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Microbiological Quality of Seafood in the Dardanelles, Turkey

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Abstract: In this study, bacteriological analyses of fish (finfish and shellfish) quality between the landing point at wholesale fish market and seafood retail stores in Dardanelles region of Turkey were compared in 2004. Fish samples (N = 200) from the seafood retail store were found to be significantly ($p < 0.05$; t-test) more contaminated than those of the wholesale fish market. Microbiological analysis showed that the total bacteria counts ranged between 1.0×10^2 and 3.9×10^5 cfu g⁻¹ in the wholesale fish market and between 1.2×10^2 and 5.8×10^7 cfu g⁻¹ in the retail seafood stores. Coliform bacteria counts ranged between $< 10^1$ and 2.4×10^4 cfu g⁻¹ in the wholesale fish market and between $< 10^1$ and 3.2×10^5 cfu g⁻¹ in the retail seafood stores. Fecal streptococci varied between $< 10^1$ and 4.9×10^3 cfu g⁻¹ in the wholesale fish market and between $< 10^1$ and 3.2×10^5 cfu g⁻¹ in the retail seafood stores. These results showed that fish sold at local retail seafood stores were either not stored in hygienic conditions or fish were contaminated during the transportation from the wholesale fish market to retail seafood stores.

Key words: Coliform, fecal streptococci, microbiological quality, fish

INTRODUCTION

Turkey has over 8000 km of shoreline at the Black Sea, Marmara Sea, Aegean Sea and the Mediterranean Sea. Dardanelles is one of the important fishing grounds in Turkey, since Dardanelles lies in a migratory route that connects Black Sea and the Mediterranean Sea and is a productive area for shellfish.

The total fish production of Turkey was 506,980 ton in 2003 (Anonymous, 2003). About 70% of the total fish production was consumed as fresh product domestically. In addition, a significant portion of the harvested fish and shellfish was exported to European countries (DIE., 2004).

Seafood is a rich source of protein, vitamins and minerals. In addition, their flesh pH is about neutral (pH ~7). These characteristics make the seafood a suitable living and proliferation place for bacteria. In unhygienic storage conditions, microorganisms spoil the fish flesh. This may be harmful for human health by causing infection and intoxication (Liston, 1980; Lundborg, 1986; Goktan, 1990).

In fish products, it is possible to diminish unwanted microorganism activity by hygienic treatments and protection. Bacterial contamination, especially if fecal, is an indicator of pathogenic presence in the environment (Sinell, 1985). Fecal streptococci have greater resistance when compared with classical indicators of coliform bacteria. This has led to an increasing tendency to include fecal streptococci in microbiological criteria as an

indicator of direct fecal contamination in plant sanitation, in waters and various food products, including seafood (El-Zanfaly and Shaban, 1991; Shapton and Shapton, 1991). In the present study, bacterial contaminations during the storage and distribution of seafood, caught and consumed in Dardanelles region from Turkey, were analyzed. The main purpose of this study was to compare the microbiological quality of seafood sold at the Wholesale Fish Market and at the Retail Seafood Store.

MATERIALS AND METHODS

Fish were randomly collected from the wholesale fish market and from different retail seafood stores between July and August 2004 in Dardanelles, Turkey. All samples consisted of unprocessed and whole seafood. The samples include 30 mullet (*Mugil cephalus*), 30 whiting (*Merlangius merlangus*), 40 sardine (*Sardina pilchardus*), 40 horse mackerel (*Trachurus trachurus*), 20 bogue (*Boops boops*) and 40 shrimp (*Parapenaeus longirostris*).

In all the samples, total aerobic bacteria were counted. In addition, coliform group and fecal streptococci were determined. Each 10 g seafood flesh sample was homogenized in 90 mL of 0.1% peptone water (Merck) by Ultra Turrax for one minute under sterile conditions. These homogenates were diluted to 10^{-7} and cultivated by using drop and plac methods (Baumgart, 1993).

Total aerobic bacteria were incubated for three days at 30°C in Plate-Count-Agar (Merck) medium. Coliforms were incubated for one day at 30°C in Coli ID-Agar (bio Merieux) medium. Fecal streptococci were incubated at 37°C for three days in Kanamycin-Esculin-Azide-Agar (Merck) medium (Baumgart, 1993).

The colonies reproduced in plate have been evaluated by counting. The results were recorded as cfu g⁻¹ (Baumgart, 1993).

For each microorganism, the counts were compared between the samples from the wholesale fish market and the samples from the retail seafood stores. Data were log-transformed prior to statistical analyses. Students t-test were used for the statistical analyses and tests were considered significant at $\alpha = 0.05$.

RESULTS

Total aerobic bacteria numbers ranged between 10² and 10⁵ cfu g⁻¹ in the wholesale fish market samples, whereas these rates ranged between 10² and 10⁷ cfu g⁻¹ in the retail seafood store samples. Moreover, the average of the bacteria number was 10³ cfu g⁻¹ for the fish wholesale fish market and was 10⁵ cfu g⁻¹ for the retail seafood stores. Total aerobic bacteria numbers between 10⁴ and 10⁵ cfu g⁻¹ were encountered in 35% of the samples from the wholesale fish market and in 82% of the samples from the retail seafood stores (Table 1).

