higher (P<0.05) than the others. It is clear that; TMA-N content could be over the limits especially in summer season due to the high ambient temperatures.

Table 1. Results of the sensory, chemical and microbiological analysis of seafood obtained from Region I (Kadıköy)

Analysis	Species	Months												
		January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Average**
Sensory	**Anchovy**	1.80	1.90	1.60	1.10	1.10	*	*	*	1.60	2.20	1.40	1.50	1.57 ± 0.35
	Whiting	2.20	1.80	1.30	1.90	0.70	1.40	1.30	1.70	1.90	2.40	1.00	1.90	1.62 ± 0.49
	Horse mackerel	2.20	1.90	2.00	2.10	1.80	1.10	1.50	2.00	2.10	2.10	2.00	2.30	1.92 ± 0.33
	Sea bass	*	*	*	*	*	2.20	1.30	2.20	*	*	*	*	1.90 ± 0.51
	Sea bream	*	*	*	*	*	2.30	1.40	2.40	*	*	*	*	2.03 ± 0.55
pH	**Anchovy**	6.19	6.21	6.25	6.16	5.77	*	*	*	5.78	5.77	6.10	6.06	6.03 ± 0.20
	Whiting	6.57	6.81	6.63	6.57	6.80	6.78	6.64	6.62	6.67	6.67	6.81	6.63	6.68 ± 0.09
	Horse mackerel	6.14	6.30	6.21	6.43	6.08	6.16	6.24	6.11	6.11	6.16	6.60	6.43	6.24 ± 0.16
	Sea bass	*	*	*	*	*	5.98	6.21	5.94	*	*	*	*	6.04 ± 0.14
	Sea bream	*	*	*	*	*	6.09	6.36	6.14	*	*	*	*	6.19 ± 0.14
TVB-N (mg/100g)	**Anchovy**	15.60	9.58	18.09	16.04	25.34	*	*	*	23.46	17.91	21.00	19.11	18.45 ± 4.64
	Whiting	18.14	15.58	46.89	29.95	51.53	26.60	65.41	17.85	22.84	67.05	38.61	19.76	35.01±18.61
	Horse mackerel	10.37	11.31	14.32	9.69	20.37	10.09	50.97	19.89	17.53	14.81	13.08	12.65	17.09 ± 11.27
	Sea bass	*	*	*	*	*	5.08	30.50	19.57	*	*	*	*	18.38 ± 12.75
	Sea bream	*	*	*	*	*	9.04	23.56	17.55	*	*	*	*	16.71 ± 7.29
