

The Effects of Starter Culture on Chemical Composition, Microbiological and Sensory Characteristics of Turkish Kasar Cheese during Ripening

Durmus Sert, Ahmet Ayar* and Nihat Akin

Selcuk University, Food Technology Department, Konya, Turkey

In this study, Kasar cheeses were produced from raw milk and starter culture was added to pasteurized milk. Chemical, microbiological and organoleptic properties of Kasar cheeses were analyzed at certain times during the ripening periods (on the 1, 7, 15, 60, 90 days). Generally, physico-chemical parameters were not affected by starter culture. The pH, ripening index, water soluble nitrogen, and TCA soluble nitrogen did not show significant differences between the cheeses groups. The addition of starter affected the microbiological quality of the cheeses. Kasar cheese with culture contained low levels of total aerobic mesophilic bacteria, moulds and yeasts, and coliforms. Organoleptic qualities of cheeses were increased by culture. The starter cultures contributed to acidity and microbial quality of the cheese.

More than 1000 varieties of cheeses are produced around the world. In Turkey, 40–50 cheeses varieties are known, but only three of them have national and economical value: Turkish White, Kasar and Tulum cheeses. Kasar cheese is the second popular traditional cheese in Turkey with an annual production of about 41000 tons. It is made from sheep or cow milk. Kasar is similar to “Kaskaval” in Bulgaria, “Ragusona” in Italy, “Kassari” in Greece, and “Kachkawaj” in Yugoslavia. Some of the Kasar cheeses which are produced from cow’s milk have a crust but the most of Kasar cheeses have vacuum packed in recent years, in Turkey. According to The Turkish Standards (TS 1999), this cheese is classified as “fresh Kasar cheese” and “matured Kasar cheese” in terms of ripening. In recent years the production of fresh Kasar cheese has increased in contrast to matured Kasar cheese because of the economical reasons. Both types are eaten at breakfast; however the fresh cheese is also consumed in toasted sandwiches or baked foods in the same way as Mozzarella cheese (7, 21).

Kasar cheese is traditionally produced in 27-30 diameter and 10-13 cm height and 6-10 kg weight. Any heat treatment is not applied to raw whole milk. No starters or additives are added. Coagulation obtained with liquid rennet (15-20 ml/100kg milk) takes 40-60 minutes at 28-35°C. Coagulum is cut in pieces of 0.5-1 cm³ and let settle. Curd grains are gathered in a cheese cloth and pressed between two boards for 2-4 hours. Curd block is matured for 24 hours and subsequently cut into pieces. Each piece is dipped by means of a plaited basket in hot water (65–75°C). The shape of the curd is made spherical by hand and the

curd is molded while it is hot. Cooling takes 3-6 hours. The surface of the cheese, after it is taken to out of molds and dry salted. It is traditionally matured without packaging at 2-3°C for 3-10 months with 75–90 g/100g humidity. Thus, moulds grow on the surface of cheese and they have to be removed from the surface of cheese before consuming by cutting off the out layer of cheese with causing some loss of cheese. It is an economical loss. However, today it is commercially produced from pasteurized milk in different shapes and in different weights and matured in vacuum packed polyethylene material for a short time (a week). In this way, the growth of moulds is prevented and the loss of cheese is limited. In the last two decades, researches have been focused on finding new starter cultures suitable for the maturation of cheeses and the methods to shorten the time of maturation including using different packaging materials (1, 10, 11). Kasar cheese contains an average of 29.18-57.29 g/100g moisture, 23.10-36.16 g/100g protein, 2.56-7.56 g/100g ash, 16.75-35.20 g/100g fat and 2.54-5.24 g/100g salt. Its pH and acidity levels (SH) are between 4.9-5.4 and 62-136 respectively (4).

There are some researches on starter culture addition in Kasar cheese. The effects of using different starters on the compositional, sensory and microbial quality of Kasar cheese produced from raw and pasteurized milk during maturing are reported in this paper.

