

Determination of the Risky Microorganisms in Frozen Ready-to-Eat Seafood Sold in Istanbul Market

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ABSTRACT

Since frozen ready-to-eat seafood has the potential to cause food poisoning, this study focuses on microorganisms that have the potential to be a health hazard found in frozen ready-to-eat seafood, which is sold to highly populous communities. Therefore, the most popular frozen ready-to-eat seafood, fish balls and surimi crab legs, from Istanbul market were studied. Samples were gathered from seven different branches of four major chain market brands, twice in winter (October-March) and twice in summer (April-September). As a result of seasonal conditions summer samples had higher microbial loads compared to winter samples. The average mesophilic and psychrophilic aerobic bacteria counts of fish balls and surimi crab legs were below ≤ 4 log cfu/g. All samples were safe in terms of *Salmonella*, *Vibrio parahaemolyticus* and *Vibrio cholerae*; and acceptable in terms of *Staphylococcus aureus*, *Clostridium perfringens*, and *Bacillus cereus*. The microbiological load of fish balls was higher ($p < 0.05$) than the other samples. It was observed that more than 80% of them are risky in terms of coliform bacteria. It is concluded that attention should be paid especially to minced and spice added products. It is essential to pay more attention to the marketing of ready-to-eat seafood during the summer seasons for the prevention of public health.

Keywords: Pathogen, seafood, surimi crab leg, fish balls, ready to eat, frozen

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INTRODUCTION

Frozen and ready-to-eat foods are increasingly more preferred due to their fast and easy preparation, proximity to qualities of fresh produce, storability for long periods after purchase, provision of an individual, complete meal to the consumer, and widespread frozen product storage facilities (Giannakourou & Taoukis, 2005). The importance of seafood is well-known in terms of nutrition. Since many consumers do not prefer to clean and cook seafood at home, they are very important in the ready-to-eat food sector (Mol & Varlik, 2004). In addition to this, currently it is of utmost importance that the product is hygienic and safe because contamination that may occur during preparation of the product or long haul transportation and inappropriate conditions that

may occur during storage or sales can cause ready-to-eat food to pose critical health risks to humans (Christison et al., 2008). In the course of transportation, storage, and sales of frozen ready-to-eat food, temperatures below -18 °C should be maintained and fluctuations in the temperature should not be allowed; otherwise, microorganisms posing health risks to humans may develop (Giannakourou & Taoukis, 2005). World Health Organization/Food and Agriculture Organization's committees of food safety experts have indicated that the most important health problem of the modern world is the diseases due to the consumption of food. Existence of risky microorganisms in ready-to-eat meals made of seafood is a great danger to public health since it may lead to mass food poisoning. However, there is very limited information on ready-to-eat seafood sold to a highly

exceeded in any of the samples in our study (Table 1). This result suggests that products did not lose their freshness; storage and sale conditions were satisfactory.

Coliform bacteria are the frequently used indicators for determining sanitation conditions (Kala, 2006). High levels of total coliform load indicate lack of hygiene and post-processing contamination (Gonzalez et al., 2003). In our study, especially fish ball samples contained a higher amount of coliform bacteria (Table 1). Spice addition and mincing was considered the cause of high levels of coliform bacteria in the fish balls. As a matter of fact, total coliform load of fish-ball mince was detected to be 3.30 log cfu/g (Suvanish et al., 2000). Since it is known that frozen storage does not have a detrimental effect on coliform bacteria load and these bacteria can grow well under low temperatures as well (Suvanish et al., 2000; Umoafia & Okoro, 2018), high levels of coliform load in our samples is of great importance.