TMA-N (mg/100g)	**Anchovy**	4.65	4.60	4.77	6.02	4.65	*	*	*	5.10	5.30	4.45	4.27	4.86 ± 0.53
	Whiting	5.15	4.65	6.12	5.65	12.60	11.00	8.90	5.07	4.45	11.75	8.10	4.27	7.30 ± 3.05
	Horse mackerel	5.30	4.60	4.57	5.02	4.85	6.25	8.77	4.65	4.60	5.00	3.98	3.65	5.10 ± 1.32
	Sea bass	*	*	*	*	*	5.15	8.35	4.32	*	*	*	*	5.94 ± 2.12
	Sea bream	*	*	*	*	*	5.47	6.05	4.22	*	*	*	*	5.24 ± 0.93
Total Aerobic Mezophilic Bacteria (log10CFU/g)	**Anchovy**	2.00	<2.00	3.47	2.30	3.39	*	*	*	6.17	3.17	3.17	3.60	3.25 ± 1.26
	Whiting	2.47	2.00	2.54	<2.00	4.32	4.46	6.00	5.63	5.86	4.69	3.73	3.87	3.96± 1.46
	Horse mackerel	<2.00	<2.00	<2.00	2.84	2.69	5.96	7.04	5.54	5.51	3.74	2.69	4.97	3.91 ± 1.79
	Sea bass	*	*	*	*	*	3.04	6.98	4.69	*	*	*	*	4.90 ± 1.97
	Sea bream	*	*	*	*	*	5.13	4.69	6.45	*	*	*	*	5.42 ± 0.91
Total Coliform Bacteria (logMPN/g)	**Anchovy**	0.55	<0.47	0.55	<0.47	0.55	*	*	*	1.96	0.55	<0.47	0.55	0.68 ± 0.48
	Whiting	<0.47	<0.47	<0.47	<0.47	3.04	1.96	1.36	1.04	1.36	3.04	2.07	1.63	1.44 ± 0.94
	Horse mackerel	<0.47	<0.47	<0.47	<0.47	1.36	3.04	3.04	2.38	2.38	2.38	<0.47	<0.47	1.45 ± 1.10
	Sea bass	*	*	*	*	*	1.36	3.04	1.36	*	*	*	*	1.92 ± 0.96
	Sea bream	*	*	*	*	*	0.55	2.66	3.04	*	*	*	*	2.08 ± 1.34
Fecal Coliform Bacteria (logMPN/g)	**Anchovy**	0.55	<0.47	<0.47	<0.47	0.55	*	*	*	0.96	<0.47	<0.47	<0.47	0.54 ± 0.16
	Whiting	<0.47	<0.47	<0.47	<0.47	1.44	<0.47	0.55	<0.47	0.96	2.38	<0.47	<0.47	0.75 ± 0.59
	Horse mackerel	<0.47	<0.47	<0.47	<0.47	<0.47	1.32	2.38	<0.47	0.96	<0.47	<0.47	<0.47	0.74 ± 0.58
	Sea bass	*	*	*	*	*	0.96	1.36	<0.47	*	*	*	*	0.93 ± 0.44
	Sea bream	*	*	*	*	*	<0.47	<0.47	0.55	*	*	*	*	0.49 ± 0.04

