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Microbiological quality of pasteurized milk on expiration date in Tehran, Iran

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ABSTRACT

The aim of this study was to determine the microbiological quality of pasteurized milk on expiration date in Tehran. Two hundred fifty-four samples collected using a simple randomized sampling method from March 2014 to January 2015 were tested for total microbial count, coliform count, and *Escherichia coli* contamination according to Iran's National Standards methods. Total microbial count, coliform count, and *E. coli* contamination exceeded the standard limits in 61.1% [$>7.5 \times 10^4$ (4.88 log) cfu/mL], 24.4% [>10 (1 log) cfu/mL], and 8.7% of the samples, respectively. The mean total microbial count [7.1×10^7 (7.85 log) cfu/mL] was above the standard limit. Only 36.6% of the studied samples were in accordance with Iran's National Standard limits. Based on our results, it is necessary to improve the microbial quality of pasteurized milk in Iran.
Key words: pasteurized milk, microbiological quality, shelf life

INTRODUCTION

Milk is a nutritious and valuable food product at any age (Koushki, 2009; Schaafsma, 2009) and, in many countries, dairy products form a large portion of the daily diet of people, especially infants and children. As milk is a rich source of nutrients, it is a suitable growth medium for pathogenic and spoilage microorganisms (Robinson, 2002; Oliver et al., 2005). Moreover, microbial characteristics of milk may directly affect the flavor and physicochemical properties of dairy products (Allen and Joseph, 1985; Simon and Hansen, 2001; Robinson, 2002). Various outbreaks of foodborne illnesses associated with the consumption of pasteurized milk or pasteurized dairy products have been reported previously (CDC, 2008; Schmid et al., 2009; Koch et al., 2010; Jackson et al., 2011).

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Although many studies have been conducted on the microbiological quality of pasteurized milk in different parts of the world (Ranieri and Boor, 2009; Breurec et al., 2010; Silva et al., 2010; Anderson et al., 2011; Martin et al., 2012; Belli et al., 2013; Quigley et al., 2013; Kamana et al., 2014), only a few studies, with limited numbers of samples and regions, have been reported about microbial contamination of pasteurized milk in Iran (Fadaei et al., 2008; Vahedi et al., 2013; Teymori et al., 2014; Koushki and Koohy Kamaly, 2016). The aim of this study was to evaluate the microbiological quality of pasteurized milk sold in Tehran on its expiration date.

MATERIALS AND METHODS

Sample Collection and Microbial Evaluation

Two hundred fifty-four samples of pasteurized milk were collected from local markets affiliated with the Fruit and Vegetable Organization in different parts of Tehran, Iran, using a simple randomized sampling method from March 2014 to January 2015. The collected samples were transported to the laboratory in a cool box and kept in the refrigerator until the expiration date. Microbial tests including total microbial count (**TMC**; ISIRI, 2000a, 2007a), coliform count (ISIRI, 2000b, 2007b), and *Escherichia coli* contamination (ISIRI, 2000c, 2005) were conducted by the methods determined in Iran's National Standards (**INS**). Duplicate plates were used for microbial enumerations. The results were analyzed according to the INS limits for pasteurized milk (ISIRI, 2008).

Statistical Analysis

Statistical analysis was performed using SPSS software, version 17 (SPSS Inc./IBM Corp., Chicago, IL). Although descriptive statistics were used in this study, the Chi-squared test was performed to assess the relationship between the variables of interest; P-values < 0.05 were considered significant.

RESULTS AND DISCUSSION

According to the microbiological criteria for pasteurized milk recommended by INS, counts of total aerobic mesophilic microorganisms and coliforms should not exceed 7.5×10^4 (4.88 log) cfu/mL and 10 (1 log) cfu/mL, respectively, and *E. coli* should be absent (ISIRI, 2008). In the present study, the microbial quality of only 36.6% of the studied samples was in accordance with the INS limits (ISIRI, 2008; Table 1).

Microbial and physicochemical quality of 38.5 and 45.7% of the 348 pasteurized milk samples was in accordance with the Agriculture Ministry Standards in Brazil (Da Silva et al., 2008). In Senegal, 93% of pasteurized milk samples, 92% of raw milk samples, and 81% of sour milk samples failed to meet official standards (Breurec et al., 2010). In a 10-yr study on the microbial quality of liquid milk in New York State, percentages of the samples with bacterial counts less than that set by the Pasteurized Milk Ordinance (2×10^4 cfu/mL) increased from 21.1% in 2002 to 48.6% in 2010 (Martin et al., 2012). In West Azerbaijan Province (Iran), 85% of studied pasteurized milk samples had acceptable microbial quality; however, only 10 samples were tested in that study (Teymori et al., 2014).

All microbial parameters determined by INS, including total aerobic mesophilic microorganism count (total microbial count), coliform count, and *E. coli* were above the standard limit in 7.1% of the studied samples (Table 1). Poor microbial quality of pasteurized milk may be caused by different factors such as microbial load of the raw milk, postprocessing contamination, and factors related to cold chain and hygienic parameters.

Total microbial count, coliform count, and *E. coli* contamination exceeded the standard limits in 61.1, 24.4, and 8.7% of the samples, respectively, in the current study (Table 2).

Total microbial count is an indicator of the hygienic quality of food products. Coliform count and *E. coli* contamination are indicators of fecal contamination caused by pasteurization deficiency, secondary contamination, and type of packaging (Tortorella, 2003; Wong et al., 2010).

In the research of Silva et al. (2010), coliform counts at 35°C and 45°C and aerobic mesophilic count were not in accordance with the current standards in 70.8, 57.5, and 40% of 120 tested samples. In a study conducted in Turkey, 20 and 5% of the pasteurized milk samples did not comply with the Turkish Food Codex limits for total aerobic mesophilic bacteria and *E. coli* count, respectively (Çardad and Yilmaz, 2011). In Brazil, more than 40% of the 260 milk samples were unacceptable by coliform count according to the official standards of the country (Zanella et al., 2010).

Table 1. Microbiological quality (number of samples; percentage in parentheses) of pasteurized milk samples in Tehran, Iran

Exceeding Iranian standard limits						Within Iranian standard limits		
TMC[1]	Coliforms	*Escherichia coli*	TMC and coliforms	TMC and *E. coli*	Coliforms and *E. coli*	TMC, *E. coli*, and coliforms	TMC, *E. coli*, and coliforms	Missing value	Total
94 (37)	4 (1.6)	0 (0)	39 (15.4)	3 (1.1)	1 (0.4)	18 (7.1)	93 (36.6)	2 (0.8)	254 (100)

[1]Total microbial count.