

Investigation of *Listeria monocytogenes* in workers, equipment and environments at Kaymak processing plants

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Abstract

Listeria monocytogenes is a nutrient-borne pathogen spread to processed products such as vegetables, fruits and dairy products. Especially in the dairy industry, the presence of *L. monocytogenes* poses a major problem in milk, dairy products and dairy plants. Infection caused by this bacterium is a serious threat to individuals such as immunosuppressed patients, newborns, the elderly and pregnant women. In this study, the presence of *L. monocytogenes* in Afyonkarahisar/Turkey in the samples taken from plants that produce three different kaymak types was investigated. For this purpose, a total of 87 samples taken from the kaymak production plant, the surfaces of the equipment in this plant and the employees were examined according to the ISO 11290-1 protocol. According to the results of our study, *L. monocytogenes* was detected in 8.33% of the 36 samples taken from the processing plant and 16.66% of the total of 24 pieces of equipment in the processing plant. *L. monocytogenes* was not detected in the workers' hands, aprons or boots at all three plants. When the results obtained are interpreted, it is understood that this may pose a significant risk to public health if the necessary precautions are not taken in production of cream.

Keywords: Kaymak; *Listeria monocytogenes*; processing plant; food safety.

Practical Application: Kaymak is one of the most important milk products. It is necessary to provide hygienic conditions necessary to minimize the contamination of *Listeria monocytogenes* in Kaymak production.

1 Introduction

Listeriosis is a severe food-borne disease, often caused by consuming food contaminated with *Listeria monocytogenes* (Sarfranz et al., 2017). A wide range of foods, especially dairy products and processed foods, may support development of *Listeria* spp. Therefore *Listeria* outbreaks are associated with milk, cheese, vegetable salads and meat products (Gohar et al., 2017; Gérard et al., 2018). It is also reported that *Listeria* spp. is commonly found in milk and at farms and processing plants (Sarfranz et al., 2017). *L. monocytogenes* and *L. ivanovii* are two species that cause disease in humans and animals (Konosonoka et al., 2012). *L. monocytogenes* is a food-borne pathogenic bacterium that is commonly found in the environment and potentially fatal (Fox et al., 2009). *L. monocytogenes*, known as a psychrophilic bacterium, is a very important microorganism in foods (Sarfranz et al., 2017).

According to the Turkish Food Codex Regulation, Kaymak is defined as cream which is formed and shaped by a special method without adding any substance in which there is at least 60% milkfat (Turkey, 2003). Kaymak must not be dirty, rancid, moldy or bitter, and microbiologically, pathogenic microorganisms and their toxins must be absent (Turkey, 2011). Because kaymak is a fat-rich dairy product, it can easily deteriorate due to failure to comply with adequate hygiene and sanitation rules, packaging and storage conditions (Tomar & Akarca, 2018).

The aim of this study was to investigate the presence of *L. monocytogenes* in the production environment and the equipment used at the three Kaymak processing plants.

2 Materials and methods

2.1 Sampling

The study involved an examination of samples from three different private kaymak (Afyon Kaymak) processing facilities (A, B and C) in Turkey's Afyonkarahisar province.

The samples were collected from the kaymak production plants (floor, wall, cold chamber floor, cold chamber wall, cold storage floor and cold storage wall; the total number of samples: 36), equipment (milk pasteurization tank, cream pasteurization tank, transport shelf, kaymak pot and knife; the total number of samples: 24) and workers (hands, aprons and boot; total number of samples: 27). As a result, the study was conducted on a total of 87 samples consisting of 36 environmental samples, 24 equipment samples and 27 worker samples from three kaymak production plants. In this study, the wet-dry double swab technique was used to collect samples from the environment, equipment and workers' surfaces from 100 cm² sampling areas.

The collected swabs were transferred to pre-numbered tubes containing 10 mL Half Fraser Medium (Oxoid, SR142). All swabs were immediately transported to the laboratory in cooler boxes containing ice packs.

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2.2 Detection of *Listeria monocytogenes*

L. monocytogenes was detected according to the ISO 11290-1 (International Standard Organisation, 1996) protocol. The swabs were placed in 10 mL Half Fraser broth (Oxoid SR142) and incubated at 30 °C for 24 hours. After incubation, 1 mL of culture was inoculated into 10 ml of Fraser broth (Oxoid SR143) and incubated at 30 °C for 24 hours. A loop culture was incubated on Oxford Agar (Oxoid CM 856) and PALCAM Agar (Oxoid, CM 0877) at 30 °C for 48 hours. Biochemical characterization of the colonies was determined using a Microbact™ TM 12L *Listeria* identification system 1 (Oxoid, MB1128). Isolated *L. monocytogenes* was confirmed with VITEC-2 Compact with a Gram-positive identification cart.

3 Result and discussion

The results of this study are summarized in Table 1. *L. monocytogenes* was determined as 8.33% at kaymak processing plants A (cold chamber floor) and B (wall and cold chamber floor). *L. monocytogenes* was detected in 16.66% of all equipment (cream pasteurization tank and kaymak pot) at plant A and B. *L. monocytogenes* was not detected in any of the 27 samples taken from the workers' hands, aprons or boots at plants A, B and C. *L. monocytogenes* was not detected in anywhere at plant C.

