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Determination of Fatty Acids and Chemical Characteristics of Cokelek Cheese from Cows Milk Using of *L. helveticus* and/or Yoghurt Bacteria

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Cokelek cheese is a very popular dairy product in Turkey. It is produced mainly by boiling of set yoghurt made from cow's milk and then straining in a special cloth bag.

In the present work, Cokelek cheeses were manufactured from cows' milk by fermenting with different starter cultures (yogurt bacteria, *Lactobacillus helveticus* or mixture of these bacteria), and then denaturing at two different temperatures (85°C or 95°C), to asses the effect on yield, chemical and sensory properties of the products. The yields of Cokelek cheeses coded Y95:C, Y85 (inoculated with yogurt culture and heated at 85°C), M95, M85 (inoculated with yogurt culture and *L. helveticus* (1:1), and heated at 85°C or 95°C), H95 and H85 (inoculated with *L. helveticus*, and heated at 85°C or 95°C) was found as 19.27 ± 0.21%, 19.78 ± 0.18%, 16.59 ± 0.76%, 18.69 ± 0.39%, 19.71 ± 2.17% and 19.88 ± 0.25%, respectively. Statistically, no significant difference ($p>0.05$) was observed among the TA %, TS %, fat/TS % and salt/TS % level of the samples during storage period. At the 45th day, the saturated fatty acid (SFA)%, total unsaturated fatty acid (TUFA)%, monounsaturated fatty acid (MUFA)% and polyunsaturated fatty acid (PUFA)% varied between 58.89 and 66.71, 27.14 and 31.80, 24.58 and 29.03, and 2.23 and 2.99, respectively. As the log counts of lactococci were determined between 2.50 ± 0.1 and 3.03 ± 0.35, the log counts of lactobacilli were found between 3.60 ± 0.26 and 4.33 ± 0.41 at the 45th day. Total sensory point of the sample made with mixture culture in boiling at 85°C was the highest at the 15th day. The investigation results showed that *L. helveticus* (single or mixture) might be proposed as a starter culture alternated to yoghurt bacteria in Cokelek cheese made from cow milk.

Keywords: cokelek, yogurt bacteria, *L. helveticus*, fatty acids, characteristics

Introduction

Cokelek is a traditional Turkish acidic cheese made of yoghurt. It is produced mainly by boiling of set yoghurt made from cow's milk and then straining in a special cloth bag. Since Cokelek cheese is made of yoghurt, yoghurt bacteria including *Lactobacillus* sp. and the other lactic acid bacteria affects to their flavour.

Microorganisms of the genus *Lactobacillus* are of great commercial value because they are widely used as starters in fermented foods and as probiotic adjuncts for human and animal health. Among them, *Lactobacillus helveticus* is extensively used as a starter culture in food fermentation (Gursoy *et al.*, 2001; Lombardi *et al.*, 2002; Hynes *et al.*, 2003). *Lactobacillus helveticus* is capable to release peptides during milk fermentation due to its high proteolytic activity. *Lactobacillus helveticus* is widely used in the production of many cheeses, including Emmental, Keffalotiry, Provolone, Grana etc. Some strains are also used as starter bacteria in the manufacture of Bulgarian sour milk in combination with *Streptococcus thermophilus*, although *Lactobacillus delbrueckii* subsp. *bulgaricus*, and *S. thermophilus* are the more common combination.

Cokelek cheese is consumed in a lot of quantity by Turkish people, because it is very economic, tasty and nutritious. When yoghurts are too sour to consume, they are processed into Cokelek cheese. We aimed to standardize heat procedure in production of Cokelek cheese and to examine if *Lactoba-*

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cillus helveticus was used as a starter culture alternated to yoghurt bacteria in Cokelek cheese made from cow milk.

In the present work, we studied chemical and lactic acid bacteria counts, protein fractions, fatty acid compositions, sensory properties during the ripening of Cokelek cheeses manufactured from cows' milk by fermenting with different starter cultures (yoghurt bacteria and/or *Lactobacillus helveticus*) and denaturing at two different temperatures including 85 and 95°C. The aim of this study was to examine the influence of different temperatures and starter cultures on some quality properties of the product during storage.