It was observed that fish-balls have statistically significantly higher ($p < 0.05$) *E. coli* load than Surimi crab legs (Table 1). On the other hand, 12% of Surimi crab legs and 39% of fish-balls exceed-

ed the limits (2 log cfu/g) suggested by Forsythe (2010) for ready-to-eat foods (Table 2, 3). Yalçın (2020) marketlerde satılan surimilerin mikrobiyolojik kalitesi üzerine yapmış olduğu araştırmada örneklerde ki *E. coli* sayısını $3,2 \times 10^2 - 9 \times 10^2$ kob/g olarak tespit etmiştir. Adebayo-Tayo et al, (2012) yapmış oldukları çalışmada üç farklı marketten temin ettikleri donmuş balık örneklerinin yüzde yirmisinde *E.coli* tespit etmişlerdir. As freezing does not destroy *E. coli*, it is important to make sure food is safe before freezing (Oranusi et al., 2014)

The limit value for *Staphylococcus aureus* was given to be 4 log cfu/g (Anon, 2011; Forsythe, 2010; ICMSF, 1986) (Table 3). None of the frozen ready-to-eat seafood samples exceeded these limits in this study. High levels of *Staphylococcus aureus* in the food indicates poor hygienic conditions in the preparation of the product, especially due to personnel (Karaboz & Dinçer, 2002). Our findings demonstrated that conditions in the preparation of these products were generally appropriate.

Clostridium perfringens and *Bacillus cereus* are spore-forming pathogens and it is known that they can be easily isolated from

Table 1. Minimum, Maximum and Average bacterial load results (log cfu/g) of the frozen fish balls and surimi crab leg in different seasons.

		Surimi crab legs			Fish-balls		
		Min	Max	Average	Min	Max	Average
Total mesophilic bacteria	Winter	2.26	4.26	2.94±0.42 ^x	2.49	5.33	3.47±0.56 ^x
	Summer	2.36	5.4	3.62±0.65 ^y	2.42	5.59	4.53±0.76 ^y
	All samples			3.28±0.64^a			4.00±0.85^b
Total Psychrophilic Bacteria	Winter	1.93	4.13	2.85±0.37 ^x	2.54	4.48	3.39±0.54 ^x
	Summer	2.45	4.98	3.62±0.58 ^y	2.73	5.39	4.40±0.64 ^y
	All samples			3.23±0.62^a			3.90±0.78^b
Total Coliform	Winter	0	3.73	1.99±1.23 ^x	0	4.27	2.40±1.33 ^x
	Summer	0	3.45	2.58±1.04 ^y	0	3.79	3.11±0.80 ^y
	All samples			2.28±1.17^a			2.75±1.15^b
Escherichia coli	Winter	0	2.7	0.09±0.50 ^x	0	3.32	0.43±0.95 ^x
	Summer	0	2.93	0.54±1.01 ^y	0	3.27	1.63±1.23 ^y
	All samples			0.31±0.82^a			1.03±1.25^b
Staphylococcus aureus	Winter	0	3.46	1.77±0.85 ^x	1.18	3.14	2.12±0.54 ^x
	Summer	0	3.54	2.38±0.52 ^y	1.88	3.3	2.68±0.47 ^y
	All samples			2.08±0.77^a			2.40±0.57^b
Bacillus cereus	Winter	0	2.3	0.17±0.56 ^x	0	3.44	1.16±1.30 ^x
	Summer	0	3.27	1.46±1.23 ^y	0	3.44	2.33±1.17 ^y
	All samples			0.81±1.15^a			1.74±1.36^b
Clostridium perfringens	Winter	0	3.51	0.14±0.30 ^x	0	2.48	0.41±0.86 ^x
	Summer	0	3.27	0.81±1.06 ^y	0	3.58	2.04±1.32 ^y
	All samples			0.48±0.93^a			1.23±1.38^b

x, y: the difference between lines; a, b: the difference between columns ($p < 0.05$).

Table 2. Exceeding the limit percentages of samples and number of samples exceeded limit/total number of samples.

