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SELECTED MICROBIOLOGICAL PROPERTIES OF KASHAR CHEESE SAMPLES PRESERVED WITH POTASSIUM SORBATE

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Kashar cheese, traditionally produced, is a popular dairy product in Turkey. Kashar cheese—a hard cheese—is frequently contaminated with mould. Potassium sorbate can be used for preservation of Kashar cheese. In this article, the effect of potassium sorbate on the microbiological characteristics of Kashar cheese was studied. It was found that the microbial counts at stored at 4 ± 0.1°C for 12 and 24 hours were not different from that of fresh milk samples. The means of total aerobic mesophilic bacteria (TAMB), lactic acid bacteria (LAB), coliforms, Staphylococcus aureus, proteolytic microorganisms, lipolytic bacteria, psychrotrophic bacteria and yeast-moulds in the cheese samples were determined as 4.3×10^7, 2.1×10^5, 3.5×10, 1.2×10, 4.5×10^5, 5.6×10^4, 1.7×10^3, and 4.8×10^4 cfu/g, respectively. The addition of potassium sorbate to Kashar cheese decreased the coliform and yeast-mould counts. The yeast and mould counts of cheese samples with added dry potassium sorbate were lower than that of fluid potassium sorbate.

Keywords: ***Kashar cheese, Potassium sorbate, Microbiological characteristics.***

INTRODUCTION

Kashar cheese, which is a semi-hard cheese, is one of the most popular cheese varieties manufactured in Turkey. The reasons of popularity are long shelf life and flavor. Kashar cheese is traditionally produced from raw or pasteurized cows' milk by local dairy herds or the dairy industry. In Turkey, the production amount of Kashar cheese is 45730 ton/year.[1] In general, Kashar cheese became contaminated with mould during ripening; this state can cause the loss of an average of 8% of the product. Because some moulds can produce toxins, the moulds can cause important health problems. Therefore, mould growth on Kashar cheese should be inhibited by preservation methods, such as vacuum packaging, UV beam treatment, and chemical preservatives such as sorbates and benzoates. Because potassium sorbate dissolves very well in water, it is generally used at

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prevention of mould growth on Kashar cheese. Less than 4.2 g/kg dosage of potassium sorbate or sorbic acid is not toxic for human health.[2] USA, Finland, and Canada standards are permitted ≤ 3000 ppm of the sorbate in cheese. The Turkish standard permits ≤ 1000 ppm of sorbic acid in cheese.[3]

In Turkey, cows' milk is milked in two periods, morning and evening. Evening milk is mixed with morning milk because evening milk is not immediately processed. Cooling of the milk can solve this problem. Ozdemir and Kurt[4] found that the ewes' milk could be preserved in refrigeration temperature (4 ± 0.1°C) for 48 hours. Some properties of raw milk are different from cold storage milk. The qualities of products made from refrigerated milk are different because some microbiological and physical characteristics of refrigerated milk are different from normal raw milk.[5]

There are many research reports presented in the literature on sorbate treatment of cheese.[6–10] Liewen and Marth[6] and Yousef and Marth[7] reported that *Aspergillus* spp., *A. paraciticus*, and *Penicillium camambertii* were inhibited by 500 ppm concentration of sorbate in cheddar cheese. The potassium sorbate inhibited the moulds for 6 months in Kashar cheese.[8] Poullet et al.[9] indicated that colifom bacteria and *S. aureus* were inhibited for 15 and 45 days during the ripening of Casar de Caceres cheese, respectively. Aworth and Egounlety[10] found that West African soft cheese was preserved with potassium sorbate against moulds and yeasts and total bacteria numbers. In addition, the microbiological and physicochemical characteristics of Kashar cheeses were examined by some researchers. [11–15] But, the studies on effect of potassium sorbate against the microbiological properties of Kashar cheese were limited.[8] The aim of this research is to determine the effects of potassium sorbate on microbiological characteristics of Kashar cheese.

MATERIALS AND METHODS

In Kashar cheese production, cows' milk was used. The fat ratio of milk was standardized to 3% with a skim milk addition. One part of the raw milk was immediately used in Kashar cheese production. The second and third lots of milk were stored at 4 ± 0.1°C for 12 and 24 hours, respectively. Then the stored raw milk samples were processed into Kashar cheese.[16] Firstly, milk was pasteurized, and then $CaCl_2$ and starter cheese cultures (*Lactococcus lactis* and *Lactobacillus casei*) were added at 35°C. This mixture was added to rennin enzyme at 32°C and curd formed in 60 minutes. Curd was cut to rice size with a knife and drained in a cloth. Then curd was ripened to 55 Soxhlet Henkel acidity and boiled in hot water at 75°C. Raw cheese samples were shaped and salted as dry. Kashar cheese samples were treated with 0.05 kg/100 kg of potassium sorbate using different methods which are dry salting (DS), dipped plunge (DP), and spraying (S). The samples untreated with potassium sorbate were accepted as control. Consequently, all cheese samples were ripened at 12 ± 0.1°C for 1, 2, and 3 months.