Material and Methods

Cokelek Cheese Production Cokelek cheeses were produced in Un-Sut Dairy Plant, Suleyman Demirel University. The first, pretesting of cow milk was made, then heated at 95°C for 30 min and inoculated with yoghurt bacteria for Cokelek cheese production. This product was chosen as the control. In yoghurt production, the method proposed by Tamime and Robinson (1985) was followed with the exception that the homogenization and solid standardization stage was ignored. Cow milk was standardized to 1.5 ± 0.2% fat and heated at 95°C with gentle stirring. The heating time was 5 min. cooling to 42-45°C. The pasteurized milk was divided into tree lots. Each lot was inoculated with a yoghurt starter culture (Yo-mix 502, Gemak-Danisco Co., Ankara-Turkey) (Y: inoculated with yogurt culture), *L. helveticus* (LH-B02, Peyma-Chr. Hansen Co., Istanbul-Turkey) (H: inoculated with *L. helveticus*) or a mixture of these (1:1) (M: inoculated with yogurt culture and *L. helveticus* (1:1)) at 3% (w/w) ratio. These lots were incubated at 42-45°C until pH 4.6, and then cooled to +4°C. After overnight refrigeration, the yoghurts were stirred manually and then each lot was heated at 85°C or 95°C for 30 min. (therefore these products were named as Y95:Control (C), Y85, M95, M85, H95 and H85), cooled to 25°C, then poured into a layer cheese cloth bag. The drainage procedure was accomplished in temperature controlled room at 25°C. Cokelek cheese was filled into a container salted with 1% salt and mixed gently to provide homogeneity. Obtained Cokelek cheeses were packaged as 500 g. and stored at 4°C for 45 days until analysis.

Chemical Analyses The titratable acidity (TA, as lactic acid %), total solid (TS %), fat%, density (g/ml) of the raw milk and whey was determined by AOAC methods (1984). The pH was measured with a HANNA pH meter (HANNA Instruments, Italy). Percentage of NaCI was determined using the method of James (1995) and moisture and TS contents were determined by heating at 105°C to a constant weight. NaCI content was expressed as salt concentration. Fat content was analyzed according to AOAC (1980). Total nitrogen (TN) and water-soluble nitrogen (WSN) levels were determined according to Grippon *et al.* (1975). Multiplication of TN by 6.38 gave the protein content. Ripening index of Cokelek cheese samples were calculated using the following equation.

$$\text{Ripening index (\%)} = (\text{WSN/TN}) \times 100$$

Enumeration of Lactic acid Bacteria Ten grams of Cokelek cheese were homogenized with 90 ml of a sterile solution of 0.85% (w/v) sodium chloride (Merck, Darmstadt, Germany) at 45°C. Decimal dilutions were prepared in 9 ml sterile NaCl (0.85%).

Lactobacilli and lactococci were enumerated on MRS and M17 agars, respectively, (Merck, Darmstadt, Germany) using the pour plate method with incubation at 30°C for 3 days (De man *et al.*, 1960; Perotti *et al.*, 2004).

Analysis of fatty acids Fatty acid composition was determined using a modified fatty acid methyl ester method as described by Marquard (1987). The oil was extracted from 10 g sample by homogenisation with hexane. The reactive was from 500 ml of total Na-metaoxid (0.5 g), isooctane (20 ml) and methanol (80 ml) added to the oil (50 µl). After the sample was waited one night, Isooctane (500 µl) added to it. The methyl esters of the fatty acids were analysed in a Hewlett-Packard 6890 series gas chromatograph (Perkin Elmer Auto System XL, USA) equipped with a flame ionising detector (FID), a fused silica capillary column (Cp SIL 88 (100 m × 0.25 mm i.d.); film thickness 0.2 µm). It was operated under the following conditions: oven temperature program, 60°C for 4 min. raised to 175°C at a rate of 13°C/min and then kept at 175°C for 27 min; after waited 215°C for 5 min. raised to 240°C at a rate of 4°C/min and then held at 240°C for 15 min injector and detector temperatures, were 240 and 240°C; respectively, carrier gas, helium at flow rate of 15 cm/sec; split ratio, 1/10 mL/min. The contents of palmitic (C16:0), stearic (C18:0), oleic (C18:1), linoleic (C18:2) and linolenic (C18:3) acids were determined by computing integrator.

