

# Seasonal Changes in Bulk Tank Milk Composition of Dairy Cows

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## Abstract

A study was conducted to determine the effect of season on milk fat, protein, solids nonfat, freezing point and bulk tank somatic cell count of dairy farm in Dolj district. Collection of data was from April to September 2010. Statistical techniques were used to determine when a real change occurred. Results showed that there were clear variations in milk composition and somatic cell count in the trial period.

**Key words:** milk composition, somatic cell count

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## 1. Introduction

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), Ozrenk et al. (2008) [1,2] have reported that percentage of fat and protein have been influenced by the seasonal variations. The light-to-dark ratio can also induce marked changes in milk yield and composition [2]. 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 [2]. Lactation period moved forward progressing and when the environmental heat degree increased, the fat content decreased.

Season affects milk component percentages and SCC (somatic cell count). Quist et al. (2008) [3] reported an inverse relationship between milk yield and component percentages, with summer

milk production being higher but percentages of fat and protein being reduced compared with production in the fall and winter months. Ng-Kwai-Hang et al. (1984) [2] concluded that milk and component yield variations were dependent on environmental conditions.

A better knowledge of the variation factors of cow's milk somatic cell count appears to be crucial because cell count is a predominant criterion for milk quality and for the price paid to farmers. Milk somatic cell count is below 100 000 cells per millilitre in healthy udders. It increases sharply in case of udder infection, due to the onset of local inflammation. In cows free of clinical mastitis, somatic cell count also increases with ageing and in late lactation, but in a more restricted manner. Also, some husbandry conditions (stress, repeated walk) may induce a significant increase in somatic cell count, as can do the nature of feeding.

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Whereas somatic cell count is generally stable during winter, it increases in many herds from turning out to pasture till the end of summer. According to a study conducted in France on 960 farms, this increase, of about 100 000 cells per ml, is likely to be the more important when the initial level is higher [4]. However, the factors responsible for that summer increase are not easily identifiable: more frequent udder infections, lactation stage, changes in milking practices, climatic stress and pasture-related factors, all can be involved. The herd-level SCC is a result of multifactorial cow factors, management practices, and seasonal fluctuations. Seasonal fluctuations such as the summer peak can also have a major effect but do not occur in all herds [4]. Ideally one would want to continuously monitor and interpret SCC on the herd level and to detect an increase or decrease in the trend over time [4]. Bonus programs are installed such as in many countries and states of the United States, which apply a cut-off value varying from 150 000 to 250 000 cells/mL [4]. It is important to know in farms that may exceed a cutoff value what is needed to bring it below the bonus program requirements. The average SCC on a national basis in the United States averages approximately 300 000 to 350 000/ml in the winter and spring, but increases approximately 50 000/ml during summer months, with the highest level occurring during August [5]. The increase during the summer does not hold true for all herds because some owners and managers do a better job of counteracting changing environmental circumstances. Nevertheless, the trend is very strong for most herds and is more pronounced in subtropical environments where heat and humidity impose additional stress on cows, often resulting in somatic cell increases of more than 100 000/ml compared with levels during other seasons. The increase can be explained by several factors: (1) the concentration effect due to reduced milk yield discussed above; (2) the fact that stress results in a reduction in the ability of white blood cells to combat invading microorganisms, resulting in an increased infection rate; (3) a build-up of mastitis organisms due to higher temperatures and moisture in the environment; (4) reduced efficiency of the immune systems of the cows when under increased stress caused by elevated temperatures and high humidity; and (5) seasonal differences in calving, resulting in a higher percentage of cows

being in late lactation during late summer. Cows harboring subclinical infections tend to exhibit a greater increase in SCC during periods of stress than uninfected cows.

## **2. Materials and methods**

The present study was conducted during April 2010 to October 2010 at Agricultural Research & Development Station Simnic Craiova. The work was completed at Agricultural Research & Development Station Şimnic (A.R.D.S.S.) Romania. Somatic cell count was estimated using SOMASCOPE milk test MK II (Delta instruments). Fat, solids non-fat, protein, freezing point were determined using Ultrasonic Milk Analyzers ECOMILK (EON trading). Assays were made on 132 composite milk samples collected in sterile bottles directly from the bulk milk tank. The milk samples were collected twice per day after each milking.