MATERIALS AND METHODS

Starter Cultures. Starter culture (25 g/100g *Lb.helv.* 7[®] (*L. helveticus*) + 75 g/100g yoghurt 709[®] (*Streptococcus salivarius* sub. *thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus*) and microbial rennet (Chymax 15 T was produced by *Aspergillus niger* var. *awamori* with kimozin) were obtained from DSM-Food İzmir, Turkey and from

*Corresponding author, mailing address: Selcuk University, Food Technology department, Konya, Turkey, Phone: +903322232923, Fax: +903322410108. E-mail: ayar@selcuk.edu.tr, Ayarst2002@yahoo.com

Peyma-Chr. Hansen's Peynir Mayası San. and Tic. A.S., İstanbul (distributor of Chr. Hansen's A/S, Denmark), respectively. This culture was selected on the basis of preliminary positive results obtained in an initial culture screening for the production of high quality Kasar cheese.

Cheese Manufacturing. Bulk cow's milk was locally obtained from a farm in Konya (Turkey). Milk had 10.08 g/100g non-fat solid dry matter, 3.09 g/100g protein, 1.031 specific gravity. Its titratable acidity was 7.53 SH and pH = 6.60. Experimental cheeses were made in the "Seker Süt Dairy Plant" in Konya. Flow diagram of production process of Kasar cheeses is shown in Fig 1.

The milk was standardized, by separation to 3.50 g/100g fat content. Cheeses were made according to the conventional and modified methods. The first lots of 3000 L raw milk was heated up to 32°C. This lot was used as control (traditional cheese) (A). Milk in the first portion was not pasteurized and the culture was not added. Second lot of milk (3000 L) was pasteurized at 72°C for 1-2 min. Starter culture (25 g/100g *Lb.helv.* 7[®] "*L. helveticus*" + 75 g/100g yogurt 709[®] "*Streptococcus salivarius* subsp. *thermophilus* and *Lactobacillus delbrueckii* subsp. *Bulgarius*") was added at the rate of 1.5 g/100g in second batch (batch B) after it was warmed to 32-35 °C. CaCl₂ solution 40 g/100g (20 g/100L milk for the second cheese milk) was then added (batch B). Subsequently, liquid calf rennet was added to each milk batches (strength 1:15000). Coagulation of milk was achieved in 45 minutes at 32°C. Draining of whey achieved by cutting of the coagulant in small pieces and then pressing in a cheese cloth. The pressing finished after pH level of curd reached to 4.9-5.3 for ripening (acidity of curd was 63-68 SH). The ripened curd was sliced and boiled in hot salty (2 g/100g NaCl) water within the slicing machine at 72°C for average 3-5 min. Immature cheese was placed in cylindrical molds. Finally, each group was divided into 36 pieces of cheese in 500 g quantities in the shape of a cylindrical. The molds were then turned upside down for three times during the first 3 h of draining and then removed from the molds. Prepared cheese samples were pre-ripened at 15 ± 1°C, 85 RH for 7 days. The Kasar cheeses were salted by rubbing. Cheese samples were ripened at 8 ± 1°C, 85 RH for 90 days. The experiment was replicated for three times.

Total solids, fat, total nitrogen, salt, pH and titratable acidity (SH) in cheese samples were determined according to the procedures described by Anonymous (3). Water soluble nitrogen (WSN) and Triclore acetic acid soluble nitrogen (TCA N)₂ and Ripening Index in cheeses were determined according to the methods of Gripon *et al.* (9). Seven trained panelists were used to evaluate the organoleptic quality of cheese samples. Samples were evaluated for overall flavor (45 point scale), appearance and color (10 point scale), and body and texture (45 point scale) (6). Fifty-gram cheese samples taken over the course of ripening were homogenized with 200 ml of a sterile

