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Some Properties of Yoghurts Produced from Goat Milk and Cow-Goat Milk Mixtures by Different Fortification Methods

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Abstract: In this study; set type yoghurt was produced from goat milk (A) and 70% goat - 30% cow (B), 50% goat - 50% cow milk © mixtures and stored 14 days at ±4°C. Two concentration methods of ultrafiltration (UF) and skim milk powder addition (MP) were applied to milk mixtures, therefore six different yoghurt samples were obtained. Some chemical, physical, microbiological and sensory properties of yoghurt samples were analysed at 1st, 7th and 14th day of storage. Effects of milk type, concentration method and storage period on physico-chemical and microbiological properties of samples were investigated statistically.

Key words: Yoghurt, goat milk, ultrafiltration, skin milk powder

INTRODUCTION

Since the 1960s, the industrial production of fermented milks (especially yoghurt) has increasingly developed worldwide. Several factors account for the success of yoghurt: its natural image, its organoleptic characteristics (fresh and acidulated taste and characteristic flavour), nutritional, prophylactic and therapeutic properties (Birollo *et al.*, 2000).

Yoghurt has richer composition than milk due to its production conditions and more different substances exist in its combination compared to milk because of fermentation. Thus, its nutritional property increases and digestion gets easy. As it contains particularly viable yoghurt bacteria and their metabolites, many undesired microorganisms couldn't grow up in yoghurt and existence of these bacteria has been correlated with several benefits for consumer's health. Hence, yoghurt is accepted to be a safety product (Rasic and Kurmann, 1978).

France and Spain established the requirement of a minimum viable lactic acid bacteria number during yoghurt's shelf life of $5x10^8$ cfu.ml^{-1}. Other countries have established values of 10^6 cfu ml^{-1} (Switzerland and Italy), 10^7 cfu.g^{-1} (Japan) and 10^8 cfu.g^{-1} (Portugal) (Birollo *et al.*, 2000). In Turkey the new legislation included in the Food Codex Fermented Milk Bulletin (Anonym, 2001) has been mandatory since September 2001 and establishes a minimum content of viable lactic acid bacteria of 10^7 cfu.g^{-1} during yoghurt's shelf life.

Yoghurt is produced approximately 1.300.000 tons (both homemade and industrial) in a year in Turkey (Yaygin, 1999). Usually cow milk is used in industrial yoghurt but both ewe and goat milk is also used in homemade yoghurts. Today goat milk and its products play an important role in certain parts of the world due to their beneficial health effects. So that, goat milk is preferred more in the nutrition of babies, children and patients in many countries like Germany and France according to its outstanding physiological, microbiologic and technological properties (Haenlein, 1996).

The total solids of milk used in the production of yoghurt is increased to preserve its structure and texture during storage and to develop its nutritional property. Therefore, like in Turkey, some milk-based substances are added into milk or its moisture is reduced by evaporation in certain amount. The ultrafiltration method, which has been used in cheese production process, is also used to concentrate the yoghurt milk in some countries. Recently this method has become applicable in Turkey.

The objective of this study was to investigate the compositional characteristics, microbiological and sensory properties of yoghurt made from 2 different cow-goat milk mixtures and only from goat milk with using 2 concentration methods.

MATERIALS AND METHODS

Fresh raw cow and goat milks were obtained from the dairy herds of Faculty farm. Ultrafiltration was carried out using pilot plant type Alfa-Laval UFR-1 unit. Skim milk powder used for concentration was from Pinar Sut Co. (Izmir, Turkey). Yoghurt produced by using starter cultures of *Streptococcus salivarius* subsp. *thermophilus* (*Str. thermophilus*) and *Lactobacillus delbrueckii* subsp. *bulgaricus* (*Lb. bulgaricus*) obtained from Wiesby GmbH and Co.KG.