Organoleptic analysis The Cokelek cheeses were tested by a panel of 25 persons familiar with cheese grading. They scored the cheeses for appearance (9 points), flavour (9 points), odour (9 points) and texture (9 points). The hedonic scale of 9 points was used (1 = dislike extremely; 5 = neither like nor dislike; 9 = like extremely). Persons were provided with unsalted crackers and mineral water to rinse their mounts when necessary. Persons were asked to evaluate these cheeses after tasting them. The graders were also asked to record any unexpected or unpleasant flavour defects and total score (Yurdakul, 1994).

Statistical analysis Analyses of variance for bacterial counts after a log transformation was performed on data

obtained at different stages of production. Chemical, microbiological, fatty acids and organoleptic characteristics of the Cokelek samples were subjected to analyses of variance using multivariate test. These results were obtained using SPSS 11.01 Statistic Package (SPSS Inc., Chicago, USA).

Results and Discussion

The pH, TA%, TS%, fat%, density (g/ml) and % protein of the raw cows milk used in this study were 6.55 ± 0.01, 0.177 ± 0.003, 11.6509 ± 0.3240, 3.433 ± 0.058, 1.027 ± 0.0006 and 3.1006 ± 0.0168, respectively.

The yields of Cokelek cheeses coded Y95:C, Y85, M95, M85, H95 and H85 was found as 19.78 ± 0.18%, 19.27 ± 0.21%, 18.69 ± 0.39%, 16.59 ± 0.76%, 19.88 ± 0.25% and 19.71 ± 2.17%, respectively. The yield of Cokelek cheese produced with *L. helveticus* and heated at 85°C is the highest. In addition, the yield of Cokelek cheeses heated at 85°C was better than those of the samples heated at 95°C. Kahyaoglu and Kaya (2003) declared that the hardness and elasticity of cheeses increased when the fat level was reduced and the curd heat-treatment temperature was increased from 75°C to 95°C in Gaziantep cheeses. Since the heated samples led to less protein hydration, less freedom of movement for the protein molecules, a larger level of intact caseins and a firmer casein matrix. In this study, it was thought that the yield of cheeses heated at 95°C were lower than others depending on the properties described above.

The chemical analysis values of Cokelek cheeses during the storage were given in Table 1. It was found that pH values were between 3.89 ± 0.02 and 4.24 ± 0.07 at the 45th day. The pH value of all Cokelek cheeses significant decreased ($p<0.05$) during the storage. These findings were lower than reported values of Agaoglu *et al.* (1996). The TA % levels of the Cokelek samples were found maximum 2.56 ± 0.10% (H95) at the 45th day. The TA % values were higher than the values reported by other researchers (Tarakci *et al.*, 2003; Agaoglu *et al.*, 1996; Kucukoner and Tarakci, 1998; Oksuztepe *et al.*, 2007). The TS% varied between 26.90 ± 1.03 and 29.95 ± 1.02 during the storage. The fat ratio in TS (fat/TS)% were found between 16.76 ± 0.46 and 20.31 ± 1.65% at the 45th day. The salt in TS (salt/TS)% were found maximum 6.62 ± 0.59% (H95) at the 45th day. Statistically, no significant difference ($p>0.05$) was observed among the TS %, fat/TS % and salt/TS % level of the samples during storage period. These findings are higher than the values reported by other researchers (Tarakci *et al.*, 2003; Agaoglu *et al.*, 1996; Kucu-

Table 1. Chemical and microbiological (log cfu g^{-1}) properties of Cokelek cheeses.

