ESTIMATION OF CORRELATIONS BETWEEN SOMATIC CELL COUNT, THE TOTAL NUMBER OF GERMS AND SEASON OF COW MILK

Mihaela OSTAN[1], Olga-Alina RADA[1], Marinela PANĂ[1], B. BAUL[1], Iuliana CREŢESCU[2]

1Banat's University of Agricultural Sciences and Veterinary Medicine „King Michael I of Romania" from Timisoara
[2]"Victor Babeş" University of Medicine and Pharmacy Timisoara
radaolga2005@gmail.com

Abstract: *Chemical composition and hygiene quality is of the greatest importance in public health, processing technology and the quality of milk products. The purpose of this study was to establish correlations between season, the total number germs and somatic cell count of cow's milk as indicators for the hygienic quality. Researches were carried out on 31 milk samples collected from domestic market. The milk samples were collected during the months of January-December 2014 at least two samples a month. The total number of germs and somatic cell count was determined using standards methods in the laboratories at Faculty of Animal Science of the Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara. All determinations were processed statistically by Principal Component Analysis (PCA). We observed a negative correlation between the total number of germs and somatic cell count (r=-0.202). The results showed a positive correlations between the total number of germs and the somatic cell count during the spring (r=0.314) and the autumn (r=0.328). We observed also a negative correlation between the total number germs and somatic cell count during the summer (r=-0.369) and the winter (r=-0.394) season. We concluded that the season has influence on the somatic cell count in milk and the milk composition. Somatic cell count was the highest in spring (a little bit over the maximum limit) and the lowest in winter and early autumn. This demonstrates a higher incidence of the mastitis during the hot season than in cold season.*

Key words: *cow milk, somatic cell count, total number of germs, season*

INTRODUCTION

Milk quality is important not only for farmers but also for processing plants that turn milk into products. Consumers want safe food. Chemical composition and hygiene quality is of the greatest importance in public health, processing technology and the quality of milk products. The hygienic quality main indicators for fresh cow's milk are the total number of germs (NTG) and the somatic cell count (SCC).

The following standards have been agreed European Union (EU) and were included in the Romanian legislation i.e. Order 389/2002of the Ministry of Agriculture and Water: NTG≤100.000 (NTG/mL) SCC≤400.000 (cells/mL). Milk quality is not related to the content of fat and protein but the following parameters: bacteria and somatic cells, inhibitory substances, including antibiotics. All the factors that harm the milk, are always marked as alterations in milk quality [15].

Milk composition, i.e. the quality of cow milk may be affected by a number of factors such as: genetic factors, state of health, the lactation period, the manner and type of nutrition,

the season, the manner of milking, as well as the age and the number of lactation, environmental factors, and finally on the individual itself [1,7,13,20].

Milk fat was the only milk ingredient measured for milk payment, but nowadays the payment criteria also include protein quantities, total microorganism count and somatic cell count in 1 mL, with compulsory determination of freshness. Somatic cell count in the milk has been the subject of research and in paper publication since 1910 [6].

SCC is widely used as an indicator for health status of the uddern [3,4,8], so the somatic cell count is acknowledged as an international standard in milk quality [4,14]. With the increase of somatic cell count above 400.000/mL, the milk is altered, and the consequences are manifested in lower secretion, alterations in physicochemical composition, bacteriologic and technologic characteristics of the milk [2]. The somatic cell count in the milk samples of healthy cows that do not have mastitis is usually lower than 200.000/mL, while most cows have somatic cell count lower than 100.000/mL [12,14]. A somatic cell count higher than 200.000/mL is a mastitis indicator [12,18]. In this case the most of somatic cells are neutrophiles. The organism reacts with a defense mechanism against irritating agents with an increased cell count (especially polimorphonuclear leukocytes), so their increased number in any of the udder quarters shows disturbed secretion [2,12,17]. The aim of our study was to establish the correlations between the season, the total number of microorganisms and the somatic cell count in bulk tank cow's milk.

