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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

The Effect of Seasonal Variation on the Composition of Cow Milk in Van Province

Elvan Ozrenk¹ and Sebnem Selcuk Inci²

¹Department of Food Engineering, Faculty of Agriculture, University of Yuzuncu Yil, 65080, Van, Turkey

²Ministry of Agriculture and Rural Affairs, Laboratories of Food Control, Van, Turkey

Abstract: The research was performed to investigate the effects of seasonal variation on changing of cow milk components in Van province. A total of 160 cow milk samples were collected and examined from January to August of 2001. These were obtained from 12 different local points of the Van province in Turkey. The research was carried out in two periods. The first period was the winter period covering January-February-March months and the second one was the summer period covering June-July-August months. Samples were collected according to season, so that milk samples could be taken from the cows which had been fed with hay in born in winter period (January-February-March) and from those which had been fed with green grass on the Pasteur in the area in summer period. According to the results paired t test, the fat content and titratable acidity of winter and summer periods have been found significantly at $p < 0.05$ level. Seasonal variation effect was found significantly on the protein content rate and total solids, fat, titratable acidity respectively levels of $p < 0.05$ and $p < 0.01$.

Key words: Seasonal variation, milk composition, cow milk

Introduction

The variation in milks and milk yield within a species depends on so many factors. Some of these factors are genetics, stage of lactation, daily variation, parity, type of diet, age, udder health and season (Kilic and Kilic, 1994; Haenlein, 2003). The process ability and quality of milk products such as cheese, butter are influenced significantly by these factors (Lindmark and Mansson, 2000; 2003; Barron *et al.*, 2001).

District, climatic conditions and lactation periods are known as seasonal changes which have influences on the milk composition. Especially, there is a negative correlation between environmental temperature and the amount of milk fat and protein. When temperature is increased the solid fat tends to decrease. Ng-Kwai-Hang *et al.* (1984) and Lacroix *et al.* (1996) have reported that percentage of fat, protein, casein and all the fraction of nitrogen have been influenced by the seasonal variations. Sevi *et al.* (2001) found high ambient temperatures to adversely affect the yield and the cheese-making properties of milk by increasing the clotting time and the rate of clot formation and decreasing clot firmness. The light-to-dark ratio can also induce marked changes in milk yield and composition (Casati *et al.*, 1998). In fact, a high light-to-dark ratio leads to a reduction in fat and protein contents of milk, probably as a consequence of a greater secretion of prolactin whose concentration in plasma is higher in the summer than in the winter (Tucker, 1989). Lactation period moved forward progressing and when the environmental heat degree increased, the fat content decreased (Kilic and Kilic, 1994; Sekerden, 1999; Yetismeyen, 2000).

Some studies show that the amount of short chain fatty acids in milk varies significantly with season. It has been found highest in the summer and lowest value in the winter. Some investigators showed that the amount of α -tocopherol raised along with the winter months to summer months (Lindmark and Mansson, 2003; Lock and Garnsworthy, 2003). Also, it has also been found that seasonal climatic changes may affect the abundance of volatile compounds. In winter and spring the terpenes' are not the most important class in the note of milk. These compounds reached important quantity only in the summer (Fedele *et al.*, 2005).

A lot of researchers realized about different breeds and region of cow milk composition in Turkey (Arslan and Ermis, 2000; Ozdemir *et al.*, 2000; Dogan *et al.*, 2002). In this research the important region of Van province according to milk yield, milk products, plants cover and geographic location have been selected. The aim of this study is to determine the composition of cow's milk and to find out the effect of seasonal variation on this composition.

Materials and Methods

The cow's milk samples were supplied from different 12 local point of the Van province. These local points are Van city central, Edremit, Gurpinar, Muradiye, Catak, Bahcesaray, Baskale, Ozalp, Caldiran, Ercis, Gevas and Saray regions.

The research was carried out in two periods. The first period was the winter period covering January-February-March months and the second one was the summer period covering June-July-August months. In the first step 80 milk samples had been taken regularly from 12

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Table 1: Some general chemical and physical characteristics of cows' milk obtained from Van province

		Total solid (%)	Fat (%)	Non fat solid (%)	Protein (%)	Titrateable acidity (%)	pH	Specific gravity	Minerals (%)
Period I	Minimum	9.9317	2.4	6.7984	2.432	0.20	5.77	1.028	0.711
	Maximum	12.6236	3.7	9.1136	3.717	0.36	6.73	1.035	0.892
	Average±Sx	11.5064±1.023 ^a	3.1±0.683 ^{a°}	8.4064±0.989	2.868±0.814 ^b	0.26±0.053 ^{a°}	6.50±0.205	1.031±0.004	0.802±0.106
Period II	Minimum	7.5161	1.3	5.3161	2.239	0.15	5.75	1.030	0.751
	Maximum	12.6298	3.5	9.5056	3.708	0.37	6.74	1.039	1.026
	Average±Sx	10.8683±1.841 ^a	2.3±0.938 ^{a°}	8.5683±1.701	2.794±0.944 ^b	0.21±0.080 ^{a°}	6.50±0.472	1.032±0.003	0.841±0.160
General	Average±Sx	11.1874±1.432	2.7±0.811	8.4874±1.345	2.831±0.879	0.24±0.066	6.50±0.339	1.032±0.004	0.822±0.133

^a:Important at the level of p<0.01, ^b:Important at the level of p<0.05, [°]:According to t-test important at the level of p<0.05

locals points in winter. In the second step the other 80 milk samples had been collected from the same 12 local points and totally 160 samples of cows milk were analyzed.