The production of yoghurt: Bulk samples of raw goat and cow milks were divided into 3 different portions (A:100% goat milk, B:70% goat - 30% cow milk, C:50% goat - 50% cow milk). Afterward six different milk portions were

obtained (A_{UF}, B_{UF}, C_{UF}, A_{MP}, B_{MP}, C_{MP}) by ultrafiltration (UF) and addition of skim milk powder (MP). Whole milk was preheated to 55°C, homogenized at 150 kg cm^{-2}, heated to 90°C for 15 min. and after cooling to 45°C, samples were inoculated with 2% starter culture and incubated at 43°C until the pH reached to 4.8. After pre-cooling at room temperature for 30 min., all yoghurt samples were stored for 1, 7, 14 d. at ±4°C.

Analyses: The yoghurt samples were analysed for pH (using a Hanna 210 pH-meter), titratable acidity (°SH), fat, total solids and total protein (Yoney, 1973; Oysun, 2001), whey off value at the end of 60 min. (a modified method according to Harwalkar and Kalap (1983)) and firmness by using a Gerber penetrometer (measured in seconds after 3 mm of penetration at a product temperature of 4°C). *Str. thermophilus, Lb. bulgaricus* and yeasts-moulds counts were enumerated in each yoghurt samples. Each sample (1g) was serially diluted to 10^{-6} using Ringers' solution. Appropriate dilutions were plated using the following media: (I) M17 Agar (Oxoid Ltd, Basingstoke, Hampshire, England) for the enumeration of *Str. thermophilus*; incubated at 37±°C for 48 h. (ii) MRS Agar (Oxoid Ltd, Basingstoke, Hampshire, England) for the enumeration of *Lb. bulgaricus*; incubated for 48 h. at 42±1°C. (iii) PDA plus tartaric acid (Oxoid Ltd, Basingstoke, Hampshire, England) for the enumeration of yeasts and moulds; incubated aerobically at 25±1°C for 5 d. Five panellists who were familiar with fermented dairy products judged sensory properties of the yoghurt samples by using a mixed-point system (rating scale of 1-5) (Anonym, 1989). The sensory vocabulary comprised attributes describing appearance, consistency in mouth and with spoon, odour and flavour. Analysis of variance (ANOVA) was performed using the General Linear Model procedure of S.A.S. (1995). In all cases 0.05 probability level was considered.

RESULTS AND DISCUSSION

Physico-chemical properties: Some properties of yoghurts produced by two different concentration methods and from goat and cow-goat mixtures presented in table 1. As seen from Table 1, total solid contents were found between 15.63-16.97% during storage. According to the statistical analysis, milk kind and concentration method were not effective on total solid contents ($p>0.05$). It is accepted that the increases during 14 days on total solid contents were not significant and attributed to the evaporation ($p>0.05$). Related with this situation Akalin (1993) reported that the increase determined during the storage period is normal. In addition, total solid contents of all yoghurt samples were consistent with the values stated in the Turkish Food Codex Fermented Milk Bulletin (Anonym, 2001). Sezgin (1988) was determined the total solids between 14.34-22.43% in yoghurts produced with cow milk and similar observations were also reported by Kilic (1986), Akalin (1993) and Karademir *et al.* (2002).

In the study, the fat contents were determined higher in yoghurt samples produced with UF. However, the concentration method was found not to be effective according to statistical analysis ($p>0.05$). Despite the total solid contents were low in A_{UF} and B_{UF}, it is supposed that it is due to less probable fat loss during the UF of the milk. Glover (1971) reported that the whole fat was caught in the UF membrane. The milk kind and storage effects were also determined not to be significant on the fat contents of yoghurt samples ($p>0.05$). All yoghurt samples were characterized as full fat (>3.8%) and fatty (>3.0%) according to the Turkish Food Codex Fermented Milk Bulletin (Anonym, 2001). It was also determined that the fat contents were generally consistent with the results of Eskici (1989) and Akalin (1993).

One of the most important parameter to determine the quality of yoghurt is the total protein. The concentration method and the milk kind were found not to be effective on the protein contents of the yoghurt samples ($p>0.05$) and were changed between 4.09-4.58%. The protein contents of C_{UF} and C_{MP} samples were determined lower than the others. Despite a parallel increase with the total solids contents was determined in the samples during the storage, this was found insignificant ($p>0.05$). Protein contents of all yoghurt samples are agree with the minimum 4% protein requirement stated in Turkish Food Codex Fermented Milk Bulletin (Anonym, 2001).

