

## STUDY ON THE RAW COW MILK HYGIENIC PARAMETERS FROM DIFFERENT MILK COLLECTION CENTERS AND DIFFERENT YEARS USING A MULTIVARIATE ANALYSIS METHOD

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**Abstract:** *The present study was performed in order to monitor the hygienic quality of raw cow milk from different milk collection centers of the Suceava County. The raw cow milk samples were collected from three milk collection centers, A, B and C, during four seasons, in two years consecutively, 2009 and 2010. The hygienic quality of cow milk from the point of view of somatic cell counts (SCC) and number of total germs (NTG) of each sample were analyzed. According to the results obtained by factorial analysis of variance (ANOVA) comparing the hygienic quality of the raw cow milk analyzed in 2009 and 2010 years, we concluded that the highest quality was obtained in 2010, in all milk collection centers. Each year had significant effect on SCC ( $p < 0.01$ ), as well as on NTG ( $p < 0.01$ ) in bulk milk. Regarding the seasonal influence on hygienic quality of raw cow milk, the higher mean values of NTG and SCC were found in the summer season, while the lowest mean values of them were found in the spring and winter seasons respectively. All these mean values obtained are in accordance with the Regulation 853/2004/CE. In addition, the milk collection centers did not have significant effect on the hygienic quality of raw cow milk, from the point of view of the SCC and NTG mean values.*

**Keywords:** *raw cow milk, hygienic quality, milk collection centers, multivariate analysis*

### 1. Introduction

The assessment of the hygienic parameters in raw cow milk, in terms of somatic cells counts (SCC) and number of total germs (NTG) is an essential stage in the quality control process. In Romania, the interest for the process of monitoring the quality of raw cow milk has increased among milk producers and processors in order to comply with the European Community legislations established after 2004 (Reg. CE 853/2004) which prohibits the collecting of cow milk that exceeds the value for somatic cell count of 400.000 no/mL and the value for number of total germs of 100.000 no/mL [1].

Knowledge of the hygienic quality of raw cow milk has great importance for

human and animal health, and therefore for milk products. Cow milk is a product that contains even from the milking stage a number of germs and it is a very good medium for the development of many spoilage and pathogenic microorganisms [2]. After its ejection from the udder, the milk may be contaminated from different sources such as microflora presented in the teat skin, milking equipment and milker's hand, water, milking environment, milking storage (at which it minimal temperature is 6°C according to CE 853/2004), e.g.

The hygienic quality of raw cow milk can be influenced by various factors. Such factors are the animal breed and genotype [3], animal health [4] (mammary gland health in particular [5, 6]), stage of lactation, season [7, 8, 9] microbiological

contamination [10], milking region [10, 11], milking conditions [8, 12, 13, 14] hygienic conditions of handling, transport, equipment for milk storage. Bacterial contamination of raw cow milk can provide from various sources such as air, soil, milking equipment, feed and grass [15, 16].

Somatic cell counts (SCC) and the number of total germs (NTG) in raw milk are an important criteria in evaluating the hygienic quality of milk. The somatic cells are a common component of milk, but if their number increases over the limit values, they affect the quality of the processed milk [17]. The SCC is an indicator of the cow's milk health state, an increase of this value indicates a poor health condition of the cow's udders or a degree of glandular alteration at the bovine mammary gland [18]. A high number of NTG in raw cow milk indicates a high microbial charge and therefore unsafe milk for consumers and milk processors.

The hygienic quality of cow's milk is an important parameter for milk processors and it must comply with the European Community legislations. Therefore the main objective of this manuscript was to analyze by a statistical approach the variation of somatic cell counts (SCC) and number of total germs (NTG) from three milk collection centers from Suceava county during four seasons, in two consecutive years and to explain and analyze the possible causes of this variations.

## **2. Materials and Methods**

### **2.1. Materials**

The samples of raw cow milk were supplied from three milk collection centers, symbolized in this manuscript *A*, *B* and *C* from Suceava County. The study was carried out in four periods corresponding to the four seasons of the year. The first period corresponding to the

winter season covered the months December-January-February, the second one corresponding to the spring season covered the months March-April-May, the third corresponding to the summer season covered the months June-July-August and the fourth period corresponding to the autumn season covered the months September-October-November. Collecting samples from *A*, *B* and *C* milk collection centers was conducted daily, during a period of two consecutive years, 2009 and 2010, respectively.