Data were analysed statistically.

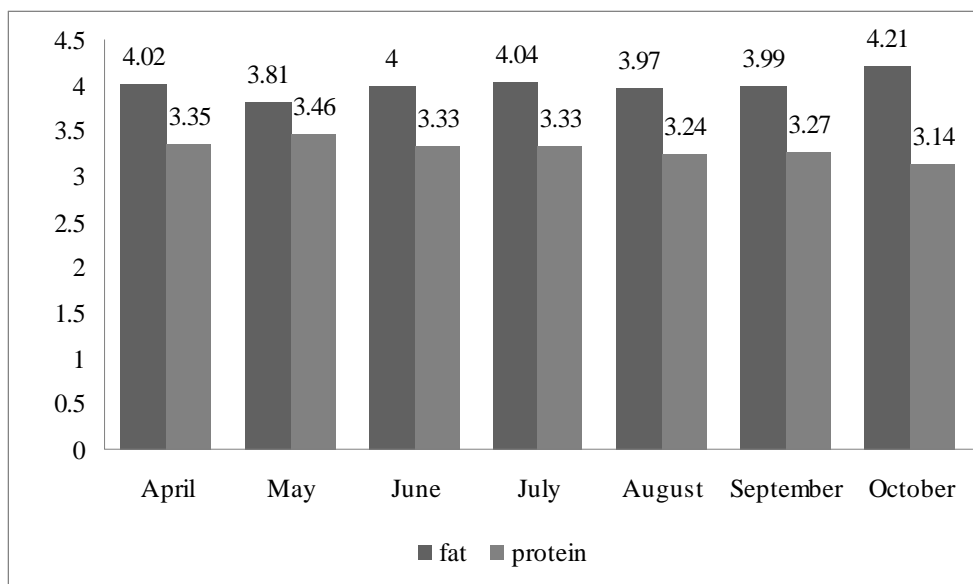
## **3. Results and discussion**

The mean fat content of the cows' milk was 3.91% for spring period, 4.00% for summer period and 4.10% for autumn. The mean protein content was 3.40% for spring period, 3.30% for summer period and 3.20% for autumn. The mean solids non fat content was 9.02% for spring period, 8.70% for summer period and 8.48% for autumn. The mean freezing point was  $-0.589^{\circ}\text{C}$  for spring period  $-0.571^{\circ}\text{C}$  for summer period and  $-0.556^{\circ}\text{C}$  for autumn. The extreme levels of milk fat content were recorded in May (3.81%) and in October 4.21%. The extreme values of protein content, 3.46% and 3.14% were in May and in October respectively. Solids non fat had the highest values in May (9.14%) and the lowest October (8.31%). Freezing point had the highest values in April ( $0.579^{\circ}\text{C}$ ) and the lowest October ( $-0.546^{\circ}$ ). Table 1 shows seasonal variation in all components and parameters. In general, fat, protein, solids nonfat percentages and freezing point had a minimum value in the spring and a maximum value in the autumn. Although the level of the main components can differ, similar seasonal patterns have been found in other studies [6].

Seasonal changes in the main components are most likely of dietary origin. Of the main milk

components (fat, protein, solids non fat and freezing point), protein and freezing point had the smallest variation, while solids non fat and somatic cells the highest variation, with fat in between. This is in line with the general observation that fat is the most sensitive component of milk to dietary changes and lactose is the least sensitive, again with protein in between [6]. A lower milk fat content with fresh pasture (summer) compared with silage (winter) is commonly observed [6]. The variation in fat and protein percentages is shown in Figure 1. 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 [2]. 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 (summer) compared with silage (winter) is composition is related to milk process ability.