Samples were collected according to season, so that milk samples could be taken from the cows which had been fed with hay in born in winter period (January-February-March) and from those which had been fed with green grass on the Pasteur in the area in summer period. For each period 80 sample was collected and totally 160 samples of cows milk were analyzed.

Cow's milk samples were collected directly from homogenized bulk milk at determined local points and put in to the 200 ml sterile plastic container stored at 4°C and immediately transported frigidly to the laboratory and analyzed.

Total solids, fat, non fat solids, protein, minerals, titrateable acidity and specific gravity of milk samples were determined as described by Kurt *et al.* (2003).

pH value of samples were determined according to the method proposed by Kosikowski (1982) and Case *et al.* (1985) using Hana Inst. 8521 pH-meter.

Statistical analysis were performed using SAS package program (Anonymous, 1997).

Results and Discussion

Table 1 gives means of data from physico-chemical analysis of cows' milk composition and statistical analyses.

It can be seen from Table 1 that milk fat, protein and total solids percentages were the highest during the winter and the lowest during the summer.

According to the results paired t test, the fat content of winter and summer periods has been found significantly at p<0.05 level.

Milk fat was the most variable component among the milk contents. The amount of fat in milk composition was affected by a lot of factors. The seasonal variation and lactation period were the important factors among them. In the lactating cow, seasonal variations have been observed for milk protein content and to a lesser extent, for the milk fat content. This might ascribe a high light-to-dark ratio leading to a reduction in fat and protein contents of milk, probably as a consequence of a greater secretion of prolactin whose concentration in plasma is higher in the summer than in winter (Sevi *et al.*, 2004).

The more pronounced seasonal variation was due to outdoor grazing in summer and bar feeding in winter. There were many important differences between the feeds composition which were given to animals during these two periods (Yetismeyen, 2000). Probably due to the fact that the feed diet was based on hay during the winter months the herbage was not available. Increased feeding frequency of low fiber, high grain diets increase milk fat levels (Waldner *et al.*, 2005). The similar variable amount of milk fat has been observed in the sheep milk. The percentage of milk fat has increased from February to June and then it has decreased gradually. This variation has been affected by the feeding and lactation (Mendia *et al.*, 2000). Isiklar and Kurdal (1999) have declared that the fat content of milk has been marketed in Bursa city is 3.30 %. According to Kovacs *et al.* (1999) the fat content of Hungarian Grey cattle has been found as 4.94%. Lindmark *et al.* (2003) have reported that the fat content of Swidish dairy milk is 4.34%. Similar results were obtained for Elazig/Turkey dairy milk by Arslan and Ermis (2000). The obtained results were appropriate for TS 1018 Turkish raw milk standard (Anonymous, 1981). The mean protein content of the cows' milk was 2.868 % for winter period and 2.794% for summer period. It was determined that the protein content of milk showed changes along the year. The differences between the two periods has been found significant statistically (p<0.05). Generally milk protein percentage is positively correlated with the milk fat percentage. If one is high, the other is usually high. It reduces in milk fat and protein concentration as a result of hot weather. Generally, milk protein does not fluctuate as much as milk fat.

The mean total solid does content of the cows' milk was 11.1874 ± 1.432%. There were differences statistically between winter and summer periods (p<0.01). Because of hot weather, high humidity decrease and dry matter intake, it decreased in the summer. Different researchers have reported that the solid content of Brown-Swiss in Kirsehir was 11.936% averagely (Dogan *et al.*, 2002), in Swiss was 13% (Lindmark-Mansson *et al.*, 2003) and cows milk in Ankara 11.18 % (Sezgin and Kocak, 1982). It is possible to say that there is a similarity between these mean values and the results obtained from this study.

The first acidity in milk is due to the amount of casein phosphate, citrate and carbondioxide. But then at the

end of the bacterial activity the lactic acid was formed and the acidity of milk increased. The extra acidity value in milk is not desirable (Kurt *et al.*, 2003). It has been explained in The Turkish Food Regulation that the acidity of cows' milk is not more than 8 SH (0.18 %). It can be seen from Table 1, that is higher than the normal value. However Turkish dairy milk acidity values have changed between 4.20 SH (0.09%) and 12 SH (0.27%) (Sezgin and Kocak, 1982; Isiklar and Kurdal, 1991; Kurt *et al.*, 2003). Similar results were obtained in this research and seasonal variation has been found significant statistically ($p < 0.05$).

Conclusions: The composition of Van dairy milk and its contents determined in this research were in agreement with other studies' results. It was determined that the fat content of Van cows' milk have been affected importantly by the seasonal changes. However the other contents of milk was not affected significantly by this factor.

According to the results obtained in this study, it is possible to say that when the milk fat content was higher, protein and total solid contents were also higher and that milk fat, protein and total solid percentages were the highest during the winter and the lowest during the summer. This result correspond to the data given in the literature. Seasonal patterns in the production of milk, fat and protein have been described in different countries and under different management practices. In the northern hemisphere, the lowest protein and fat percentages occur in the summer months (June-August), and the highest percentage occur between October and December (Sargeant *et al.*, 1998). For this reason during the summer season, strategies for reducing the impact of high heat loads on lactating cows, such as shading, increased ventilation, changing the time of feeding to the late afternoon, and an appropriate administration of mineral elements with the feed rations are necessary to prevent deterioration of cheese yield and quality.

Nutrition can be regarded as one of the most important sources of variation in the yield and composition of milk, but climatic conditions and seasonal variation and regional differences can also play an important role. Also the quality and the composition of the milk are of the most importance to the dairy industry and human health because milk composition is related to milk process ability. When the milk has higher protein content it should be processed to cheese. If it has higher level fat, then it should be used to produce butter.

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