### **2.2. Methods**

Milk quality tests were accomplished according to Romanian standard method for somatic cell counts (SR EN ISO 13366-3:2001) by infrared spectrophotometry using a Bentley Somacount 150 (Bentley Instruments Inc., Chaska, MN). The number of total germs was determined by flow cytometry count analyzer unit BactoCount IBC 50 (Bentley Instruments Inc., Chaska, MN, USA).

### **2.3. Statistical analysis**

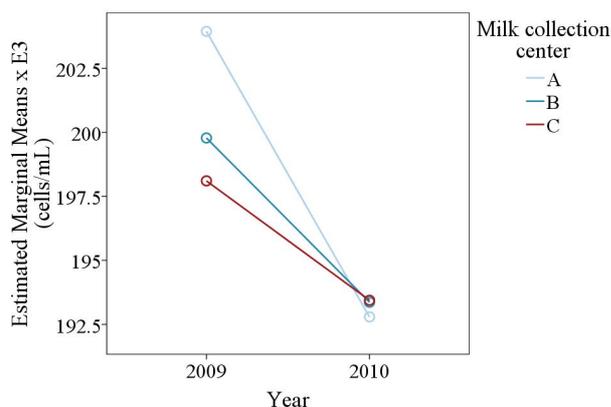
The collected data was analyzed using factorial analysis of variance (ANOVA) with the Statistical Package for Social Science (v. 16, SPSS Inc., Chicago, IL, USA). The General Linear Model (GLM) procedure was applied and the least significant difference (LSD) method for comparison of mean values of the characteristics was studied. A  $2 \times 4 \times 3$  factorial experiment for the type of years, seasons and milk collection centers, was conducted to evaluate the effect of each treatment. A 5% significance level was used throughout the study.

## **3. Results and discussion**

The results obtained emphasize the mean variation of somatic cells count

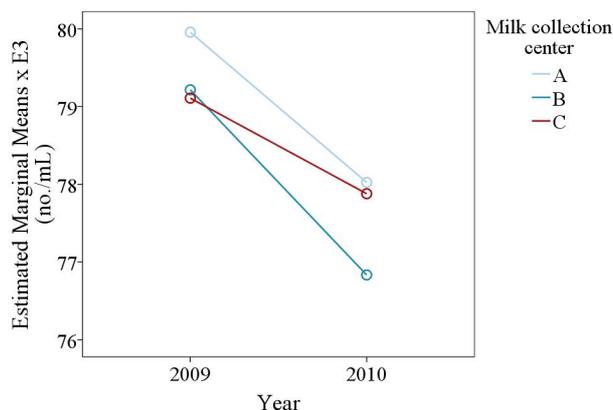
(SCC) and number of total germ (NTG) values with the seasons, milk collection centers and the collecting years on the one hand and the interaction effect between the factors (season, milk collection center, year) on the other hand. Factorial ANOVA revealed significant main effects for season and year on SCC and statistically significant interaction effects, at different levels, between factors.

It can be noted that the mean values of somatic cells count in the raw cow milk is lower from all milk collection centers in the year 2010 compared to 2009 (Figure 1), the mean difference being significant at  $p < 0.01$ . In terms of comparison between milk collection centers A, B and C, the highest mean values for somatic cells count are recorded in B and C centers, while the lowest mean values is recorded in A center which does not exceed the value of  $400 \times 10^3$  cell/mL for proper milk, according to the EU legislations, in all centers. The most significant decrease in somatic cells counts from A milk collection center, in the year 2010 is probably due to the animal health, mammary gland health in this area, the absence of subclinical mastitis and to the high natural resistance of the cows to mammary infections.



**Figure 1. Variation of somatic cells counts (SCC) in milk collection centers from the two years consecutively**

Figure 2 shows the results of the number of the total germs variation for the raw cow milk, from A, B and C collection centers during the two years. In our study, the year factor had a significant effect on the NTG ( $p < 0.01$ ) which has been proven. The effect of milk collection centers did not have a significant impact on the mean values of NTG. In this study it was found that NTG values are comparatively higher in milk samples from the year 2009 and lower in the milk samples from the year 2010. The decreasing mean values of NTG from milk samples may be due to the hygienic maintenance during milking and cleanliness. According to Parekh and Subhash (2008), the use of clean milking and transport equipments contributed to the good hygienic quality of produced milk. In the B milk collection center we noticed a lower number of total germs comparatively with the values from A and C centers. This difference may be due to poorer hygiene and other sanitary conditions during milking, storage and transporting when compared with the conditions from the B milk collection center. However, we have not found a relatively significant difference between the mean values of NTG from the milk collection centers that were analyzed.