The counts of the coliform group bacteria in the samples were found between <10¹ and 10⁴ cfu g⁻¹ in the wholesale fish market and between <10¹ and 10⁵ cfu g⁻¹ in the retail seafood stores. Coliforms counts under 10² cfu g⁻¹ were found in 90% of the wholesale fish market samples, while 82% of the retail seafood stores coliform counts were between 10²-10⁵ cfu g⁻¹. Coliform bacteria counts above 10² cfu g⁻¹ constituted 58% of the all samples combined (Table 2).

Fecal streptococci counts were found between <10¹ and 10³ cfu g⁻¹ in the fish wholesale fish markets and between <10¹ and 10⁵ cfu g⁻¹ in the retail seafood stores. About 95% of the samples in the wholesale fish market was determined between <10¹ and 10² cfu g⁻¹ and 77% of the samples in the retail seafood stores were determined in the range of <10¹-10² cfu g⁻¹. For both sale point samples combined, it was found that 41% of the samples were between 10² and 10⁵ cfu g⁻¹ (Table 3).

Statistical results showed that the log transformed total aerobic bacteria mean counts from the retail seafood store samples (1.4×10⁵ cfu g⁻¹) were significantly higher (p<0.05) than the log transformed total aerobic bacteria mean counts from the fish market samples (3.6×10³ cfu g⁻¹). Similarly, log transformed coliform

Table 1: Total aerobic bacteria counts and frequencies encountered in the wholesale fish market and retail seafood store samples

Count (cfu g ⁻¹)	Frequency of encounter			%
	Wholesale	Retail	Total	
10 ⁷	0	5	5	2
10 ⁶	0	12	12	6
10 ⁵	5	42	47	24
10 ⁴	30	23	53	26
10 ³	45	15	60	30
10 ²	20	3	23	12
Total No.	100	100	200	100

Table 2: Coliform counts and frequencies encountered in the wholesale fish market and retail seafood store samples

Count (cfu g ⁻¹)	Frequency of encounter			%
	Wholesale	Retail	Total	
10 ⁵	0	10	10	5
10 ⁴	3	12	15	7
10 ³	7	33	40	20
10 ²	25	27	52	26
10 ¹	30	15	45	23
<10 ¹	35	3	38	19
Total No.	100	100	200	100

Table 3: Fecal streptococci counts and frequencies encountered in the wholesale fish market and retail seafood store samples

Count (cfu g ⁻¹)	Frequency of encounter			%
	Wholesale	Retail	Total	
10 ⁵	0	2	2	1
10 ⁴	0	8	8	4
10 ³	5	13	18	9
10 ²	25	30	55	27
10 ¹	20	22	42	21
<10 ¹	50	25	75	38
Total No.	100	100	200	100

mean counts from the retail seafood store samples (1.2×10³ cfu g⁻¹) were significantly higher (p<0.05) than the log transformed coliform mean counts from the fish market samples (2.5×10¹ cfu g⁻¹). Also, log transformed fecal streptococci mean counts from the retail seafood store samples (7.2×10¹ cfu g⁻¹) were significantly higher (p<0.05) than the log transformed fecal streptococci mean counts from the fish market samples (8.7×10¹ cfu g⁻¹).

DISCUSSION

It was found that the seafood in the wholesale fish market and the retail seafood stores were different in terms of hygiene in Dardanelles region of Turkey. Although, seafood in the wholesale fish market had the amount of bacteria which was in the expected rates, the amount reached higher levels after they were transferred to and remained in the retail seafood stores.

The maximum microbiological limit for the total aerobic bacterial counts in fresh fish is recommended as 10⁷ cfu g⁻¹ (ICMSF, 1986). Wholesale fish market samples were below this limit, but 5% of the retail seafood store

samples exceeded this maximum limit (Table 1). This study showed that fish from the wholesale fish market had good quality, because 100% of the samples had a value less than 10^5 cfu g⁻¹.

The maximum limit value for coliform group bacteria in the fresh fish is recommended as 4×10^2 cfu g⁻¹ by the International Commission on Microbiological Specifications for Foods (1986) and as 2.1×10^2 cfu g⁻¹ in the TS (2000). In the samples from wholesale fish market, 25% of the coliform counts were above the acceptable limits. The proportion in the retail seafood stores that exceeded the limits of coliform counts were about 75%. The high rate found in the coliform group bacteria from both of the sale points showed that the fish analyzed were exposed to some kind of contamination either during storage or while transporting. Shewan (1971) noted that coliform counts of recently caught fish were relatively low, but increased considerably during handling. Limit values of indicator bacteria for fecal contamination varies among countries. However, according to Shewan (1970) fecal coliform, an indicator of fecal contamination, should be less than 10^1 cfu g⁻¹. Fecal streptococci count was relatively high in most of the fish that were sampled from the whole sale market and from the retail stores. In terms of hygiene, fecal streptococci have more potential pathogen threat because they are more resistant (e.g., low temperature) than coliform bacteria (Mossel *et al.*, 1978; Seidel, 1992).

As a result, present analyses indicated that a great proportion of the fish sold in the whole sale market and in the retail stores were not in the domestic and international hygienic quality standards limits. In order to avoid possible health problems due to fish consumption, hygienic conditions should be checked regularly at fish sale points and the sanitary conditions in the fishing vessels should be improved. In addition, all of the relevant personnel that handle and manipulate the seafood should be educated and trained for hygienic practices.

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