Microbiological Analyses

In the raw and refrigerated milk samples, total aerobic mesophilic bacteria (TAMB), coliform, *S. aureus*, lactic acid bacteria (LAB), and psychrotrophic bacteria were enumerated. Kashar cheese samples were analyzed for TAMB, LAB, *S. aureus*, coliform, proteolytic microorganism, lipolytic bacteria, psychrotrophic bacteria, and yeasts and moulds.[17] For the microbiological analysis, 25 g of Kashar cheese was homogenized using a Warring blender at 6000 rpm in 225 of ml sterile serum physiological salt solution (0.85% NaCl). Decimal

dilutions were prepared in 9 ml sterile NaCl (0.85%). Total aerobic mesophilic bacteria (TAMB) were enumerated on plate count agar (Oxoid) following the pour-plate method and incubated at 32°C for 48 hours. Psychrotrophs were grown on plate count agar (Oxoid) and incubated at 7°C for 10 days. Lipolytic bacteria were counted on Sulphate Agar and incubated at 25°C for 72 hours. Coliforms were determined on Violet Red Bile Agar (Oxoid), respectively and incubated at 35°C for 24 hours. Proteolytic organisms were grown on Caseinate Agar (Oxoid) at 32°C for 72 hours. *Staphylococcus aureus* was enumerated by plating on *Staphylococcus* medium 110 (Oxoid) at 35°C for 48 hours. Yeast and moulds were determined on Potato Dextrose Agar (Oxoid) acidified with 10% lactic acid (Merck, Darmstadt, Germany) following the surface plate method, with incubation at 20–25°C for 5 to 7 days. Lactic acid bacteria (LAB) were enumerated on MRS (Oxoid) using the pour plate method with incubation at 37°C for 3 days.[17] All analyses were performed in duplicate.

RESULTS AND DISCUSSION

The microbiological characteristics of raw and refrigerated cows' milk samples were summarized in Table 1. As seen in Table 1, the highest TAMB count was found in the cooled samples for 24 hours, although the lowest degree was determined in the refrigerated samples for 12 hours. The coliform bacteria and *S. aureus* counts of the milk samples increased during cold storage periods for 12 and 24 hours. The microbiological analysis results of Kashar cheese samples were given in Table 2. The means of TAMB and LAB counts of Kashar cheese samples were 4.3×10^7 cfu/g and 2.1×10^7 cfu/g, respectively. The potassium sorbate no affected the LAB counts of Kashar cheeses compared to control treatment during 90 days. While the mean of coliform bacteria counts was to 35 cfu/g, the mean of *S. aureus* counts was determined as 12 cfu/g. In general, potassium sorbate decreased *S. aureus* count below < 10 cfu/g.

The mean of proteolytic microorganism count in Kashar cheeses was 4.5×10^5 cfu/g and their counts of the samples increased during the ripening periods. While the mean of lipolytic bacteria count in Kashar cheeses was 5.6×10^4 cfu/g, the mean of psychrotrophic bacteria counts was 1.7×10^3 cfu/g. The results of present study showed that the potassium sorbate addition to Kashar cheese did not affect TAMB and LAB, proteolytic microorganism, and lipolytic bacteria counts. The potassium sorbate in the cheese samples decreased coliform bacteria, *S. aureus* and yeast and mould counts. It has been found that potassium sorbate can be used for preservation of Kashar cheese.

At ripening period for 30 days of Kashar cheese, TAMB increased at high level. This state was found in Kachkaval cheese samples too.[18] Guizani et al.[19] made Camembert

Table 1 The microbiological characteristics of the milk samples (log cfu/ml).

		Cooled raw cows' milk	
Microbiological characteristics	Raw cows' milk	12 h	24 h
TAMB	7.90	7.67	8.04
LAB	6.26	4.52	6.51
Coliforms	4.83	5.38	5.41
S. auerus	2.30	2.63	2.85
Psycrotrophs	3.54	4.11	5.94

TAMB: Total aerobic mesophilic bacteria; LAB: Lactic acid bacteria.

Table 2 The microbiological characteristics of Kashar cheeses (log cfu/g).