(*): Not Analysed

Table 2. Results of the sensory, chemical and microbiological analysis of seafood obtained from Region II (Beşiktaş)

Analysis	Species	Months												
		January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Average**
Sensory	**Anchovy**	2.10	2.00	1.00	1.70	0.60	*	*	*	2.00	2.20	2.20	2.20	1.76 ± 0.57
	Whiting	2.40	2.20	1.70	1.50	2.30	1.90	0.90	1.80	1.90	1.60	1.60	2.30	1.89 ± 0.43
	Horse mackerel	2.20	2.10	1.80	1.80	2.90	1.60	1.70	2.20	1.80	2.00	2.00	2.00	2.04 ± 0.35
	Sea bass	*	*	*	*	*	2.20	1.40	2.20	*	*	*	*	1.93 ± 0.46
	Sea bream	*	*	*	*	*	2.40	1.90	2.40	*	*	*	*	2.33 ± 0.28
pH	**Anchovy**	6.16	5.89	6.14	6.13	5.83	*	*	*	5.65	5.73	5.86	6.64	6.00 ± 0.30
	Whiting	6.51	6.74	6.69	6.62	6.43	6.65	6.72	6.61	6.66	6.44	6.44	5.97	6.53 ± 0.21
	Horse mackerel	6.35	6.06	6.24	6.23	6.42	6.17	6.25	6.11	6.13	6.42	5.43	6.06	6.19 ± 0.15
	Sea bass	*	*	*	*	*	6.03	6.03	6.17	*	*	*	*	6.07 ± 0.08
	Sea bream	*	*	*	*	*	6.29	6.26	6.25	*	*	*	*	6.26± 0.02
TVB-N (mg/100g)	**Anchovy**	13.41	13.12	14.19	11.19	14.69	*	*	*	25.51	14.35	28.09	4.80	15.48 ± 7.11
	Whiting	29.61	18.89	28.66	45.07	37.11	22.39	56.01	15.86	18.58	40.62	41.90	4.90	29.97± 14.62
	Horse mackerel	9.28	15.90	14.18	9.71	10.79	6.80	25.61	12.58	14.68	13.37	17.97	4.70	12.96± 5.50
	Sea bass	*	*	*	*	*	7.30	9.60	15.08	*	*	*	*	10.66± 3.99
	Sea bream	*	*	*	*	*	5.92	2.62	15.87	*	*	*	*	8.13± 6.89
TMA-N (mg/100g)	**Anchovy**	4.57	4.82	6.47	5.75	3.87	*	*	*	4.95	3.50	3.55	4.85	4.70± 0.98
	Whiting	4.50	4.90	4.82	9.62	4.22	9.95	21.80	4.67	5.17	4.30	3.75	3.96	6.80 ± 5.16
	Horse mackerel	4.60	5.02	4.52	5.57	3.12	5.70	7.35	4.75	4.80	3.40	4.27	3.80	4.74± 1.13
	Sea bass	*	*	*	*	*	5.20	4.10	4.45	*	*	*	*	4.58± 0.56
	Sea bream	*	*	*	*	*	4.80	4.87	4.60	*	*	*	*	4.75 ± 0.14
Total Aerobic Mezophilic Bacteria (log10CFU/g)	**Anchovy**	3.39	3.30	2.17	<2.00	4.76	*	*	*	4.17	4.50	3.65	2.92	3.42± 1.96
	Whiting	<2.00	<2.00	2.60	3.00	3.87	6.31	7.49	6.32	5.06	4.79	4.17	2.17	4.14± 1.87
	Horse mackerel	3.00	3.04	3.49	2.54	3.17	4.38	6.53	5.90	4.87	3.39	4.17	4.00	4.04 ± 1.21
	Sea bass	*	*	*	*	*	5.27	6.07	5.90	*	*	*	*	5.74± 0.42
	Sea bream	*	*	*	*	*	6.04	5.54	5.46	*	*	*	*	5.68 ± 0.31
Total Coliform Bacteria (logMPN/g)	**Anchovy**	<0.47	0.55	<0.47	0.55	1.32	*	*	*	1.96	2.66	0.96	<0.47	1.04 ± 0.79
	Whiting	<0.47	2.66	<0.47	<0.47	1.36	0.55	3.04	2.17	2.66	2.38	1.57	1.36	1.59 ± 0.96
	Horse mackerel	<0.47	<0.47	0.86	<0.47	0.96	2.38	1.96	1.63	2.66	2.17	1.63	3.04	1.55 ± 0.90
	Sea bass	*	*	*	*	*	<0.47	2.66	1.63	*	*	*	*	1.58± 1.09
	Sea bream	*	*	*	*	*	<0.47	2.38	2.38	*	*	*	*	1.74± 1.10
Fecal Coliform Bacteria (logMPN/g)	**Anchovy**	<0.47	<0.47	<0.47	<0.47	<0.47	*	*	*	<0.47	<0.47	0.96	<0.47	0.52± 0.16
	Whiting	<0.47	<0.47	<0.47	<0.47	1.36	<0.47	0.55	<0.47	0.55	2.38	1.57	<0.47	0.80± 0.62
	Horse mackerel	<0.47	<0.47	<0.47	<0.47	<0.47	<0.47	1.63	<0.47	0.96	<0.47	1.63	<0.47	0.70 ± 0.45
	Sea bass	*	*	*	*	*	<0.47	<0.47	1.36	*	*	*	*	0.76 ± 0.51
	Sea bream	*	*	*	*	*	<0.47	<0.47	0.55	*	*	*	*	0.49 ± 0.04

(*): Not Analysed

Table 3. Results of the sensory, chemical and microbiological analysis of seafood obtained from Region III (Kumkapı)