L. monocytogenes is a serious foodborne pathogen that may be found in raw milk and milk products. Moreover, meningitis, septicemia and very serious clinical symptoms such as miscarriage may cause Listeriosis (Akrami-Mohajeri et al., 2018; Stahl et al., 1996; Kasalica et al., 2011). Listeriosis is an infectious disease of humans and animals, and 99% of cases are caused by consumption of food contaminated by *L. monocytogenes* (Farber & Peterkin, 1991; Todar, 2009). Therefore, especially contamination of milk and dairy products by this pathogen is considered as a great danger to public health (Murru et al., 2018; Akrami-Mohajeri et al., 2018; Stahl et al., 1996; Kasalica et al., 2011).

During production of food products (contamination, cutting and packaging) and in the production environment, determining the presence of *L. monocytogenes* will help avoid possible failure to implement hygienic measures. In this study, the prevalence of *L. monocytogenes* was investigated in samples taken from three kaymak processing plants. *L. monocytogenes* was detected in the processing plants (3/36 = 8.33%) and equipment (4/24 = 16.66%).

In the related study, Akrami-Mohajeri et al. (2018) detected *Listeria* spp. by 11% in 540 milk and dairy products in Iran (raw milk, cheese, butter, cream, etc.). 4% of the isolates were identified as *L. monocytogenes*. In terms of prevalence, the results of Akrami-Mohajeri et al. (2018) were consistent with our results. However, unlike our study, *L. monocytogenes* related to a single product was screened. In the study by Amajoud et al. (2018), *L. monocytogenes* was found in 0.74% of 404 dairy products (raw milk and whey milk) in Morocco. In comparison to our results, this ratio was found to be very low. Mary and Shrinithiviahshini (2017) isolated *L. monocytogenes* in 219 (52.7%) of 415 milk and milk product samples in India. It was stated as quite a high rate that can occur through poor quality milk and additives (Mary & Shrinithiviahshini, 2017). Similarly, Muthulakshmi et al. (2018), in their study in India, found that milk and dairy products were positive for *L. monocytogenes* at a rate of 11.42%. Owusu-Kwarteng et al. (2018) found the prevalence of *L. monocytogenes* as 5.5% in 254 milk samples collected from dairy farms and market vendors in Ghana. Navratilova et al. (2004) reported the presence of *L. monocytogenes* in 31 (5.0%) of 619 raw milk samples examined in the Czech Republic between 2000 and 2002. Chavez-Martinez et al. (2019) reported *L. monocytogenes* in two cheese samples (cheddar and Ranchero) in Mexico.

In similar studies conducted in Turkey, Şanlıbaba et al. (2018) found the presence of *L. monocytogenes* in 4.5% of 110 milk and dairy products they collected from markets and shops in Ankara. Aksoy et al. (2018) found that the rate of *L. monocytogenes* as 5% in raw milk and traditional products in Kars. Moreover, *Listeria*

Table 1. Distribution and prevalence of *Listeria monocytogenes* at Kaymak processing plants, in production environments, equipment and workers.

Sample type	N	n	%	A	B	C
Floor	6	-	-	-	-	-
Wall	6	1	16.66	-	1	-
Cold Chamber Floor	6	2	33.33	1	1	-
Cold Chamber Wall	6	-	-	-	-	-
Cold Storage Floor	6	-	-	-	-	-
Cold Storage Wall	6	-	-	-	-	-
Total Processing Plant	36	3	8.33	1	2	-
Milk Pasteurization Tank	3	-	-	-	-	-
Cream Pasteurization Tank	3	1	33.33	1	-	-
Transport Shelf	3	-	-	-	-	-
Kaymak Pot	9	3	33.33	2	1	-
Knife	6	-	-	-	-	-
Total Equipment	24	4	16.66	3	1	-
Hands	9	-	-	-	-	-
Apron	9	-	-	-	-	-
Boot	9	-	-	-	-	-
Total Workers	27	-	-	-	-	-
Total	87	7	8.05	4	3	-

N: total number of samples; n: number of positive samples; A,B,C: Different Processing plant -: Not detected.

spp. was detected as 0.5-3% on the floor, walls, cold storage corridors and cold storage walls at five dairy plants (Tomar & Akarca, 2019). In comparison to the results of our study, these rates seem low.

Similar to our study, Leong et al. (2014) aimed to investigate the contamination of food processing plants in Ireland. *L. monocytogenes* was detected in 4.6% of the samples taken from food and environmental sources (Leong et al., 2014). In the European dairy processing plant survey, the *L. monocytogenes* prevalence values of 7.22% and 26% were reported in Greece and Austria, respectively (Muhterem-Uyar et al., 2015). The prevalence of *L. monocytogenes* has been reported in studies conducted at cheese processing plants ranging from 33.3% (Ibba et al., 2013) to 50% (De Cesare et al., 2007). The differences observed in different studies may be due to milk used as raw material, processing plants, personnel, equipment used in production and storage conditions.

4 Conclusion

In this study, possible contamination points and frequencies of *L. monocytogenes* were determined at the production stages of Kaymak which is a dairy product that is produced intensively and presented to public consumption. In this study, *L. monocytogenes* was identified at different points during the Kaymak production process, and it may pose a potential risk to public health. Besides, it is recommended to take the necessary measures for reliable production and presentation of cream, and inform the producers and apply effective food safety control systems.

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