MATERIAL AND METHODS

Material:

Researches were carried out on 31 milk samples collected from domestic market. The samples were taken from the bulk tank, right after the morning milk, the quantity taken being of 500 mL in sterile bottles, and were brought into the lab. During the transportation the milk samples were kept in a refrigerating bag. The milk samples were collected during the months of January-December 2014, at least two samples a month.

Determination of NTG and SCC:

The total number of germs (NTG) is a very important general sanitary microbiological indicator. NTG was determined using the Horizontal method for the enumeration of microorganisms – Colony count technique at 30°C, according to the ISO 4833/2003 Standard [5,10].

From the same sample the somatic cell count was determined using the instrument MT-02®. This instrument is using viscosity to determine the number of somatic cells, after adding to 10 ml milk 5 ml coagulation reagent.

Statistical analysis:

All determinations were processed statistically with XLSTAT Version 2013 5. 02. by Principal Component Analysis (PCA). The values of the parameters are expressed as the mean. To verify the relation between NTG and SCC, the following method of interpreting the Pearson correlation coefficients was used [16]: very strong association for a correlation of 0.7 or higher; substantial association for a correlation of 0.5 or higher; moderate association for a correlation

of 0.3 or higher; low association for a correlation of 0.1 or higher. A p-value <0.05 was considered statistically significant.

RESULTS AND DISCUSSIONS

In Figure 1, the results of the somatic cell count in the milk are shown, in terms of the season.

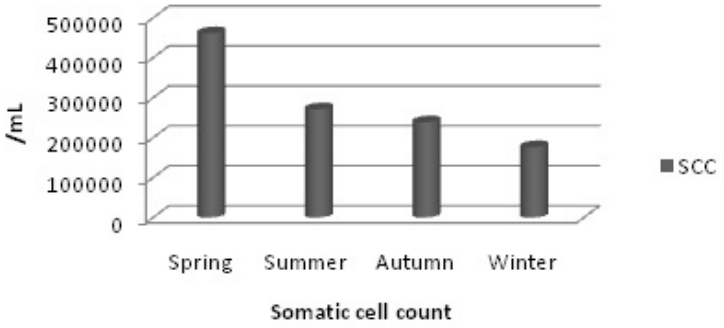

Figure 1. The somatic cell count in the bulk tank milk samples in different seasons

A larger difference was observed between the season regarding the somatic cell count with higher values in summer and autumn and the lowest value during the winter (176.250 cells/ml) (Figure1). The SCC in milk was way below the maximum limit admitted for the raw milk (400.000 cells/ml). The highest value (a little bit over the maximum limit) was observed in spring (461.000 cells/ml).

In Figure 2, the results of the NTG are shown, in terms of the season.

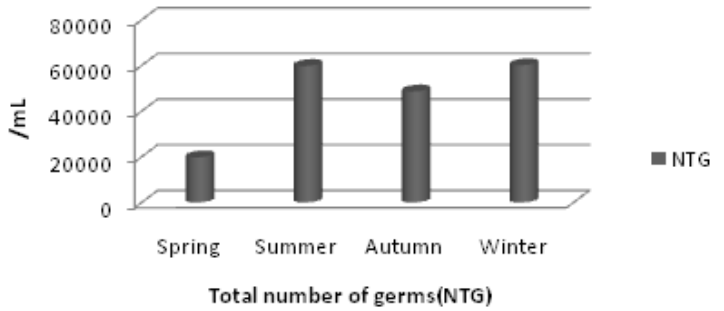

Figure 2. The NTG in the bulk tank milk samples in different seasons

A larger difference was observed between the season regarding the NTG with higher values in summer and winter and the lowest value during the spring (19.777,77 NTG/ml) (Figure 2). The highest value was observed in winter (60.125 NTG/ml). The maximum admitted limit stipulated by European Union standards for NTG is 100.000 NTG/ml. The total

number of germs in milk was way below the maximum limit admitted for the raw milk (100.000 NTG/ml).

The results of the correlation (Matrix Pearson) between NTG and SCC have been centralized in Table 1. The results of the correlation (Matrix Pearson) between NTG and SCC during the each season have been centralized in Table 2.