Analysis	Species	Months												
		January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Average**
Sensory	**Anchovy**	2.30	2.10	2.30	2.10	1.90	*	*	*	1.80	1.80	2.30	1.80	2.04 ± 0.22
	Whiting	2.30	2.40	2.20	2.50	2.10	1.50	1.40	1.30	1.30	*	2.10	2.40	1.95 ± 0.47
	Horse mackerel	1.60	2.40	2.30	2.50	2.30	1.90	1.30	1.70	1.60	2.10	2.10	2.20	2.00 ± 0.37
	Sea bass	*	*	*	*	*	2.20	2.10	2.30	*	*	*	*	2.20 ± 0.10
	Sea bream	*	*	*	*	*	2.30	1.80	2.50	*	*	*	*	2.20 ± 0.36
pH	**Anchovy**	5.88	6.02	5.88	6.14	5.82	*	*	*	5.71	5.78	5.80	5.87	5.87 ± 0.13
	Whiting	6.55	6.57	6.70	6.66	6.52	6.73	6.35	6.42	6.14	*	6.52	6.66	6.52 ± 0.17
	Horse mackerel	6.16	6.06	6.14	6.16	6.02	6.34	6.34	6.00	6.57	6.24	6.20	6.13	6.19 ± 0.15
	Sea bass	*	*	*	*	*	5.92	6.06	6.07	*	*	*	*	6.01 ± 0.08
	Sea bream	*	*	*	*	*	6.00	6.06	6.43	*	*	*	*	6.16 ± 0.23
TVB-N (mg/100g)	**Anchovy**	11.14	15.94	8.63	17.32	26.11	*	*	*	16.81	17.05	27.65	8.03	16.50 ± 6.89
	Whiting	17.42	20.61	17.95	13.19	23.43	69.33	26.62	27.78	25.12	*	28.11	14.90	25.86 ± 15.32
	Horse mackerel	16.19	14.98	10.01	13.84	14.05	21.14	40.93	11.98	20.71	24.92	20.70	4.16	17.80± 9.21
	Sea bass	*	*	*	*	*	21.05	6.38	16.27	*	*	*	*	14.56 ± 7.48
	Sea bream	*	*	*	*	*	24.28	10.36	21.01	*	*	*	*	18.55 ± 7.27
TMA-N (mg/100g)	**Anchovy**	3.87	5.07	4.40	5.42	4.25	*	*	*	4.40	4.05	4.82	5.55	4.64 ± 0.59
	Whiting	4.55	4.65	4.60	5.20	4.90	20.55	8.75	6.52	8.95	*	5.60	4.63	7.17 ± 4.72
	Horse mackerel	4.15	4.60	4.40	4.22	3.62	6.92	14.65	6.60	6.65	4.92	4.85	5.22	5.90 ± 2.95
	Sea bass	*	*	*	*	*	4.42	5.15	5.35	*	*	*	*	4.97 ± 0.48
	Sea bream	*	*	*	*	*	4.67	5.75	5.97	*	*	*	*	5.46 ± 0.69
Total Aerobic Mezophilic Bacteria (log10CFU/g)	**Anchovy**	3.09	2.00	2.54	<2.00	2.69	*	*	*	5.66	3.33	3.60	3.00	3.10 ± 1.10
	Whiting	2.30	<2.00	<2.00	<2.00	3.87	3.54	5.39	5.02	5.26	*	3.17	2.92	3.40 ± 1.32
	Horse mackerel	2.39	2.17	<2.00	<2.00	<2.00	4.17	5.17	3.54	5.31	3.77	3.90	3.93	3.36 ± 1.22
	Sea bass	*	*	*	*	*	4.39	2.65	4.87	*	*	*	*	3.97 ± 1.16
	Sea bream	*	*	*	*	*	3.47	3.85	3.84	*	*	*	*	3.72 ± 0.21
Total Coliform Bacteria (logMPN/g)	**Anchovy**	<0.47	<0.47	<0.47	<0.47	0.96	*	*	*	1.04	<0.47	0.55	0.96	0.65 ± 0.25
	Whiting	<0.47	<0.47	1.36	<0.47	1.36	0.55	3.04	1.63	3.04	*	1.36	0.55	1.30 ± 0.96
	Horse mackerel	<0.47	0.55	<0.47	0.96	0.55	<0.47	3.04	0.96	1.32	2.38	0.55	<0.47	1.01 ± 0.84
	Sea bass	*	*	*	*	*	<0.47	<0.47	<0.47	*	*	*	*	0.47±0.00
	Sea bream	*	*	*	*	*	<0.47	0.96	0.55	*	*	*	*	0.66 ± 0.26
Fecal Coliform Bacteria (logMPN/g)	**Anchovy**	<0.47	<0.47	<0.47	<0.47	0.55	*	*	*	<0.47	<0.47	<0.47	0.55	0.48 ± 0.03
	Whiting	<0.47	<0.47	0.96	<0.47	<0.47	0.55	0.96	<0.47	0.96	*	<0.47	<0.47	0.61 ± 0.22
	Horse mackerel	<0.47	<0.47	<0.47	<0.47	<0.47	<0.47	2.66	<0.47	<0.47	0.55	0.55	<0.47	0.66 ± 0.62
	Sea bass	*	*	*	*	*	<0.47	<0.47	<0.47	*	*	*	*	0.47± 0.00
	Sea bream	*	*	*	*	*	<0.47	0.55	<0.47	*	*	*	*	0.49 ± 0.04