**Figure 2. Variation of number of total germs (NTG) in milk collection centers from the two years consecutively**

A significant variation in the quality of raw cow milk, from the point of view of somatic cells count and the number of total germ values has been found during the two years of analysis in all milk collection centers used in our study. When comparing the mean values of SCC noticed in the year 2009 with the mean values noticed in the year 2010, a decrease in SCC values was noticed in 2010, in each season (Figure 3). The highest mean values of SCC were noticed during summer season, while the lowest mean values were noticed during winter season. Somatic cells count was significantly ( $p < 0.05$ ) higher in summer season comparatively to winter season (Figure 3) which it may be related to the increasing temperatures in the environment and therefore to a more intense microbial multiplication. These results are in agreement to the results obtained by Auldist (1998), Adesiyun et al. (1995) who have analyzed the effects of seasons on the hygienic quality of raw cow milk.

The high level of somatic cells counts during summer season may be related to

the animal health from this period and can be due poor health condition of the cow's udders [20, 22]. By applying the control measures on animal health, an increase of the milk quality parameters in the year 2010 was noticed, when compared with the year 2009. Therefore, the raw cow milk parameters were filed in a proper milk category according to the UE legislation. The results obtained for the number of total germs (Figure 4) show a significant influence of the factors season and year and also a significant interaction between them. Regarding the NTG values, in the summer season, the highest mean values were noticed, whereas in the spring season the lowest values were noticed, with lower mean values in the year 2010 when compared to the values from the year 2009. Season variations had a major impact on ( $p < 0.05$ ) the number of total germs from cow milk. The mean values for NTG noticed in all seasons show that the raw cow milk analyzed was classified in a proper milk category according to the UE legislation.

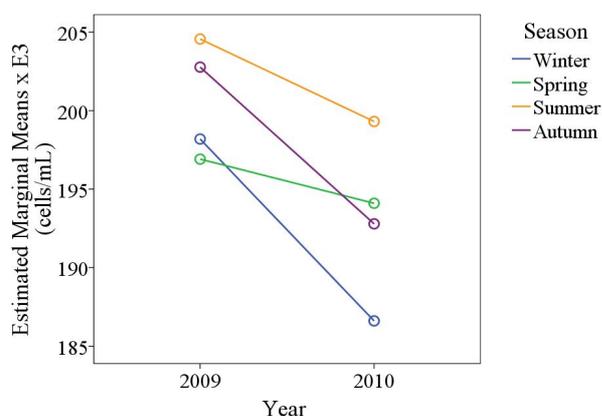


Figure 3. Variation of somatic cells counts (SCC) during seasons from the two years consecutively

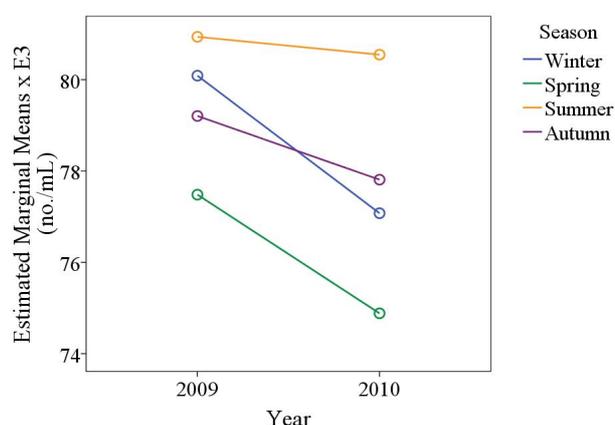


Figure 4. Variation of number of total germs (NTG) during seasons from the two years consecutively

#### 4. Conclusions

This study shows that different results were obtained for hygienic quality of raw cow milk from three milk collection centers during four seasons in two consecutively years. The obtained results

indicate the fact that a decrease of the number of total germs and of the somatic cells count leads to an increase of the hygienic quality of milk, positively affecting the milk and milk products quality. The decreased values of somatic cell count (SCC) and the number of total

germ (NTG) in the raw milk samples that were collected in the Suceava County from the analyzed milk collection centers, shows that the proper hygiene practices in milking and collecting the milk are applied. The principal hygiene practices are: taking action in order to establish proper sanitation procedures during the milking process, the high degree of farmers education, the interest of the farmers for a decrease of the microbiological charge due to the fact that this influences the price of the milk, e.g. Therefore the practices and regulations such as food safety management systems, which only follow established standards, have been properly used and have facilitated the production of cow milk of high quality and safety.

## 5. References

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