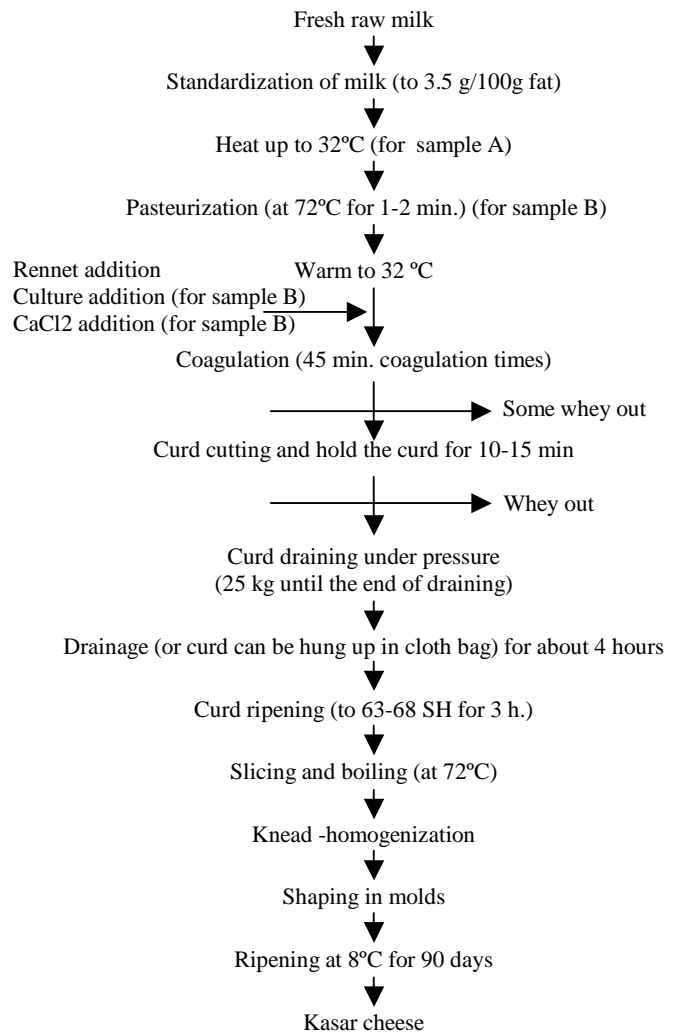


Fig 1. Flow diagram of production process of Kasar cheese.

solution of 2 mL/100mL (v/v) of sodium citrate (pH = 7.5–8.5) (Panreac, Barcelona, Spain) at 40–45°C for 3 min in a Stomacher 400 Lab Blender (Seward Medical, London, UK), to obtain a 1:5 dilution. Decimal dilutions were prepared by mixing 10 mL with 90 ml of 0.1 g/100mL (w/v) sterile peptone water (Oxoid, Unipath, Ltd., Basingstoke, UK) according to International Dairy Federation (IDF) standard 122 B (12). Total aerobic mesophilic bacteria was enumerated on standard Plate Count Agar (Merck) after incubation at 30°C for 48 h, total psychotropic bacteria on Plate Count Agar after incubation at 5°C for 7 days, thermophilic lactococci on M17 and MRS agar (Merck), after incubation at 42°C for 48 h, mesophilic lactobacilli on Rogosa and MRS agar at 25°C for 48 h, coliform and *E. coli* on Fluorocult Violet Red Bile agar at 35°C for 24 h, and moulds and yeasts on Potato Dextrose Agar at 25°C for 4 days. After incubation, plates with 3–300 colonies were counted and the results expressed as a

logarithm of colony forming units (log CFU/g) (8). Cheeses were periodically analyzed on the 1st, 7th, 15th, 30th, 60th, 90th days in duplicate during the ripening period.

The effect of culture adding in cheese was evaluated by variance analysis. According to the results of variance, when it was necessary Duncan test was used to determine the groups significantly different from each other (15). All data is reported as means together with standard deviation.

RESULTS AND DISCUSSION

Changes in the physicochemical characteristics during the ripening. Table 1 shows the results obtained from the physicochemical analyses of the two batches at different moments of the ripening period. Generally, physicochemical parameters were not affected by starter culture. As a result of the changes with the environment, all the cheeses underwent a significant loss in humidity. This was detected as a continuous increase in total solids throughout ripening. The total solids content increased considerably during 90 days of ripening, reaching very high levels of around 59 g/100g ($P < 0.01$). When the physicochemical evolution of the two batches were compared, no significant differences observed about total solid, pH, water soluble nitrogen, non-protein nitrogen (NPN) and ripening index levels in the batches ($P > 0.01$). These results were compatible with the values found by other authors for cheeses with similar characteristics (14, 17, 22)