Another important quality criterion that determines the acceptability and shelf life of yoghurt is acidity. The differences between the titratable acidity (°SH) during the storage of yoghurt samples concentrated with UF and addition of skim milk powder were found to be significant ($p>0.05$). Despite using the same starter culture, an important amount of lactose stayed at permeate (>40%) at the end of UF process and this caused less acidity formation in yoghurts concentrated with UF. Glover (1971) also reported that the 57% of the lactose during UF was caught in membrane. The milk kind was effective only on the acidity of samples concentrated with UF ($p<0.05$). The acidity increase in all yoghurts during the storage was found also to be significant ($p<0.05$) and the acidity values were consistent with the values given by the Turkish Food Codex Fermented Milk Bulletin (>26 °SH) (Anonym, 2001).

The pH value was similar in all samples, ranging from 4.15 to 4.50. Additionally, the effects of the concentration method, milk kind and storage period on the pH values were determined not to be significant ($p>0.05$). Sezgin (1988) obtained the pH values 3.9-4.9 in 25 yoghurt samples and Kilic (1986) found an average value of 4.32.

Table 1: Physico-chemical properties of yoghurt samples during storage for 14 days (n=3)

S	Sd	Total solids (%)	Fat (%)	Protein (%)	Acidity (°SH)	pH	Penetration value (sec.)	Whey off value (%)
A_{UF}[1]	1.0	15.84	3.80	4.43	30.96	4.50	13.80	28.18
	7.0	15.91	3.80	4.43	38.33	4.30	14.60	22.49
	14.0	16.19	3.85	4.51	44.33	4.20	16.90	18.00
B_{UF}[2]	1.0	15.63	3.50	4.50	32.66	4.40	13.78	28.72
	7.0	15.78	3.45	4.53	37.67	4.35	13.98	25.46
	14.0	16.07	3.50	4.58	39.66	4.25	15.01	24.92
C_{UF}[3]	1.0	16.33	3.80	4.26	35.66	4.15	15.07	21.63
	7.0	16.36	3.80	4.32	42.66	4.30	16.02	20.60
	14.0	16.44	3.85	4.38	47.40	4.25	16.58	18.79
A_{MP}[4]	1.0	16.13	3.60	4.45	33.97	4.40	13.95	26.50
	7.0	16.26	3.60	4.46	44.82	4.30	15.21	21.86
	14.0	16.28	3.60	4.52	45.00	4.15	17.80	16.72
B_{MP}[5]	1.0	15.73	3.50	4.48	40.66	4.30	15.63	24.40
	7.0	15.93	3.50	4.51	45.50	4.20	16.08	20.60
	14.0	16.97	3.55	4.58	48.33	4.15	17.00	19.22
C_{MP}[6]	1.0	16.34	3.60	4.09	40.00	4.40	16.15	20.13
	7.0	16.40	3.65	4.09	45.66	4.30	16.72	18.56
	14.0	16.43	3.70	4.19	47.46	4.20	18.66	17.61

Table 2: Microbiological characteristics of yoghurt samples during the storage for 14 days (cfu.g^{-1}, n = 3)

S	Sd	*Lb. bulgaricus*	*Str. thermophilus*	Yeasts and moulds
A_{UF}[1]	1	$6.76x10^7$	$7.41x10^7$	$6.76x10^2$
	7	$1.07x10^6$	$1.25x10^6$	$1.20x10^2$
	14	$1.38x10^6$	$1.17x10^6$	$1.28x10^2$
B_{UF}[2]	1	$7.58x10^7$	$8.70x10^7$	$1.34x10^2$
	7	$1.17x10^6$	$1.23x10^6$	$1.77x10^2$
	14	$1.25x10^6$	$1.12x10^6$	$1.25x10^2$
C_{UF}[3]	1	$7.07x10^7$	$8.31x10^7$	$3.46x10^2$
	7	$1.17x10^6$	$1.25x10^6$	$2.08x10^2$
	14	$1.38x10^6$	$1.20x10^6$	$1.65x10^2$
A_{MP}[4]	1	$4.89x10^6$	$6.02x10^7$	$3.80x10^2$
	7	$6.00x10^6$	$1.07x10^6$	$1.44x10^2$
	14	$1.38x10^6$	$1.20x10^6$	$6.30x10^2$
B_{MP}[5]	1	$6.30x10^7$	$8.70x10^7$	$1.69x10^2$
	7	$1.20x10^6$	$1.25x10^6$	$1.25x10^2$
	14	$1.65x10^6$	$6.00x10^6$	$7.94x10^2$
C_{MP}[6]	1	$6.60x10^7$	$9.12x10^7$	$6.02x10^2$
	7	$1.12x10^6$	$1.25x10^6$	$3.63x10^2$
	14	$1.31x10^6$	$1.14x10^6$	$1.28x10^2$