(*): Not Analysed

The limit value for total mesophilic aerobic bacteria for seafood is 10^6 CFU/g (6.00 log CFU/g) (Anon 1992). This limit is accepted as $5.00x10^5$ CFU/g (5.69 log CFU/g) by ICMFS (1986). The average values were remained below these limits, but as it was shown in Table 1 and 2, samples obtained from the retailers in Region I and II excess these limits especially between June-August. However total mesophilic aerobic bacteria counts of the samples obtained from Region III (Table 3) remained lower (P<0.05). In a similar study 78% of the samples were unacceptable in terms of microbiological quality and in Finnish retail market. It was concluded that, the hygienic quality of fish roes in Finnish retail market should be improved (Miettinen et al., 2003).

The limit value for the total coliform bacteria is 160-210 MPN/g (2.20-2.32 log MPN/g) (Anon 1992). According to the average total and fecal coliform bacteria counts; the samples obtained from Region III were in better quality (P<0.05) than the samples obtained from the other regions of Istanbul. The average fecal coliform values were lower than 1.0 log MPN/g during the study. Similarly, microbiological quality of *Trachurus sp*. sold at the retail level in Valdivia – Chile was reported to have fecal coliforms as 0.72 log MPN/g (Schoebitz et al., 1985).

European Union prohibits the trade of seafood containing *Salmonella sp*. and raw seafood must not contain it (Anon 1992; Huss et al., 2003). The prevalence of *Salmonella* in fish from markets in Coimbatore, South India was studied. Samples were found to be contaminated (14.25%) with *Salmonella* sp (Hatha and Lakshmanaperumalsamy, 1997). However; in this study all the samples were found as free of *Salmonella sp*. similar to Schoebitz et al. (1985).

Conclusion

It was concluded that quality of the samples were lower during summer season due to the high ambient temperatures (32 ±2 ºC) and the quality of fish selling in Region III, where wholesale fish market also located in, was generally better than far-distance regions (Regions I and II). Therefore it was concluded that; unsuitable transport conditions of seafood from whole sale market to the retailers are the main reasons of decreasing quality. Refrigerated transport and temperature control are very important especially in summer season regarding the high ambient temperatures. The regulation of Turkish government (Anon 2002), which is harmonious with EC criteria must be strictly followed to avoid secondary contamination and to maintain the safe trade of seafoods from in to Europe.

Acknowledgements

This work was supported by the Research Found of Istanbul University. Project Number: T-127/11112002.

References

Andrews, W., (1992), *Manuals of Food Quality Control*, 4. Microbiological Analysis, FAO, Rome.

Anon, (1992), Tarih: 28 Mayıs 1992 no: 20884 *Resmi gazete*, Ankara.

Anon, (1996),. *Laying down common marketing satandarts for certain fishery products*. EC Concil reglation N 2406/96.

Anon, (2000), *Su Ürünleri İstatistikleri.* Türkiye Cumhuriyeti Başbakanlık Devlet İstatistik Enstitüsü Basımevi, Ankara.