	Surimi Crab leg		Fish Ball	
	<i>E. coli</i>	<i>S. aureus</i>	<i>E. coli</i>	<i>S. aureus</i>
Anon 2011		0%		0%
ICMSF 1986	4% (4/112)	0%	16% (18/112)	6% (7/112)
Forsythe 2010	12% (10/112)	0%	39% (44/112)	0%

Table 3. Microbiological Limits (log cfu/g).

	<i>E. Coli</i>	<i>S. aureus</i>	<i>B. cereus</i>	<i>C. perfringens</i>
Anon 2011	No limit	4	4	No limit
ICMSF 1986	2.69	4	No limit	No limit
Forsythe 2010	2	4	4	5

spices as well (Iurlina et al., 2006). As a matter of fact, we observed that both bacteria species were present at significantly higher levels ($p < 0.05$) in the fish-balls which contained spices (Table 1). *C. perfringens* can be found in raw ingredients like spices used in food processing. *C. perfringens* outbreaks usually occur from improper handling, such as insufficient cooling at the home, retail, or during food service (Juneja et al., 2009). However, there are no official criteria established by the European Commission (EC) for *Bacillus cereus* and *Clostridium perfringens*. But according to Anon (2011) the *Bacillus cereus* limit is 4 log cfu/g. Also Forsythe, (2010) reported 5 log cfu/g and 4 log cfu/g as inappropriate values for *Bacillus cereus* and *Clostridium perfringens*, respectively. In our study, these bacteria were higher in the summer period ($p < 0.05$).

Food codex urges that 25 g food should not have any *Salmonella* spp. and in the case of their presence these products should not be offered for human consumption (ICMSF, 1988), because *Salmonella* spp. is the most widely spread bacteria that causes food poisoning in the world (Gonowiak, 1990). Similarly, *Vibrio parahaemolyticus* and *Vibrio cholerae* should not be present in the 25 g of seafood (ICMSF, 1988). In our study, *Salmonella* spp., *Vibrio parahaemolyticus* and *Vibrio cholerae* were not detected in the Surimi crab legs and fish-ball samples.

As a result of our study, we observed that fish-balls have statistically significantly higher microbial load than Surimi crab legs ($p < 0.05$). The mincing operation in the preparation of fish-balls leads to extension of the surface and microorganisms spread all over this surface (Vural & Yesilmen, 2003). Moreover, it is known that spices are contamination sources (Little et al., 2003) and it is concluded that spices present in fish-balls are effective at producing this result. As a matter of fact, an increase in the bacterial load of fish was reported after mixing with spices.

It was observed that there are differences between samples of both Surimi crab legs and fish-balls taken in summer and winter in terms of all bacteria ($p < 0.05$) and bacterial load of samples taken in summer were always higher (Table 1). It was also reported as a result of a study conducted on shrimps stored at different temperatures that increasing temperature led to increased microbial activity and quality of the food degraded rapidly (Umoh & Odoaba, 1999). Likewise, the microbial load of foods is estimated to be higher in summer by Vural & Yesilmen (2003).

CONCLUSION

It was concluded in our study that samples of Surimi crab legs and fish-balls were marketed without losing their freshness and they were safe in terms of *Salmonella* spp., *Vibrio parahaemolyticus*, and *Vibrio cholerae*, and acceptable in terms of *Staphylococcus aureus* *Clostridium perfringens* and *Bacillus cereus* which are generally observed due to inappropriate processing conditions. In general, fish-balls have a higher microbiological load. It was also detected that bacterial load of samples taken in summer time is always higher ($p < 0.05$). The fact that microbial load of fish-balls is higher than surimi crab legs indicates that this product can pose hazard on public health if the conditions of storage and sale are inappropriate. The minimum and maximum values recorded for each parameter demonstrated variability within samples. This variation can be defined by the fact that the samples were collected from various sellers where the selling conditions are very important. According to the findings of our study, careful action should be taken in terms of working conditions and raw material procurement in the production of especially minced food with spice addition; special attention should be paid to the sales of ready-to-eat frozen seafood in terms of public health especially in summer.

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