Storage Time	No	pH**	TA%*	TS%*	Fat/TS%*	NaCl/TS%*	WSN%**	TN%**	Rip. In%**	Lactic acid bacteria	
										Lactococci**	Lactobacilli**
1st day	Y95:C	4.12 ± 0.35 ^{ab}	2.51 ± 0.25	27.97 ± 1.80	19.90 ± 0.20	5.61 ± 0.81	0.34 ± 0.02 $^{d-e}$	2.00 ± 0.02 ^{ab}	17.22 ± 1.18 ^{cd}	1.66 ± 0.20 $^{e-h}$	2.56 ± 0.25 $^{e-h}$
	Y85	4.10 ± 0.34 ^{ab}	2.43 ± 0.18	27.83 ± 1.35	21.18 ± 0.46	5.74 ± 0.15	0.36 ± 0.03 $^{c-e}$	1.97 ± 0.10 ^{ab}	18.44 ± 2.50 ^{bcd}	1.36 ± 0.25 ^{gh}	2.53 ± 0.20 $^{e-h}$
	M95	4.09 ± 0.08 ^{ab}	2.47 ± 0.12	27.95 ± 3.45	18.25 ± 3.12	5.76 ± 0.50	0.33 ± 0.02 ^{e}	1.99 ± 0.04 ^{ab}	16.55 ± 1.09 ^{d}	1.43 ± 0.30 ^{fgh}	2.20 ± 0.26 ^{h}
	M85	4.07 ± 0.01 ^{ab}	2.32 ± 0.04	27.31 ± 2.36	19.22 ± 1.27	6.18 ± 0.81	0.37 ± 0.01 $^{b-e}$	1.92 ± 0.05 ^{b}	19.56 ± 0.67 $^{a-d}$	1.73 ± 0.11 $^{e-h}$	2.43 ± 0.35 ^{fgh}
	H95	3.83 ± 0.11 ^{b}	2.51 ± 0.18	28.09 ± 1.51	19.13 ± 2.89	5.55 ± 0.50	0.37 ± 0.01 $^{b-e}$	2.02 ± 0.07 ^{ab}	18.36 ± 0.58 ^{cd}	1.73 ± 0.11 $^{e-h}$	2.33 ± 0.28 $^{g-h}$
	H85	3.89 ± 0.04 ^{ab}	2.39 ± 0.23	26.90 ± 1.03	19.32 ± 3.55	6.09 ± 0.23	0.36 ± 0.02 $^{b-e}$	1.97 ± 0.06 ^{ab}	18.73 ± 1.42 ^{bcd}	1.30 ± 0.10 ^{h}	2.30 ± 0.30 $^{g-h}$
15th day	Y95:C	4.24 ± 0.03 ^{ab}	2.61 ± 0.09	28.60 ± 1.30	19.71 ± 2.27	6.36 ± 0.21	0.36 ± 0.03 $^{b-e}$	2.02 ± 0.02 ^{ab}	18.17 ± 1.38 ^{cd}	2.33 ± 0.41 ^{bcd}	3.23 ± 0.25 ^{cde}
	Y85	4.22 ± 0.05 ^{ab}	2.39 ± 0.14	28.41 ± 0.67	21.03 ± 3.06	6.13 ± 0.14	0.36 ± 0.02 $^{b-e}$	1.86 ± 0.04 ^{b}	19.61 ± 1.48 $^{a-d}$	1.96 ± 0.25 $^{c-e}$	3.36 ± 0.35 ^{bcd}
	M95	4.49 ± 0.06 ^{ab}	2.33 ± 0.20	29.37 ± 1.45	16.72 ± 1.38	6.02 ± 0.52	0.40 ± 0.01 $^{a-e}$	2.31 ± 0.53 ^{a}	17.90 ± 3.73 ^{cd}	2.10 ± 0.36 ^{cde}	2.86 ± 0.23 $^{d-h}$
	M85	4.14 ± 0.02 ^{ab}	2.33 ± 0.16	28.87 ± 1.31	17.75 ± 1.18	6.25 ± 0.50	0.37 ± 0.01 $^{a-e}$	1.74 ± 0.22 ^{b}	21.69 ± 2.52 ^{abc}	2.46 ± 0.05 ^{abc}	3.16 ± 0.40 $^{c-f}$
	H95	3.96 ± 0.10 ^{b}	2.59 ± 0.12	28.68 ± 0.63	17.64 ± 1.41	6.49 ± 0.85	0.41 ± 0.03 $^{a-d}$	2.04 ± 0.05 ^{ab}	20.06 ± 2.05 $^{a-d}$	2.46 ± 0.11 ^{abc}	2.96 ± 0.20 $^{d-g}$
	H85	4.29 ± 0.07 ^{ab}	2.38 ± 0.01	29.78 ± 0.23	18.69 ± 2.84	6.12 ± 0.24	0.37 ± 0.03 $^{b-e}$	1.98 ± 0.05 ^{ab}	18.88 ± 1.46 $^{a-d}$	1.86 ± 0.05 $^{d-g}$	2.93 ± 0.32 $^{d-h}$
45th day	Y95:C	4.24 ± 0.07 ^{ab}	2.53 ± 0.01	27.77 ± 1.62	20.31 ± 1.65	6.62 ± 0.59	0.43 ± 0.02 $^{a-c}$	2.07 ± 0.02 ^{ab}	21.12 ± 1.10 ^{abc}	3.03 ± 0.35 ^{a}	4.23 ± 0.20 ^{a}
	Y85	4.21 ± 0.05 ^{a}	2.46 ± 0.07	28.77 ± 1.21	19.80 ± 1.51	6.23 ± 0.27	0.44 ± 0.02 ^{ab}	1.93 ± 0.04 ^{ab}	22.85 ± 1.08 ^{ab}	2.86 ± 0.25 ^{ab}	4.33 ± 0.41 ^{a}
	M95	4.15 ± 0.14 ^{ab}	2.52 ± 0.10	29.95 ± 1.02	17.48 ± 1.11	6.12 ± 0.40	0.39 ± 0.02 $^{a-e}$	2.07 ± 0.03 ^{ab}	19.00 ± 0.73 $^{a-d}$	2.86 ± 0.30 ^{ab}	3.76 ± 0.15 ^{abc}
	M85	4.16 ± 0.06^{ab}	2.38 ± 0.06	29.62 ± 0.97	16.76 ± 0.46	6.28 ± 0.51	0.45 ± 0.03 ^{a}	1.94 ± 0.03 ^{ab}	23.32 ± 1.69 ^{a}	3.00 ± 0.00 ^{a}	4.06 ± 0.46 ^{ab}
	H95	3.89 ± 0.02 ^{ab}	2.56 ± 0.10	27.86 ± 1.25	18.61 ± 2.78	6.58 ± 0.39	0.41 ± 0.04 $^{a-d}$	2.07 ± 0.05 ^{ab}	20.13 ± 1.77 $^{a-d}$	3.03 ± 0.11 ^{a}	3.76 ± 0.30 ^{abc}
	H85	3.93 ± 0.11 ^{ab}	2.45 ± 0.02	29.10 ± 1.36	17.99 ± 4.29	6.31 ± 0.49	0.42 ± 0.04 ^{abc}	2.09 ± 0.01 ^{ab}	20.30 ± 2.18 $^{a-d}$	2.50 ± 0.10 ^{abc}	3.60 ± 0.26 $^{a-d}$