S: Samples
Sd: Storage Days
[1] Yoghurt made from 100% goat milk by ultrafiltration,
[2] Yoghurt made from 70% goat - 30% cow milk by ultrafiltration,
[3] Yoghurt made from 50% goat - 50% cow milk by ultrafiltration,
[4] Yoghurt made from 100% goat milk by skim milk powder addition,
[5] Yoghurt made from 70% goat - 30% cow milk by skim milk powder addition,
[6] Yoghurt made from 50% goat - 50% cow milk by skim milk powder addition

Moreover Akalin (1993) and Karademir *et al.* (2002) were reported similar and lower pH values, respectively.

The penetration values of the yoghurts were not affected from the milk kind, concentration method and storage period ($p>0.05$). Nevertheless, the penetration values of the yoghurts concentrated with UF method were determined to be lower. Eskici (1989) and Uysal (1993) reported that yoghurts produced by UF were in weak structure than classical yoghurts whereas Abrahamsen and Holmen (1980), Abrahamsen and Holmen (1981) were observed results in contrast to our data.

Yaygin (1999) reported that yoghurts had higher whey off values due to the lack of lactose and mineral in milk concentrated with UF. Whey off values in UF samples was determined more than other group so the concentration method was found effective on the whey off values ($p<0.05$) and lowest value was found in A_{MP} and C_{MP} samples at the end of storage. As shown in table 1 these samples had also higher total solid contents. However, Abdel Salam and El Alamy (1982) reported that yoghurt samples with high total solids had lower whey off values. For all samples whey off values were decreased during storage and this was found to be statistically significant ($p<0.05$).

Microbiological properties: The viable number of *Lb. bulgaricus* and *Str. thermophilus* as it is presented in table 2, declined on the 7th day compared to 1st day and at the end of storage a slight increase was determined, however the milk kind, concentration method and storage period were not effective on these changes ($p>0.05$). The necessary processes were carried out in the lab during the preparation of the starter culture, to equalize the number of both bacteria and keep them active. Because of the fact that the production was applied under control, the ratio between the bacteria was kept approximately at 1:1 level. But to meet the requirement given in Turkish Food Codex Fermented Milk Bulletin (>10^7 cfu.g^{-1}) (Anonym, 2001) there should be higher number of bacteria in the culture.

The yeast-mould counts were ranged from $1.20x10^2$ to $7.94x10^2$ cfu.g^{-1}. It was stated in Turkish Food Codex Fermented Milk Bulletin Anonym (2001) that the yeast-mould counts couldn't be higher than 10^1 cfu.g^{-1} in the point of hygiene and the lastingness of the product. Therefore, it appeared to be necessary to pay more attention to hygiene and sanitation of the pilot plant during the production.

Sensory evaluations: The yoghurts produced with addition of skim milk powder were liked more according to

sensory evaluation. The panelists stated that the UF yoghurts had lack of flavour and weak structure. However, the UF yoghurts were liked in the point of appearance. The most liked yoghurt was C_{MP} (total point 24.00) among all samples and similar flavour and appearance were determined in sample B_{MP} (4.20 and 4.75 points, respectively).