During the first 15 days of ripening in batch B, the decrease in pH level was detected as a consequence of the production of acid by culture microorganisms. The inoculated batch showed the fastest decrease in pH levels. The drop in pH values and humidity was accompanied by a major decrease in microbial counts in batches. This sharp decrease in pH levels might be expected as lactococci and lactobacilli (the main producers of lactic acid) which was the dominant microbial group at the beginning of the ripening period. These differences decreased and no significant differences were found after 60 days of ripening. This could be explained by the low levels of lactic acid bacteria (18, 20). From table 1 it can be seen that use of the culture caused the higher titratable acidity values; high titratable acidity in a cheese increases the extent of whey separation and results in increased total solids.

The evolution of the WSN/N could be interpreted as the level of proteolysis. The values obtained in these cheeses could be explained by the low levels of water activity and the pH reached; under these conditions, milk and microbial proteases showed low activity (16). Significant differences in proteolysis were not found during ripening period between batch A and batch B. There were significant differences each of the ripening periods. The proteolysis was higher in batch A than that batch B. This difference could be explained by the milk non-pasteurized in batch A. Because, total aerobic mesophilic, total psychotropic

bacteria, moulds and yeasts counts in batch A were higher than that of batch B.

Changes in the microbial groups during the ripening. Table 2 shows the results obtained from the microbiological analysis of the samples during the ripening process. The counts of aerobic mesophilic flora, obtained after adding the starter to the pasteurized milk, were the range of 7.00 log CFU/g, values which were the highest in the 1-day-old cheese. This growth in counts is a normal phenomenon during the producing of cheeses, due to physical retention of the microorganisms in the coagulum and microbial multiplication during coagulation and whey drainage. From this point onwards, counts declined up to the end of ripening, going down to levels of around 4.00-4.50 log CFU/g in the batches A and B. This decrease occurred due to rind in surface of cheeses. The penetrating of oxygen into cheeses was prevented by rind. On the basis of the results obtained, it is possible to conclude that in general no major differences appeared in the counts of aerobic mesophilic bacteria between the cheeses matured in the A and B batches. The total psychotropic bacteria ranged from 3.58 to 0.30 and 0.70 to 0.48 log CFU/g in the batches A and B during ripening, respectively. The differences found between batches A and B, in the evolution of the total psychotropic bacteria, can be explained by the thermal treatment of the milk in the batch B. These results are lower than that of the values found by other authors for Kasar cheeses with similar characteristics (13, 19)

The addition of starter affected the microbiological quality of the cheeses, and differences in moulds and yeasts and faecal coliform counts found in the batches A and B. The moulds and yeasts and coliforms did not grow in batch B. The maximum level of moulds and yeasts was attained on the 30th day in batch A. The faecal coliform counts decreased throughout the ripening period in batch A. *E. coli* were not found in culture added cheese (batch B) and raw milk cheese (batch A) during ripening. A similar result was observed in Kasar cheese by Akyüz (2). The low counts of this group can be explained by the low pH of the cheese throughout ripening and the antagonistic activity of the lactic acid bacteria (5).

Batch A showed lower lactic acid bacteria counts (thermophilic lactococci) than the inoculated batch B during the ripening period. Lactic acid bacteria counts were higher in batch A at the beginning of ripening because milk of batch A was not heated. Lactic acid bacteria counts were maximum in the 7-day-old cheeses (batch A and B). However, significant differences between the ripening periods were found in batches A and B ($P < 0.01$). After 15 days, the lactic acid bacteria counts decreased in the two batches. The decrease in lactic flora can be explained by the lower water activity and high acidity in the cheeses (20). This was especially noticeable in the cheeses of batch B, in which the lactic acid bacteria present were exogenous, because it was elaborated with the addition of starter.