*: Statistically not significant different $p>0.05$, **: Statistically significant different $p<0.05$, C: Control, Y85, Y95: inoculated with yogurt culture, and heated at 85°C or 95°C; M85, M95: inoculated with yogurt culture + *L. helveticus* (1:1), and heated at 85°C or 95°C; H85 and H95: inoculated with *L. helveticus*, and heated at 85°C or 95°C.

Note: means in the same column with different letters show statistically significant differences.

koner and Tarakci, 1998; Oksuztepe *et al.*, 2007).

While the ranges of TN% of samples were found between 1.9367 ± 0.0496 and 2.0953 ± 0.0107, the ranges of WSN% of the same sample determined between 0.3944 ± 0.0212 and 0.4541 ± 0.0374 at 45th day. WSN% ranges were significant increased the ripening period ($p<0.05$). It was found that the ripening indexes of Cokelek cheeses at the end of heated at 95°C were lower than heated at 85°C. Interactions between storage period and culture type, between storage period and heated temperature for TN % and ripening indexes were found to be significant at the level of $p<0.05$. This finding was lower than reported by Tarakci *et al.* (2003) for Darende Dumas Cokelek. But, they were similar to those given by Kucukoner and Tarakci (1998), Agaoglu *et al.* (1996). The differences found between the present study and previous literature can be due to Cokelek samples produced in different ways.