Experiment milk	K sorbate treatments	Ripening (days)	TAMB	LAB	Coliform	*S. aureus*	Proteolytics	Lipolytic	PB	Yeast and mould
Raw cows' milk	Control	2 (raw)	7.15	3.98	2.88	1.54	3.88	4.64	3.81	4.94
		30	8.41	6.30	1.74	2.32	4.30	5.11	2.48	6.79
		60	8.62	5.98	1.65	1.18	4.67	5.74	3.79	5.41
		90	7.88	6.11	1.65	1.00	6.52	5.40	4.32	1.58
		Mean	8.01 ± 0.57	5.59 ± 0.94	1.98 ± 0.52	1.51 ± 0.51	4.84 ± 1.01	5.22 ± 0.40	3.60 ± 0.68	4.68 ± 1.92
	DP	2 (raw)	7.62	4.18	2.20	1.00	4.30	3.82	4.04	4.66
		30	8.26	6.68	1.00	1.40	6.08	4.78	2.65	6.59
		60	7.80	6.34	1.00	1.00	4.70	5.45	3.18	4.65
		90	8.59	6.20	1.30	1.00	6.26	5.85	4.61	5.95
		Mean	8.07 ± 0.38	5.85 ± 0.98	1.38 ± 0.49	1.10 ± 0.17	5.33 ± 0.85	4.97 ± 0.77	3.62 ± 0.76	5.47 ± 0.84
	S	2 (raw)	8.70	4.70	2.90	1.40	3.34	3.97	3.00	4.52
		30	8.11	5.60	1.00	1.74	5.11	4.65	2.20	4.85
		60	9.00	6.15	1.00	1.40	4.20	5.20	3.26	4.30
		90	7.98	6.08	1.65	1.18	5.30	5.04	4.38	4.11
		Mean	8.45 ± 0.42	5.63 ± 0.58	1.64 ± 0.78	1.43 ± 0.20	4.49 ± 0.78	4.72 ± 0.48	3.21 ± 0.78	4.44 ± 0.27
	DS	2 (raw)	6.45	3.68	2.64	1.00	3.85	4.52	2.60	3.62
		30	7.72	6.34	1.00	1.00	5.78	4.76	2.32	4.45
		60	7.53	6.30	2.00	1.00	5.53	5.43	3.72	3.68
		90	7.59	6.46	1.00	1.00	5.48	6.04	3.41	4.15
		Mean	7.32 ± 0.51	5.70 ± 1.17	1.66 ± 0.70	1.00 ± 0.00	5.16 ± 0.77	5.19 ± 0.60	3.01 ± 0.57	3.97 ± 0.34
For 12 hours at 4 ± 0.1°C	Control	2 (raw)	8.15	4.66	2.40	1.48	3.95	3.53	3.94	5.32
		30	8.45	5.78	2.18	1.78	5.34	5.23	3.49	5.72
		60	7.95	7.23	2.15	1.18	5.82	5.87	4.40	5.08
		90	7.72	6.00	1.95	1.18	6.56	5.49	4.62	6.59
		Mean	8.07 ± 0.27	5.92 ± 0.91	2.17 ± 0.16	1.40 ± 0.25	5.42 ± 0.95	5.03 ± 0.89	4.11 ± 0.43	5.68 ± 0.57
	DP	2 (raw)	7.78	4.89	2.00	2.04	3.67	3.34	4.04	5.41
		30	7.59	5.85	1.74	1.00	5.51	5.32	2.67	5.65
		60	7.70	6.66	1.30	1.00	5.04	5.48	4.49	4.58
		90	8.11	5.62	1.00	1.00	4.84	5.51	4.30	6.74