Anon, (2002), *Su Ürünleri Toptan ve Perakende Satış Yerleri Yönetmeliği*. 19.06.2002 tarih ve 24790 sayılı resmi gazete. T.C. Tarım ve Köyişleri Bakanlığı Koruma Kontrol Genel Müdürlüğü, Ankara

Baumgard, J., (1986), *Lebensmittel tierischer Herkunft, Feinkosterzeugnisse, gefrorene, tiefgefrorene und getrocknete lebensmittel, Fertiggerichte, hitzekonservierte Lebensmittel, Speiseeis, Zucker, Kakao, Zuckerwaren, Rohmassen. Mikrobiologische Untersuchung von Lebensmitteln.* Jürgen Baumgart, unter Mitarbeit von Jürgen Firnhaber**,** Gottfried Spicher (ed) Behr's Verlag Hamburg.

Baygar, T., Özden, Ö., (2004), Dondurma ve Çözündürme İşleminin Balık Kalitesi Üzerine Etkisi. *Turkish Journal of Veterinary and Animal Science*, **28** (1):173-178.

Baygar, T., Erkan,N., Metin, S, Özden, Ö., Varlık, C., (2002), Soğukta Depolanan Alabalık Dolmasının raf Ömrünün belirlenmesi. *Turkish Journal of Veterinary and Animal Science*, **26**(3): 577-580.

Broek, M.J.M., Mossel, D.A.A., Mol, H., (1984), Microbiological Quality of Retail Fresh Fish Fillets in the Natherlands. *Food*

Microbiology, **1**(2): 53-61. **doi:10.1016/0168-1605(84)90008-4**

Connell, J.J., (1980), *Control of Fish Quality* 2nd ed., Fishing New Books Ltd., UK: Farnham.

Dillon, R., Patel, T., Ratnam, S., (1994), Occurrence of *Listeria* in Hot and Cold Smoked Seafood Products. *Inernational. Journal of Food Microbiology*, **22**(1): 73-77. **doi:10.1016/0168-1605(94)90009-4**

Dominguez, C., Gamez, I., Zumalacarregur, J., (2001), Prevalence and contamination levels of *Listeria monocytogenes* in smoked fish and pate sold in Spain. *Journal of Food Protection*, **64**(12): 2075-2077.

European Union, (1995), Commission Decision 95/149/ EC of 8 March 1995 fixing the total volatile basic nitrogen (TVB-N) limit values for certain categories of fishery products and specifying the analysis methods to be used. *Official Journal*, L097, 84-87.

FDA, (1984), *Bacteriological Analytical Manual*, 6th Edition, Ch.4 and 5. AOAC, Arlington, VA.

Handa, S., Kimura, B., Takahashi, H., Koda, T., Hisa, K., Fujii, T., (2005), Incidence of *Listeria monocytogenes* in Raw Seafood Products in Japanese Retail Stores. *Jorunal of Food Prot*ection, **68**(2): 411-415.

Hatha, A.A.M., Lakshmanaperumalsamy, P., (1997), Prevalance of *Salmonella* in Fish and Crustaceans from Markets in Coimbatore, South India. *Food Microbiology*, **14**(2): 111-116. **doi:10.1006/fmic.1996.0070**

Huss, H.H., (1988), *Fresh Fish Quality and Quality Changes*, FAO Fisheries Series, vol. 29, FAO, Rome.

Huss, H. H., Ababouch, L., Gram, L., (2003), Assessment and Management of Seafood Safety and Quality. FAO Fisheries Technical Paper 444.

ICMSF, (1986), International Commission on Microbiological Spesifictions for Foods, Sampling Plans for fish and Shellfish. In: *ICMSF, Microorganisms in Foods.* Sampling for Microbiological Analysis: Principles and Sciencetific Applications, 2nd Edition Vol 2, University of Toronto Press, Toronto.

İnal, T., (1992), *Besin Hijyeni*. Final ofset A. S., İstanbul, Türkiye, pp. 345-592.

Johansson, T., Rantala, L., Palmu, L., Honkanen-Buzalski, T., (1999), Occurrence and Typing of *Listeria monocytogenes* Strains in Retail vacuum-packed Fish Products and in a Production Plant. *International Journal of Food Microbiology*, **47**(1): 111-119. **doi:10.1016/S0168-1605(99)00019-7**

Kietzman, U., Priebbe, K., Rakow, D., Reichstein, K., (1969), *Seefisch als Lebensmittel*. Paul Parey Verlag, Hamburg-Berlin., pp. 176-368.