The fatty acid compositions of Cokelek cheeses were presented in Table 2. The range of SFA of the samples (Y85, Y95:C, M85, M95, H85 and H95) was found as 61.46, 63.02, 61.26, 61.19, 59.00 and 74.43 on first day. The SFA levels of Surk with hot pepper and Dolaz cheeses were determined as 60.80-68.66 % by Donmez *et al.* (2005). Myristic (C14:0), palmitic (C16:0), stearic (C18:0) and oleic (C18:1) acids are higher than the other fatty acids in Cokelek cheeses. The range of TUFA of the samples was determined as 27.14-31.80 at the 45th day. The findings of this study were similar to the findings of Zeppa *et al.* (2005), and Kondyli and Katsiari (2002).

Both lactococci and lactobacilli counts were increased during the storing period. While the log counts of lactococci were determined between 2.50 ± 0.1 and 3.03 ± 0.35, the log counts of lactobacilli were found between 3.60 ± 0.26 and 4.33 ± 0.41 at the 45th days (Table 1). These findings were determined as lower than the findings reported by researchers (Tarakci *et al.*, 2003; Oksuztepe *et al.*, 2007). The found discrepancy is probably caused by the variations in productions of Cokelek cheeses.

The scores of the sensory evaluation of the Cokelek samples are shown in Table 3. In the control cheeses, the total sensory point was the highest at the first day. But, total sensory point of the sample made with mixture culture in boiling at 85°C was the highest at the 15th day. We did not analyzed sensory evaluation of the samples at 45th days, because of bad taste and odour of the cheeses.

Table 2. Fatty acid compositions of Cokelek cheeses (%).

Fatty acids	First day						45th day					
	Y95:C	Y85	M95	M85	H95	H85	Y95:C	Y85	M95	M85	H95	H85
$C_{4:0}$	2.04	1.52	1.72	1.80	7.61	1.09	1.58	2.01	2.28	3.35	1.55	2.50
$C_{6:0}$	1.87	1.20	1.40	1.15	4.94	0.91	0.82	1.19	1.35	1.83	0.97	1.81
$C_{8:0}$	1.28	0.88	1.11	0.82	2.83	0.77	0.61	0.63	0.95	1.05	0.60	0.99
$C_{10:0}$	2.96	2.42	2.98	2.30	5.95	2.32	1.36	1.33	2.14	2.10	1.52	1.97
$C_{12:0}$	3.11	2.90	2.81	2.95	5.69	2.74	1.89	1.63	2.53	2.27	2.32	2.15
$C_{14:0}$	10.40	10.43	9.78	10.66	13.97	10.16	8.97	8.04	9.73	8.59	10.19	8.18
$C_{16:0}$	29.30	29.21	28.56	29.70	25.73	28.76	32.61	31.41	32.40	29.19	32.04	28.80
$C_{17:0}$	0.69	0.69	0.70	0.66	0.11	0.71	0.61	0.67	0.54	1.01	0.45	0.35
$C_{18:0}$	11.37	12.21	12.13	11.22	7.60	11.54	14.33	14.99	14.79	14.02	10.91	12.14
SFA	63.02	61.46	61.19	61.26	74.43	59.00	62.78	61.90	66.71	63.41	60.55	58.89
$C_{11:1}$	0.35	0.27	0.27	0.29	0.68	0.25	0.17	0.16	0.26	0.25	0.21	0.27
$C_{16:1}$	1.19	1.18	1.10	1.27	0.83	1.19	0.21	0.50	0.28	0.23	0.69	0.76
$C_{17:1}$	0.18	0.19	0.19	0.19	0.10	0.19	0.20	0.19	0.21	0.19	0.22	0.15
$C_{18:1}$ *trans*	1.18	1.16	2.40	1.12	1.19	2.56	0.00	0.45	1.31	0.47	1.01	0.00
$C_{18:1}$ *cis*	22.42	16.24	22.98	22.77	15.52	24.00	26.11	27.73	22.52	26.55	26.80	23.58
TUFA	28.54	22.19	30.04	28.94	20.34	31.48	29.68	31.80	27.14	29.92	31.75	27.66
MUFA	25.32	19.04	26.94	25.64	18.32	28.19	26.69	29.03	24.58	27.69	28.93	24.76
$C_{18:2}$	2.39	2.33	2.30	2.44	1.59	2.44	2.68	2.49	2.32	1.91	2.57	2.59
$C_{18:3}$	0.83	0.82	0.80	0.86	0.43	0.85	0.31	0.28	0.24	0.32	0.25	0.31
PUFA	3.22	3.15	3.10	3.30	2.02	3.29	2.99	2.77	2.56	2.23	2.82	2.90