		Mean	7.80 ± 0.20	5.75 ± 0.63	1.51 ± 0.39	1.26 ± 0.45	4.76 ± 0.68	4.91 ± 0.91	3.88 ± 0.71	5.60 ± 0.77
	S	2 (raw)	8.18	3.48	2.85	1.60	3.61	4.04	4.11	3.49
		30	8.04	5.74	1.00	1.74	4.98	5.61	4.78	5.04
		60	9.15	8.11	1.74	1.00	4.72	5.66	4.49	4.85
		90	8.23	6.18	1.18	1.00	5.86	4.95	4.30	4.93
		Mean	8.40 ± 0.44	5.88 ± 1.65	1.69 ± 0.72	1.34 ± 0.34	4.79 ± 0.80	5.07 ± 0.66	4.42 ± 0.25	4.58 ± 0.63
	DS	2 (raw)	7.49	3.81	1.60	1.00	4.54	3.54	3.08	4.97
		30	8.11	4.88	1.00	1.00	5.00	4.53	2.67	5.23
		60	7.49	6.61	1.00	1.00	4.45	5.36	3.48	3.65
		90	8.11	6.95	1.00	1.00	6.32	5.04	4.43	4.54
		Mean	7.80 ± 0.31	5.56 ± 1.28	1.15 ± 0.26	1.00 ± 0.00	5.08 ± 0.75	4.62 ± 0.69	3.41 ± 0.65	4.60 ± 0.60
For 24 hours at 4 ± 0.1°C	Control	2 (raw)	7.34	3.72	3.43	2.90	4.00	4.63	4.70	4.86
		30	8.28	5.74	1.00	1.28	5.58	4.83	3.85	5.93
		60	9.00	5.58	1.54	1.00	4.89	5.34	4.32	5.38
		90	7.78	6.99	1.88	1.18	6.41	5.79	4.63	5.45
		Mean	8.10 ± 0.62	5.51 ± 1.17	1.96 ± 0.90	1.59 ± 0.76	5.22 ± 0.89	5.15 ± 0.45	4.37 ± 0.34	5.40 ± 0.38
	DP	2 (raw)	9.11	5.20	3.45	1.54	3.51	3.36	3.15	4.11
		30	8.00	6.30	1.00	1.30	4.68	5.70	2.85	4.71
		60	7.62	6.70	1.60	1.00	3.85	5.79	4.41	5.40
		90	7.28	6.11	1.00	1.00	6.08	5.77	4.64	4.85
		Mean	8.00 ± 0.69	6.08 ± 0.55	1.76 ± 1.00	1.21 ± 1.21	4.53 ± 0.99	5.16 ± 1.04	3.76 ± 0.78	4.77 ± 0.46
	S	2 (raw)	7.23	3.34	2.18	3.04	4.15	3.90	3.81	4.08
		30	7.81	5.68	2.41	1.00	4.79	5.41	2.26	4.15
		60	8.08	6.57	1.00	1.00	5.38	5.00	3.48	4.45
		90	7.93	5.26	1.00	1.00	5.20	5.59	4.61	4.86
		Mean	7.76 ± 0.32	5.21 ± 1.18	1.65 ± 0.65	1.51 ± 0.88	4.88 ± 0.47	4.98 ± 0.66	3.54 ± 0.85	4.38 ± 0.31
	DS	2 (raw)	7.88	4.38	2.23	1.00	3.20	3.08	3.94	3.89
		30	7.76	5.85	1.00	1.74	4.36	4.34	1.74	4.76
		60	7.26	5.70	1.65	1.30	5.71	4.65	3.46	4.54
		90	7.61	6.08	1.00	1.00	4.95	5.32	4.48	4.46
		Mean	7.62 ± 0.23	5.50 ± 0.66	1.47 ± 0.51	1.26 ± 0.30	4.56 ± 0.92	4.35 ± 0.81	3.41 ± 1.03	4.41 ± 0.32

DP: Dipped plunge: S: spraying; DS: dry salting; TAMB: Total aerobic mesophilic bacteria; LAB: Lactic acid bacteria; PB: Psychrotroph bacteria.

cheese from pasteurized cow's milk and found that total bacteria count were high in cheese throughout ripening. But, Akyuz[12] reported that the TMAB count in Kashar cheese samples decreased during the ripening periods. The LAB counts increased during the ripening period. The result was similar to findings of Akyuz.[12] The potassium sorbate added in different methods to the cheeses were inhibited the coliform count according to control. As the cheese samples were ripened for 30, 60, and 90 days, the coliform counts of the samples decreased too. Girgis et al.[20] added the potassium sorbate to feta cheese samples and found that the coliform bacteria count decreased during its ripening periods. In ripening period for 90 days, the *S. aureus* count was lower than that of other periods. Poullet et al.[21] found that the 2.2×10^2 cfu/g *S. aureus* level of raw Caser de Caceres cheese was completely inhibited after from ripening.

The potassium sorbate addition to the cheese samples did not inhibit the lipolytic bacteria count. As ripening periods increased, the lipolytic bacteria count increased. The potassium sorbate addition did not affect the psychotropic bacteria counts, but psycrotrophic bacteria counts decreased in the first month of ripening. The average count of yeasts and moulds in the samples was found as 4.8×10^4 cfu/g. The potassium sorbate addition to the cheeses decreased the yeast and mould counts. Aly,[22] Aworth and Egounlety,[10] and Girgis et al.[20] found that the sorbate added to cheese decreased the yeast and mould counts. The dry salting addition of potassium sorbate decreased at high level the yeast and mould counts from other potassium sorbate treatments. Spraying potassium sorbate on the cheeses decreased the higher level yeast and mould counts than the of dipping method. The microbiological results found in our research were lower than that of Kurultay.[11] However, Kivanc[13] claimed that the potassium sorbate addition to Kashar cheese completely inhibited the yeasts and moulds.

CONCLUSION

The results of the present study showed that the potassium sorbate did not affect TAMB, LAB, proteolytic microorganism, and lipolytic bacteria counts of Kashar cheeses. In contrast to, the potassium sorbate decreased coliform, *S. aureus* and yeast and mould counts of Kashar cheese. In Kashar cheese, the dry potassium sorbate treatment was more effective on yeast and mould count than fluid potassium sorbate. Consequently, potassium sorbate could be used for inhibition of mould contamination and growth in Kashar cheese.

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