Table 1.

Correlation matrix (Pearson (n))between NTG and SCC

	SCC	NTG
SCC	1	
NTG	-0,202	1

From Table 1, we observed a negative correlation between the total number of germs and somatic cell count (r= -0.202). From Table 2, we observed a positive correlation between NTG and SCC during the spring (r=0.314) and the autumn (r=0.328) but we observed, also, a negative correlation between NTG and SCC during the summer (r= -0.369) and the winter (r= -0.394). Bacterial infection of the dairy gland represents the main source of somatic cell count increase in milk, and the total count in 1 mL is an internationally accepted parameter in the evaluation of udder health status. With the increase of the somatic cell count above 400.000/mL, the milk is altered, and the consequences are manifested in lower secretion, alterations in chemical composition and physical, bacteriologic and technologic characteristics of the milk [2]. In our research we confirmed the conclusions by these authors, we did not find alterations in bacteriologic of milk, since the somatic cell count was not over 400.000 somatic cells per mL with a bit exception of spring season (March, April and May months) when SCC was the highest (461.000/ml) and the lowest is in winter season (December, January and February months) when SCC was (176.250/ml). COLEMAN and MOSS (1989) [9] showed that the highest SCC in Holstein cows (412.000/mL) is in May and June, and the lowest is in July and August (132.000/mL). These authors suggest that the season does not affect the SCC in Holstein cows. This is not in accordance with the results of our research, since we established that the season has a significant influence on the somatic cell count in the milk. SCHULTZ et al. (1990) [19] researched the influence of the season, the age and the number of lactations on SCC.

Table 2.

Correlations between NTG and the somatic cell count (SCC)during the each season

Spring	SCC	NTG
SCC	1	
NTG	0.341	1

Autumn	SCC	NTG
SCC	1	
NTG	0.328	1

Winter	SCC	NTG
SCC	1	
NTG	-0.394	1

Summer	SCC	NTG
SCC	1	
NTG	-0.369	1

Considering the age, authors said that in the cows of six years of age or more, the SCC is the lowest from November to February, and the highest is from July to August, while in three year old cows it is the other way around. Somatic cell count was higher in spring and finishing of summer (over 400.000 cells/ml from March to April) and lower at the end of winter and beginning of autumn (lower than 400.000 cells/ml from December till February) (Figure 3). This demonstrates a higher incidence of the mastitis during the hot season than in cold season, according to some results obtained from other studies [11].

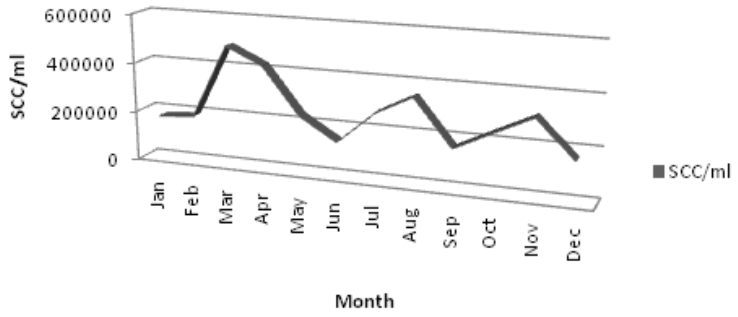

Figure 3. Monthly evolution of the somatic cell count in milk

CONCLUSIONS

We observed a negative correlation between the total number of germs and somatic cell count (r= -0.202). The results showed correlations between the total number of germs and the somatic cell count during the each season. We concluded that the season has influence on the somatic cell count in milk and the total number of germs. Somatic cell count was the highest in spring (a little bit over the maximum limit) and the lowest in winter and early autumn. This demonstrates a higher incidence of the mastitis during the hot season than in cold season.