SFA: Saturated fatty acid, TUFA: total unsaturated fatty acid, MUFA: mono unsaturated, Y85, Y95: inoculated with yogurt culture, and heated at 85°C and 95°C; M85, M95: inoculated with yogurt culture + *L. helveticus* (1:1), and heated at 85°C or 95°C; H85 and H95: inoculated with *L. helveticus*, and heated at 85°C or 95°C.

Table 3. Organoleptic properties of Cokelek cheeses.

No	Appearance*	Odour*	Texture*	Flavour*	Total*
			1st day		
Y95:C	7.90±0.53	7.60±0.26	7.67±0.51	7.90±0.17	31.07
Y85	7.53±0.64	7.50±0.26	7.40±0.52	7.67±0.15	30.1
M95	7.63±0.45	7.57±0.40	7.57±0.55	7.57±0.90	30.34
M85	7.93±0.40	7.53±0.37	7.73±0.40	7.83±0.57	31.02
H95	7.60±0.40	7.60±0.35	7.40±0.53	7.40±0.36	30
H85	7.30±0.26	7.27±0.15	7.17±0.35	7.27±0.45	29.01
			15^{th} day		
Y95:C	7.90±0.17	7.47±0.15	7.53±0.06	7.37±0.06	30.27
Y85	7.53±0.12	7.20±0.35	7.37±0.25	7.27±0.23	29.37
M95	7.93±0.57	7.60±0.46	7.67±0.15	7.13±0.50	30.33
M85	7.77±0.21	7.73±0.45	7.60±0.17	7.70±0.70	30.8
H95	7.63±0.71	7.20±0.66	7.30±0.26	7.00±0.35	29.13
H85	7.37±0.91	7.00±0.85	7.30±0.44	6.97±0.96	28.64

*: Statistically not significant different $p>0.05$, C: Control, Y85, Y95: inoculated with yogurt culture, and heated at 85°C or 95°C; M85, M95: inoculated with yogurt culture + *L. helveticus* (1:1), and heated at 85°C or 95°C; H85 and H95: inoculated with *L. helveticus*, and heated at 85°C or 95°C.

Conclusions

The investigation results showed that *L. helveticus* (single or mixture) might be proposed as a starter culture alternated to yoghurt bacteria in Cokelek cheese made from cow milk. The yield and other properties of the Cokelek cheeses heated at 85°C were better than those of the samples heated at 95°C. Shortly, we may be proposed to apply of heat treatment at 85°C. However, more research is required to ascertain effect of temperatures and *L. helveticus* in Cokelek cheese.

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References

Agaoglu, S., Ocak, E. and Mengel, Z. (1996). Van ve yoresinde uretilen cokeleklerin mikrobiyolojik, kimyasal, fiziksel ve duyusal nitelikleri uzerinde bir arastirma. *Ankara Universitesi*, *Veteriner Fakultesi Dergisi*, **44**(1-6), 7-12.

AOAC. (1980). Official Methods of Analysis of Association of Official Chemists, 13^{th} ed. Washington DC pp 300.

AOAC. (1984). Official Methods of Analysis of the Association of Official Chemists. 14^{th} Ed. Washington DC, pp 308.