Table 1. Evolution of the physicochemical characteristics during the ripening of Kasar cheeses

Groups	Ripening Period (Days)	Total Solids (g/100g ¹)	Fat (g/100g)	NaCl (g/100g)	Nitrogen (g/100g)	Water soluble N (g/100g)	In 12 TCA soluble N (g/100g)	Ripening index	Titrateable Acidity (SH)	pH
A	1	51.72 ± 0.17 e*	23.00 ± 1.41 a	2.21 ± 0.29 b	3.26 ± 0.02 e	0.26 ± 0.00 f	0.18 ± 0.00 d	7.97 ± 0.03 e	71.00 ± 4.24 b	5.40 ± 0.14 a
	7	55.38 ± 0.17 d	25.00 ± 0.00 a	2.79 ± 0.14 ab	3.86 ± 0.01 d	0.36 ± 0.00 e	0.18 ± 0.00 d	9.32 ± 0.09 e	73.50 ± 2.12 b	5.31 ± 0.05 a
	14	56.87 ± 0.09 c	23.50 ± 0.00 a	2.90 ± 0.04 ab	4.09 ± 0.01 c	0.49 ± 0.00 d	0.19 ± 0.00 d	11.98 ± 0.02d	77.00 ± 0.00 ab	5.18 ± 0.08 ab
	30	57.17 ± 0.00 bc	23.25 ± 0.35 a	2.95 ± 0.09 ab	4.29 ± 0.02 b	0.65 ± 0.01 c	0.22 ± 0.00 c	15.15 ± 0.22 c	76.00 ± 4.24 ab	5.05 ± 0.16 b
	60	57.56 ± 0.10 b	24.00 ± 1.41 a	3.08 ± 0.04 a	4.32 ± 0.00 b	0.88 ± 0.02 b	0.34 ± 0.01 b	20.37 ± 0.52 b	79.00 ± 2.83 ab	5.03 ± 0.01 b
	90	58.49 ± 0.05 a	24.50 ± 2.12 a	3.27 ± 0.35 a	4.42 ± 0.00 a	1.01 ± 0.04 a	0.58 ± 0.00 a	22.85 ± 0.83 a	89.00 ± 5.66 a	5.06 ± 0.04 b
	Average		56.20 ± 2.30 A	23.88 ± 1.28 A	2.87 ± 0.37 A	4.04 ± 0.41 B	0.61 ± 0.28 A	0.28 ± 0.15 A	14.61 ± 5.81 A	77.58 ± 6.54 B
B	1	50.52 ± 0.72 d	22.50 ± 0.71 b	2.23 ± 0.16 a	3.75 ± 0.02 e	0.31 ± 0.00 f	0.14 ± 0.00 f	8.26 ± 0.07 f	71.50 ± 0.71 a	5.30 ± 0.04 a
	7	54.84 ± 0.23 c	25.50 ± 0.71 a	2.25 ± 0.67 a	4.10 ± 0.02 d	0.40 ± 0.00 e	0.19 ± 0.00 e	9.75 ± 0.00 e	80.50 ± 10.61 a	5.28 ± 0.01 ab
	14	56.32 ± 0.16 b	25.25 ± 1.06 a	2.44 ± 0.00 a	4.63 ± 0.01 c	0.53 ± 0.00 d	0.20 ± 0.00 d	11.44 ± 0.06 d	87.00 ± 5.66 a	5.32 ± 0.04 a
	30	57.30 ± 0.04 b	24.75 ± 1.06 a	2.46 ± 0.07 a	4.65 ± 0.00 c	0.69 ± 0.00 c	0.23 ± 0.00 c	14.83 ± 0.03 c	93.00 ± 15.56 a	5.17 ± 0.04 b
	60	58.75 ± 0.11 a	25.25 ± 0.35 a	2.25 ± 0.18 a	4.80 ± 0.00 b	0.84 ± 0.00 b	0.31 ± 0.00 b	17.42 ± 0.02 b	99.50 ± 0.71 a	4.98 ± 0.04 c
	90	59.54 ± 0.15 a	25.25 ± 0.35 a	2.48 ± 0.14 a	4.87 ± 0.01 a	0.92 ± 0.00 a	0.50 ± 0.00 a	18.89 ± 0.05 a	97.00 ± 4.24 a	4.91 ± 0.01 c
	Average		56.21 ± 3.11 A	24.75 ± 1.31A	2.35 ± 0.25 B	4.47 ± 0.42 A	0.61 ± 0.23 A	0.26 ± 0.12 A	13.43 ± 4.06 A	88.08 ± 11.84 A

(A): Raw milk cheese, (B): Pasteurized + Lb.helv.7[®] Yoghurt 709[®] added Cheese.