It was found that yoghurts made of goat and cow-goat milk mixtures, not differed in their chemical properties and microbiological characteristics. But beside these, sensory properties of a fermented dairy product have an important role for its consumption. If all these factors considered together, sample C_{MP} attracts attention within other yoghurt samples. This case indicates that goat milk could be suitable for production of set type yoghurt and in addition a mixture of 50% cow - 50% goat milk could also be suitable due to the economical advantages comparison with other mixtures. Moreover, if acidity, flavour and taste are taken into consideration and because of its cost, the UF method is not a convenient method for the yoghurt technology that addresses to Turkish taste.

REFERENCES

Abdel-Salam, M.H. and H.A. El-Alamy, 1982. Production and properties of yoghurt and concentrated yoghurt (Labneh) from ultrafiltrated recombined milk. Ain Shams University, Faculty of Agriculture, publications, Cairo, Egypt.

Abrahamsen, R.K. and T.B. Holmen, 1980. Yoghurt from hyperfiltrated, ultrafiltrated and evaporated milk and from milk with added milk powder in Milchwissenschaft, 35: 399-402.

Abrahamsen, R.K. and T.B. Holmen, 1981. Goat's milk yoghurt made from non-homogenized and homogenized milks concentrated by different Methods in Journal of Dairy Res., 48: 457-463.

Akalin, S., 1993. Investigations on the production of fermented milk products like yoghurt and determination of some properties. Ph.D. thesis. Faculty of Agriculture, Ege University, Izmir, Turkey.

Anonym, 1989. Standard of yoghurt. TS. 1330. Turkish standards institute, Ankara, Turkey.

Anonym, 2001. Turkish Food Codex Fermented Milk Bulletin.24512, Ankara, T.C. Official Gazette.

Birollo, G.A., J.A. Reinheimer and C.G. Vinderola, 2000. Viability of lactic acid microflora in different types of yoghurt in Food Research International, 33: 799-805.

Eskici, K.S., 1989. A study on the determination of some properties of yoghurts produced from milks concentrated with different methods. M.Sc. thesis. Institute of Science, Ege University, Izmir, Turkey.

Glover, F.A., 1971. Concentration of Milk by Ultrafiltration and Reverse Osmosis in Journal of Dairy Res., 38: 373-379.

Haenlein, G.F.W., 1996. Nutritional value of dairy products of ewe and goat milk. Proceedings of the IDF/CIRVAL Seminar Production and Utilization of Ewe and Goat Milk, Grete, Greece, October 19-21, 1995, International Dairy Federation, Brussels, Belgium, pp: 159-178.

Harwalkar, V.R. and M. Kalap, 1983. Susceptibility of yoghurt to syneresis comparison of centrifugation and drainage methods in Milchwissenchaft, 38: 517-522.

Karademir, E., M. Atamer, B. Tamucay and S. Yaman, 2002. Some properties of goat milk yoghurts produced by different fortification methods in Milchwissenschaft, 57: 261-263

Kilic, S., 1986. Les sescherches sur caracteristiques des yoghourts produits avec des cultures liquides, congelees et lyophilise contenant les bacteries L. bulgaricus et S. thermophilus d'origines, de properietes et de proportions differentes. Ph.D. thesis. Faculty of Agriculture, Ege University , Izmir.

Oysun, G., 2001. Analysis Methods of Milk Products, Faculty of Agriculture, Ege University, Izmir, Turkey, pp: 504.

Rasic, J. and J.A. Kurmann, 1978. Yoghurt: Scientific Grounds, Technology, Manufacture and Preparations, Vol. 1. Technical Dairy Publishing House, Copenhagen, Denmark.

Sezgin, E., M.A. Atamer and A. Gursel, 1988. A study on the quality of yoghurt produced by using domestic and foreign in Gida, 13: 5-11.

Uysal, H.R., 1993. Investigations on comparison with classical method and making strained yoghurt from milk concentrated by vacuum and ultrafiltration techniques. PhD thesis. Faculty of Agriculture, Ege University, Izmir, Turkey.

Yaygin, H., 1999. Yoghurt Technology. Akdeniz University, Antalya, pp: 75.

Yoney, Z., 1973. Analysis Methods of Milk and Milk Products, Ankara University, pp: 165.