De man, J.C., Rogosa, M. and Sharpe, M.E. (1960). Medium for the Cultivation of Lactobacilli. *Journal.of Applied Bacteriology*, **23**, 130-138.

Donmez, M., Seckin, A. K., Sagdic, O. and Simsek, B. (2005). Chemical characteristics, fatty acid compositions, conjugated linoleic acid contents and cholesterol levels of some traditional Turkish cheeses. *International Journal of Food Science and Nutrition*, **56**, 157-163.

Gripon, J.C., Desmazeaud, M.J., Beas, D. and Bergere, J.H. (1975). Role des micro-organsmes et des enzymes du cours de la maturation. *Le Lait.*, **55**(548), 502-516.

Gursoy, A., Senel, E., Gursel, A., Deveci, O., Karademir, E. and Yaman, S. (2001). Yag icerigi azaltilmis beyaz peynir uretiminde isil islem uygulanan *Lactobacillus helveticus* ve *Lactobacillus bulgaricus* kulturlerinin kullanimi. *Gida*, **26**(5), 375-383.

Hynes, E.R., Bergamini, C.V., Suarez, V.B. and Zalazar, C.A. (2003). Proteolysis on Reggianito Argentino cheeses manufactured with natural whey cultures and selected strains of *Lactobacillus helveticus*. *Journal Dairy Science*, **86**, 3831-3840.

James, C.S. (1995). Analytical Chemistry of Foods. Chapman&Hall, Oxford.

Kahyaoglu, T. and Kaya, S. (2003). Effects of heat treatment and fat reduction on the rheological and functional properties of Gaziantep cheese. *International Dairy Journal*, **13**, 867-875.

Kucukoner, E. and Tarakci, Z. (1998). V. Geleneksel Sut Urunleri. In: Sut ve Sut Urunleri Sempozyumu, May 21-22 1998, Tekirdag, Turkey.

Kondyli, E. and Katsiary, M.C. (2002). Fatty acid composition of raw caprine milk of a native Greek breed during lactation. *International of Dairy Technology*, **55**, 57-60.

Lombardi, A., Maistro, L.D., de Dea, P., Gatti, M., Giraffa G. and Neviani, E.A. (2002). Polyphasic approach to highlight genotypic and phenotypic diversities of *Lactobacillus helveticus* strains isolated from dairy starter cultures and cheeses. *Journal of Dairy Research*, **69**, 139-149.

Marquard, R. (1987). Qualitatsanalytik im Dienste der Olpflanzenzuchtung. *Fat Science Technology*, **89**, 95-99.

Oksuztepe, G.A., Patir, B., Dikici, A., Bozkurt, O.P. and Calicioglu, M. (2007). Microbiological and chemical quality of cokelek mar-

keted in Elazig. *Firat Universitesi Saglık Bilimleri Dergisi*, **21**(1), 27-31.

Perotti, M.C., Bernal, S.M., Meinardi, C.A. and Candioti, M.C. (2004). Substitution of natural whey starter by mixed strains of *Lactobacillus helveticus* in the production of Reggianito Argentino cheese. *International of Dairy Technology*, **57**, 45-51.

Tamime, A.Y. and Robinson, R.K. (1985). *Yoghurt: Science and Technology*. Pergamon Press, London, UK. pp 431.

Tarakci, Z., Yurt, B. and Kucukoner, E. (2003). Darende dumas cokeleginin yapilisi ve bazi ozellikleri uzerine bir arastirma. *Gida*, **28**(4), 421-427.

Yurdakul, S. (1994). Degisik pH ve sicakliklarinda islenen lor peynirinin bazı nitelikleri uzerinde arastirmalar. M. Sc. Thesis, Ankara University, Ankara, Turkey.

Zeppa, G., Giordano, M., Bertolino, M. and Gerbi, V. (2005). Application of artificial neural network on mono- and sesquiterpenes compounds determined by headspace solid-phase microextraction-gas chromatography-mass spectrometry for the piedmont ricotta cheese traceablity. *Journal of Chromatography*, **1071**, 247-253.