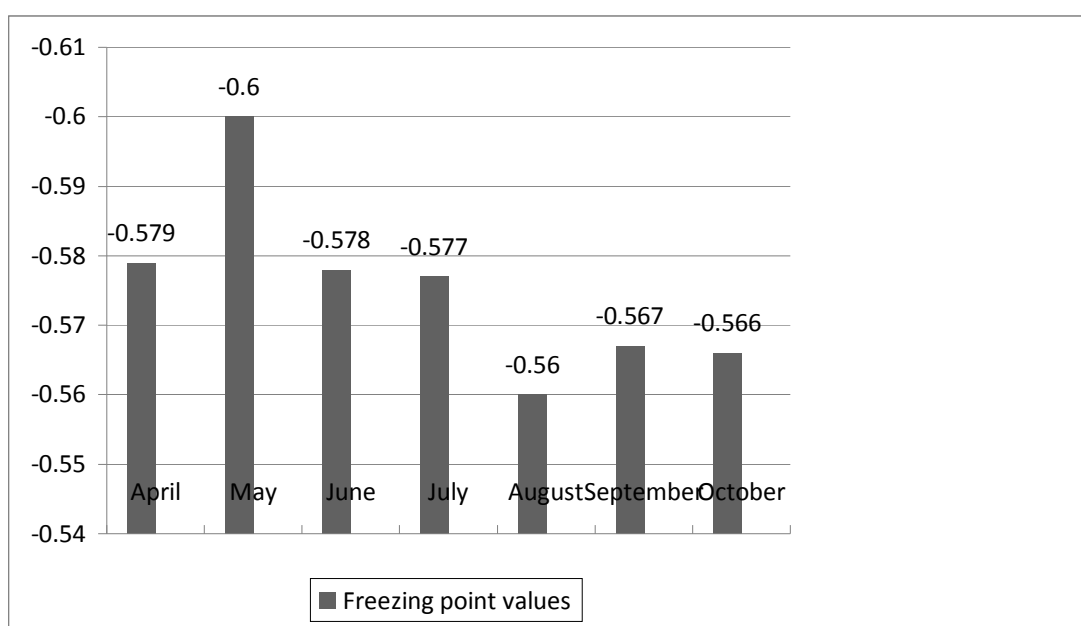
**Figure 1.** Mean fat and protein percentages for a period of 7 months ( April-October)

**Table 1.** Mean values of examined parameters

	Fat	±SD	Protein	±SD	Freezing Point	±SD	Solids no fat	±SD
April	4.02	0.68	3.35	0.03	-0.579	0.07	8.91	0.17
May	3.81	0.21	3.46	0.14	-0.600	0.01	9.14	0.32
Mean	3.91	0.44	3.40	0.08	-0.589	0.04	9.02	0.24
June	4.00	0.25	3.33	0.07	-0.578	0.01	8.82	0.21
July	4.04	0.28	3.33	0.12	-0.577	0.01	8.74	0.48
August	3.97	0.18	3.24	0.18	-0.560	0.02	8.56	0.42
Mean	4.00	0.35	3.30	0.12	-0.571	0.01	8.70	0.37
September	3.99	0.25	3.27	0.17	-0.567	0.02	8.66	0.44
October	4.21	0.57	3.14	0.27	-0.546	0.51	8.31	0.66
Mean	4.10	0.41	3.20	0.22	-0.546	0.26	8.48	0.55
Mean IV-X	4.00	0.34	3.30	0.14	-0.572	0.06	8.73	0.38

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 [2].