* Different letters (A–B) in the same columns were significantly different from each other for cheeses groups ($P < 0.01$). Different capital letters (a-f) in the same columns were significantly different from each other for ripening periods ($P < 0.01$).

Table 2. The results obtained from the microbiological analysis of the samples during the ripening process (log CFU/g)

Group	Ripening period (days)	Total Aerobic Mesophilic	Total Psychotropic Bacteria	Moulds and Yeasts	Coliform	Mesophilic Lactobacilli		Thermophilic Lactococci	
						Rogosa	MRS	MRS	M17
A	1	7.51 ± 0.03 a*	3.58 ± 0.02 a	0.24 ± 0.33 a	0.54 ± 0.08 a	3.61 ± 0.02 f	4.57 ± 0.09 d	4.62 ± 0.01 e	5.69 ± 0.01 c
	7	6.61 ± 0.01 b	3.09 ± 0.09 b	0.15 ± 0.21 a	0.48 ± 0.00 a	7.57 ± 0.01 a	7.67 ± 0.01 a	6.57 ± 0.03 a	7.51 ± 0.04 a
	14	6.51 ± 0.02 b	2.32 ± 0.02 c	0.24 ± 0.33 a	0.39 ± 0.12 ab	6.48 ± 0.01 b	6.55 ± 0.03 b	5.60 ± 0.01 b	6.41 ± 0.00b
	30	5.40 ± 0.04 c	2.10 ± 0.02 d	0.54 ± 0.08 a	0.30 ± 0.00 b	5.64 ± 0.01 c	6.49 ± 0.00 b	5.46 ± 0.01 c	5.48 ± 0.01 d
	60	4.54 ± 0.04 d	0.30 ± 0.00 e	0.35 ± 0.49 a	0.30 ± 0.00 b	5.46 ± 0.01 d	5.35 ± 0.03 c	5.25 ± 0.01 d	4.93 ± 0.01 e
	90	4.29 ± 0.03 e	0.30 ± 0.02 e	0.24 ± 0.33 a	0.30 ± 0.00 b	4.59 ± 0.04 e	3.58 ± 0.01 e	4.48 ± 0.01 f	3.64 ± 0.01 f
	Average	5.81 ± 1.21 A	1.95 ± 1.32 A	0.29 ± 0.27 B	0.39 ± 0.11 B	5.56 ± 1.33 A	5.70 ± 1.42 A	5.33 ± 0.72 A	5.61 ± 1.25 A
B	1	7.36 ± 0.01 a	0.70 ± 0.00 a	0	0	3.52 ± 0.00 e	3.58 ± 0.00 f	3.58 ± 0.00 f	5.35 ± 0.01 cd
	7	6.53 ± 0.01 b	0.59 ± 0.16 a	0	0	6.64 ± 0.01 a	6.53 ± 0.01 a	7.54 ± 0.01 a	7.58 ± 0.04 a
	14	6.17 ± 0.01 c	0.60 ± 0.03 a	0	0	5.56 ± 0.02 b	5.70 ± 0.00 b	6.68 ± 0.02 b	6.74 ± 0.01 b
	30	5.19 ± 0.01 d	0.30 ± 0.05 b	0	0	5.50 ± 0.01 c	5.57 ± 0.01 c	5.72 ± 0.01 c	5.46 ± 0.07 c
	60	4.91 ± 0.01 e	0.30 ± 0.02 b	0	0	4.95 ± 0.00 d	5.32 ± 0.01 d	5.36 ± 0.02 d	5.32 ± 0.01 d
	90	4.57 ± 0.02 f	0.48 ± 0.00 ab	< 1	0	3.54 ± 0.01 e	4.64 ± 0.01 e	4.68 ± 0.02 e	4.53 ± 0.01 e
	Average	5.79 ± 1.03 A	0.50 ± 0.17 B	0.08 ± 0.18 A	0.00 A	4.95 ± 1.17 A	5.22 ± 0.96 A	5.59 ± 1.34 A	5.83 ± 1.06 A

* Different letters (A–B) in the same columns were significantly different from each other for cheeses groups ($P < 0.01$). Different capital letters (a-f) in the same columns were significantly different from each other for ripening periods ($P < 0.01$).