BIBLIOGRAPHY

1. ACATINCĂI S., Producţiile bovinelor. Ed. Eurobit, Timişoara, p. 31-54, 2004
2. ANTUNAC N., LUKAC-HAVRANEK J., SAMARŽIJA D., Somatske stanice i njihovutjecaj na kakvoću i preradu mlijeka. Mljekarstvo. 47, 183-193, 1997
3. ATASEVER, S., Estimation of correlation between somatic cell count and coagulation score of bovine milk. Int. J. Agric. Biol.14: 315– 317, 2012
4. ATASEVER S., ERDEM H., Relationships between somatic cell count and udder type scores in Holstein cows. Int. J. Agric. Biol.15: 153–156, 2013
5. AVRAMESCU, D., PETROMAN I., AVRAM E., PETROMAN C., BĂLAN I., IOSIM I., ORBOI M.D., MARIN D., Quality of raw milk from different dairy farms. Journal of Food, Agriculture & Environment, 11 (2): 267-269, 2013
6. BAGADI H.O., Production and counting of spores of *Clostridium chauvoei*., Appl. Environ. Microbiol. 33: 1277-1288, 1977

7. BENIĆ M., Vrste stanica u sekretu vimena krava s mastitisom uzrokovanim streptokokimai stafilokokima. Disertacija, Veterinarski fakultet Sveučilišta u Zagrebu, Zagreb, 2004

8. ČAČIĆ Z., KALIT S., ANTUNAC N. AND ČAČIĆ M., Somatske stanice i čimbenici koji utječuna njihov broj u mlijeku. Mljekarstv., 53: 23-36, 2003

9. COLEMAN D.A., MOSS B.R., Effect of several factors on quantification of fat, protein and somatic cells in milk. J. Dairy Sci. 72: 3295-3303, 1989

10. Consiliul European Regulamentul CE 853/2004 de stabilire a unor norme specifice de igienă care se aplică alimentelor de origine animală, p. 14- 15, 2004

11. CZISZTER L.T., MILOVAN GH., SALA C., MORAR A., ACATINCĂI S., BAUL S., ERINA S.I., PETREUȘ C., Researches on chemical composition and somatic cell count in raw, Lucrări ştiinţifice Zootehnie şi Biotehnologii, 40(2): 521-529, 2007

12. DOBRANIĆ V., NJARI B., SAMARDŽIJA M., MIOKOVIĆ B., RESANOVIĆ R., The influence of the season on the chemical composition and the somatic cell count of bulk tank cow's milk Vet. Arhiv.78 (3): 235-242, 2008

13. DRONCA D., Ameliorarea genetică a populaţiilor de animale, Ed. Mirton, Timişoara, 2007

14. HARMON R. J., Somatic cell counts: A primer. 40th Annual Meeting. Proceedings National Mastitis Council. Arlington, USA, p. 9, 2001

15. HAVRANEK J., RUPIĆ V., MLIJEKO - značenje, prehrambene osobine. In: Mlijekodobivanje, čuvanje i kontrola. Hrvatski poljoprivredni zadružni savez, Zagreb. p. 3-6, 1996

16. KOTRLIK J.W., WILLIAMS H.A., The incorporation of effect size in informationtechnology, learning, and performance research. Information Technology, Learning and Performance Journal, 21:1–7, 2003

17. NG-KWAI HANG H., HAYES K.F., MOXSLEY J.E., MONARDES H.G., Variability of test-day milk production and composition and relation of somatic cell counts with yield andcompositional changes of bowine milk. J. Dairy Sci. 67: 361-366, 1984

18. RUEGG P. L., Investigation of mastitis problems on farms. Vet. Clin. Food Anim. 19: 47- 73, 2003

19. SCHULTZ M.M., HANSEN L.B., STEUERNAGEL G. R., Variation of milk, fat, protein and somatic cells for dairy cattle. J. Dairy Sci. 73: 484-493, 1990

20. TRATNIK LJ., Mlijeko. In: Mlijeko - tehnologija, biokemija i mikrobiologija. Hrvatska, utjecaj na kakvoću i preradu mlijeka. Mljekarstvo, Veterinarski Fakultet, Zagreb, 47: 183-193, 1998