Lalitha, K.V., Surendran, P.K. (2002), Occurrence of *Clostridium botulinum* in fresh and cured fish in retail trade in Cochin (India). *International Journal of Food Microbiology*, **72**(1): 169-174. **doi:10.1016/S0168-1605(01)00632-8**

Lang, K., (1979), Der Flüchtige Basenstichstoff (TVB-N) bei im Binnenland in der Verkehr gebracheten frichen seefischen. *Archiev für Lebensmittelhygiene*, **30:** 215-217.

Lang, K., (1983), Der Flüchtige Basenstichstoff (TVB-N) bei im Binnenland in der Verkehr gebracheten frichen seefischen. 11. Mitteilung. *Archiev für Lebensmittelhygiene*, **34:** 7-10.

Manthey, M., Karnop, G., Rehbein, H., (1988), Quality Changes of European Catfish (*Silurus glanis*) from Warm- Water Aquaculture During Storage Ice. *International Journal of Food Science and Technology*, **23**(1): 1-9. **doi:10.1111/j.1365-2621.1988.tb00543.x**

Miettinen, H., Arvola, A., Luoam, T., Wirtanen, G., (2003), Prevalance of *Listeria monocytogenes* and Microbiological and Sensory Quality of Rainbow Trout, Whitefish, and Vendace Roes from Finnish Retail Markets. *Journal of Food Protection*, **66**(10): 1832-1839.

Özden, Ö., Baygar, T., (2003), Farklı Paketleme Yöntemlerinin Marine Edilmiş Bazı Balıkların Kalite Kriterleri Üzerine Etkisi. *Turkish Journal of Veterinary and Animal Science*, **27**(4): 899-906.

Perk, E., (1995), *Farklı Cins Balıkların Tazelik Kriterlerinin İncelenmesi*, İstanbul

Üniversitesi Fen Bilimleri Enstitüsü Yüksek Lisans Tezi, İstanbul.

Renner, E., (1970), *Mathematisch-Statitische Methoden in der Praktischen Anwendung*. Verlag Paul Parey, Berlin Und Hamburg, pp. 9-90.

Schoebitz, R., Tamayo, R., Davis M., (1985), Microbiological quality of the fish species *Trachurus murphyi*, sold at the retail level in the town of Valdivia, Chile. *Food Mic*robiology, **2**(4): 243-247. **doi:10.1016/0740-0020(85)90004-8**

Schormuller, J., (1968), *Handbuch der Lebensmittelchemie*. Springer-Verlag. Berlin- Heidelberg-New York, pp. 1341-1397, 1584-1585.

Sikorski, Z.E., Kolakowska, A., Burt, J.R., (1990), Postharvest Biochemical and Microbial Changes. In: *Seafood: Resources Nutritional Composition and Preservation*, Sikorski, Z.E (chief ed.), CRC Press Inc, USA: Florida, pp. 55-77.

Sümbüloğlu K., Sümbüloğlu V., (2002), *Biyoistatistik.* Hatipoğlu Basım ve Yayım San. Tic. Ltd. Şti. Ankara.

Türker, S., Gökoğlu, N., Özden, Ö., Ekan, N., Metin, S., Baygar, T., (1999), Avlanma mevsiminin Hamsi (*Engraulis engrasicolus*, Lin. 1758) Balığında Bazı Kalite Değerlerine ve Dayanma Süresine Etkisi. *Biyoteknoloji (KÜKEM) Dergisi*, **22**(2): 41-48.

Varlık, C., Erkan, N., Metin, S., Baygar, T., Özden, Ö., (2000). Marine Balık Köftesinin Raf Ömrünün Belirlenmesi. *Turkish Journal of Veterinary and Animal Science*, **24**(6): 593-597.

Vivekanandhan, G., Hatha, A.A.M., Lakshmanaperumalsamy, P., (2005), Prevalance of *Aeromonas hydrophila* in fish and Prawns from the Seafood Market of Coimbatore, South India. *Food Microbiology*, **22**: 133-137. **doi:10.1016/j.fm.2004.01.015**