Table 3. The effects of addition of starter culture on sensory properties of the Kasar cheeses

Group	Ripening period (days)	Flavor and Odor 45 point	Body and Texture 45 point	Appearance (Rind) 5 point	Appearance (cutaway) 5 point
A	1	33.93 ± 3.53	34.99 ± 1.01	3.50 ± 0.50	3.50 ± 0.09
	7	34.50 ± 2.72	33.57 ± 1.01	3.35 ± 0.30	3.50 ± 0.09
	14	35.36 ± 1.51	34.14 ± 0.80	3.28 ± 0.40	3.35 ± 0.50
	30	35.00 ± 0.00	33.57 ± 5.04	3.64 ± 0.91	3.57 ± 0.00
	60	33.00 ± 3.23	34.07 ± 2.72	3.21 ± 0.10	3.71 ± 0.60
	90	33.00 ± 1.82	33.57 ± 6.05	3.21 ± 0.30	3.57 ± 0.80
	Average		34.131 ± 2.046 A*	33.986 ± 2.619 A	3.369 ± 0.398 B
B	1	34.07 ± 0.70	36.78 ± 0.50	3.64 ± 0.70	3.64 ± 0.09
	7	37.35 ± 2.32	36.07 ± 4.54	3.93 ± 0.50	3.85 ± 0.40
	14	31.42 ± 1.01	34.78 ± 1.30	4.07 ± 0.09	3.86 ± 0.00
	30	36.78 ± 1.52	33.21 ± 2.52	3.92 ± 0.30	3.07 ± 0.30
	60	36.78 ± 5.55	36.85 ± 1.01	3.85 ± 0.40	4.07 ± 0.30
	90	37.85 ± 6.05	34.28 ± 1.01	3.43 ± 0.00	3.50 ± 0.29
	Average		35.712 ± 3.543 A	35.333 ± 2.190 A	3.808 ± 0.377 A

* Different letters (A–B) in the same columns were significantly different from each other for cheeses groups ($P < 0.01$).

Organoleptic examination. The results of organoleptic examination of cheeses A and B on the 1st, 7th, 15th, 30th, 60th, 90th days are presented in table 3. On account of the differences in the proteolysis and lipolysis were not observed for batch A and B cheeses, no differences in cheese flavor were statistically observed. But, flavor and odor scores in culture added batch B was higher. The only important difference observed was for appearance (rind of cheese) between cheeses samples ($P < 0.01$). The rind appearance point of starter culture added cheese was higher, because moulds and yeasts did not growth on rind. Different ripening times hadn't effect on sensory scores.

CONCLUSION

It may be concluded that microbial quality of Kasar cheese was improved by adding of starter cultures. The results of this study indicated that the use of the commercially available special starter cultures improved the body and texture and highly appearance of Kasar cheese. Generally, physico-chemical parameters were not affected by culture adding. If it is kept in mind that lactobacilli can contribute to quality of cheese and the production of the characteristic flavor of cheese, such as production of higher microbial quality a Kasar cheese, it can be used in Kasar cheese making.