**Figure 2.** Mean freezing point for a period of 7 months ( April-October)

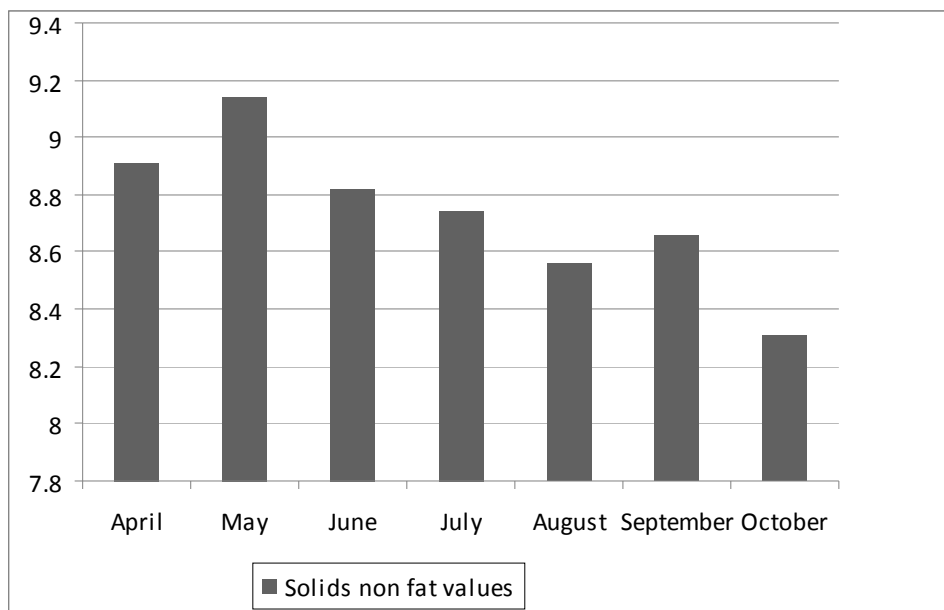


Figure 3. Mean solids non fat for a period of 7 months ( April-October)

The mean freezing point was  $-0.572^{\circ}\text{C}$ , but it is assumed that these seasonal changes were due primarily to changes in feed. However, differences in environmental temperature were a contributing factor to the seasonal variation that we observed. Thermal stress during summer months was associated with increase in somatic

cell count. Cell count had a minimum value in April (421 000 cell/ml) as is shown in Figure and a maximum value in July (683 000 cell/ml). SCC demonstrated a seasonal trend, with higher SCC in the summer months than in the spring months data also observed by others authors.

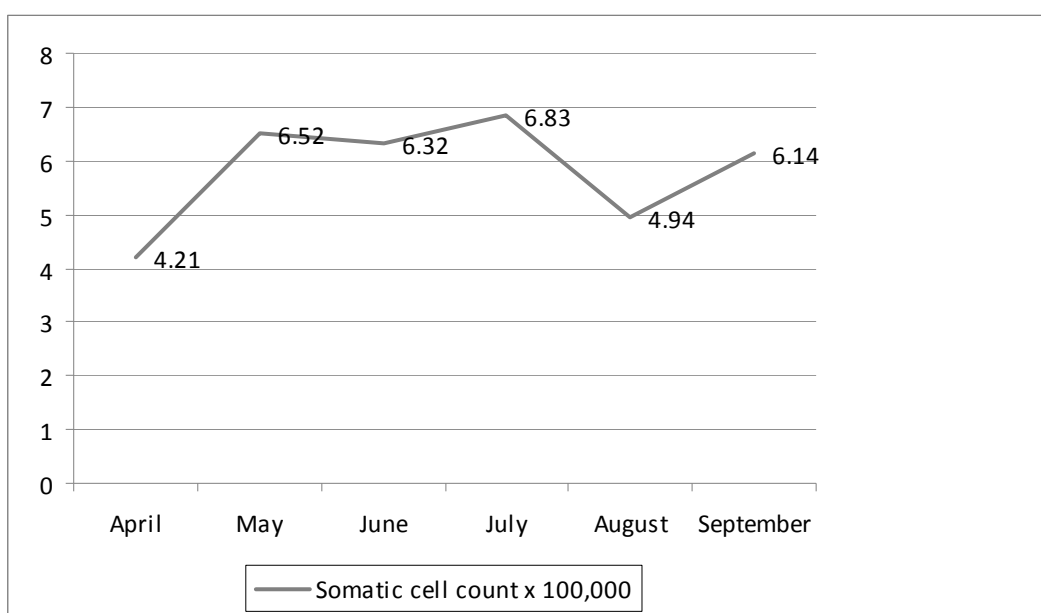


Figure 4. The number of somatic cells ( $\times 100\ 000$ ) in raw milk during April-September 2010 at S.C.D.A. Simnic

#### **4. Conclusions**

It was determined that the fat content has 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, total solid contents, freezing point were also higher and that milk fat, protein and total solid percentages were the lowest during the spring and the highest during the autumn.

The chemical composition of milk can be highly variable in concentrations and yearly patterns, and protein and fat content can vary independently, regardless of factors that are difficult to control in the short term (average estimated breeding value, calving period). Therefore, substantial opportunity exists to manipulate independently the mean concentrations and patterns of protein and fat content, in particular through nutritional factors.

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