REFERENCES

- Akyüz, N. 1978. Research On Effects Of Heat, Using Culture And Package To Quality And Flavor In Kasar Cheese. Atatürk Univ. Agric. Fac. Associated Prof. Thesis, Erzurum, Turkey.
- Akyüz, N. 1983. Research on effects of pasteurization, microbial flora and package material to quality and flavor in Kasar cheese. *Doğa Tarım Orman* 7:123-132.
- Anonymous. 1989. Kasar Cheese Standard. TS 3272. Turkish Standards Institute. Ankara
- Ayar, A. 1991. The Suitability To Codex And Standard Of Kasar Cheeses Consumed In Trabzon, Turkey. Ondokuz Mayıs Univ. Master Thesis, Samsun, Turkey.
- Babel, F. J. 1977. Antibiosis by lactic acid bacteria. *J. Dairy Sci.* 60:815-821.
- Bodyfelt, F. W., Tobias, J. and Trout, G. M. 1988. The Sensory Evaluation Of Dairy Products. Van. Nostrand Reinhold, London. p. 598.
- Çetinkaya, A., Yaman, H., Elmalı, M., and Karadağoğlu, G. 2003. A preliminary study of Kashar cheese and its organoleptic qualities matured in bee wax. *Int. J. Food Safety* 6:1-4
- Gobbetti, M., Morea, M., Baruzzi, F., Corbo, M. R., Matarante, A., Considine, T., Cagno, R. Di, Guinee, T., and Fox, B. F. 2002. Microbiological, compositional, biochemical and textural characterization of Caciocavallo Pugliese cheese during ripening. *Int. Dairy J.* 12:511-523.
- Gripon, J. C., Desmazeaud, M. J., Baes, D. Et. Le., and Bergere, J. H. 1975. Role des micro-organismes et des enzymes du cours de la maturation. *Le Lait* 548:502-516.
- Güven, M., and Konar, A. 1994. A comparative study on the physical, chemical and organoleptic qualities of Tulum cheese which were made from cow's milk and packed and ripened in different materials. *Gıda* 5:287-293.
- Güven, M., Konar, A., and Akın, M. S. 1997. Effect of different packing materials and ripening periods on the proteolysis level of Edam cheese. *The J. Agric. Fac. Cukurova Univ.* 4:1-10.
- International Dairy Federation (IDF). 1992. Milk and milk products. Preparation of test samples and dilutions for microbiological examination. IDF Standard, 122B, Brussels, Belgium.
- Kurultay, S. 1993. A Research On Kasar Cheeses Made From Raw And Pasteurized Milks With Different Culture Combinations. Trakya Univ., Tek. Agric. Fac., Doctoral Thesis, Tekirdağ, Turkey.
- Metin, M., Öztürk, G. F. 1991. National Milk and Milk Products Symposium "Cheese with All Ways" 12-13 June, Tekirdağ, Turkey
- Minitab. 1991. Minitab Reference Manual (Release 7.1). Minitab Inc. State Coll. PS 16801 USA.
- Olarte, C., Sanz, S., Gonzalez-Fandos, E., and Torre, P. J. 2000. The effect of a commercial starter culture addition on the ripening of an artisanal goat's cheese (Cameros cheese). *Applied Microbiology* 88:421-429
- Öztek, L. 1983. The Researches On Production, Composition And Ripening Of Kasar Cheeses Made In Kars And Comparison Of This Cheeses With Other Cheeses. Atatürk Univ. Agric. Fac. No: 240, Erzurum, Turkey.
- Poulet, B., Huertas, M., Sanchez, A., Caceres, P., and Larriba, G. J. 1991. Microbial study of Casar de Ca'ceres cheese throughout ripening. *Dairy Res.* 58:231-238.
- Tavacı, M. 1997. A Research On Various Herbs Added And Vacuum Packaged Kasar Cheeses. Trakya Univ., Food Engine. Dep., Master Thesis, Tekirdağ, Turkey.
- Tornadijo, M. E., Fresno, J. M., Bernardo, A., Martín, R., and Carballo, J. 1995. Microbiological changes throughout the manufacturing and ripening of Spanish goat's raw milk cheese (Armada variety). *Lait*, 75:551-570.
- Üçüncü, M., 2004. Milk Technology. 1.Part, Milk Composition and Technology. Ege Üniversitesi Basımevi, Bornova, İzmir, Turkey.
- Yaygın, H., and Dabiri, K. 1989. The researches on properties of Kasar cheeses made from cow, goat and ewe milks, ripened at different temperatures. *Ege Univ. Agric. Fac. J.* 1:333-345.