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THE INFLUENCE OF SEASON OF THE COW MILK QUALITY AND HYGIENE IN DAIRY PLANT IN POLOG REGION

Biljana TRAJKOVSKA[1], Ljupce KOCOSKI[1], Kujtim ELMAZI[1], Guxim ABDULLAHI[1], Vesna K.HRISTOVA[1], Stefce PRESILSKI[1], Fejzulla FEJZULLAH[2], Borce MAKARIJOSKI[1], Liljana KUZMANOVSKA[1], Nesim SEFERI[2]

[1]Faculty of Biotechnical Sciences – Bitola, "St. Kliment Ohridski" University, Bitola, Macedonia
[2]Faculty of Food Technology and Nutrition, University of Tetovo, Macedonia
Contact: e-mail: bile.petkovska@yahoo.com

Abstract

Producing high quality dairy products is preconditioned by the production of raw milk with good quality determined by the parameters of the chemical composition and hygienic accuracy of the milk itself.

The aim of this study is to present and discuss the evaluation of the quality of cow's raw milk which was processed into Mini Dairy Plant in Polog region. Individual daily milk samples were taken from 18 dairy milk producers – cooperators with dairy industry. Within a period of one year (2015-2016), 383 raw milk samples were analyzed for their physical and chemical parameters using an infrared analyzer Milcoscan (proteins, milk fat, dry matter), pH meter Metller Toledo (pH) and thermometer (temperature) as well as their microbiological parameters (somatic cells (SCC) (Fossomatic 5000), total bacteria count (TBC) (BactoScan). The presence of antibiotic residues in bulk milk samples was determined.

The following results were reached during this research: the average number of SCC in bulk tank milk was in spring 244, 96 x 10^3 cells/mL, summer 238,32 x 10^3 cells/mL , autumn 237,22 x 10^3 cells/mL, winter 246,11 x 10^3 cells/mL. Also, a decrease was recorded in the average number of microorganisms (CFU) which was from spring 373,51 x 10^3 cells/mL, summer 383,24 x 10^3 cells/mL, autumn 365,31 x 10^3 cells/mL and in winter 358,16 x 10^3 cells/mL. There was a significance registered at the level of $p<0,05$ between SCC/mL and CFU/mL. No significant changes in the physical and chemical properties of the milk were registered and all the samples appeared negative for presence of antibiotics.

Key words: *raw milk, somatic cell, safety, dairy plant, total bacteria count*

Introduction

Taking into consideration the consumer demands, the dairy industry's goal has always been to produce milk with good quality (Oltenacu PA., and DM., Broom, 2010). In order to get hygienic safe milk the dairy cowsneed to have healthy udder. The somatic cells count (SCC) and the CFU (Colony forming units) are necessaryparameters in order to follow the milk hygienic standard.

According to many authors, SCC < 100,000 cells/mL is reported to be normal in a healthy mammary gland (Sordillo, LM. et al 1997), whereas SCC > 200,000 cells/mL is suggestive of bacterial infection (Schepers, AJ., et al 1997).

Milk somatic cell count (SCC) is a key measure of milk quality, reflecting the health status of the mammary gland and the risk of non-physiological changes of the milk composition (Hamann 2005). It is also the key component of national and international regulative for milk quality, udder health and the prevalence of clinical and subclinical mastitis in dairy herds. As a result to the increase ofsomatic cells and the changes in the chemical structure, the milk has a diminished technological quality, the cheese yieldis decreased, the pasteurized milk shelf life is shortened and unwanted odors might appear with these products. (Trajkovska B., et al 2011). But, on the other hand high cell count milk is not associated with direct risks to human health. However, there are a number of indirect risks as a result of poor farm hygiene, presence of antibiotic residues and pathogenic organisms and their toxins in milk (More SJ., 2009).

The aim of this research is to determine the influence of seasonal variation of the main chemical components and hygienic safety and quality traits of raw cow milk during the period of one year in Polog region.

Material and Methods

The present study was carried out during the period from November 2015- November 2016. Data was collected from 18 individual dairy milk producers and were taken 383 (N=383) milk samples. The milk samples were collected from the lactofrizer, in sterilized plastic cups (100 ml), and were taken to the laboratory immediately after collection and were kept at 4 ^{0}C until getting for the laboratory analyses. The chemical composition analysis refer to determining milk fat content, protein, and dry matter using infrared analyzer Milkoscan in accordance with the IDF 141C:2000 standard. The pH value was measured with a pH meter MetllerToledo. The cell count was determined with Fossomatic 5000 and milk - enumeration of somatic cells was done according to ISO 13366/2:2006 standard. The hygienic quality of the milk was estimated on the basis of the colony forming units (with the IDF 161A:1995 reference method as well as with the BactoScan FC apparatus). All samples were examined by Beta starscreening kit (Neogen, USA) for the presence of beta-lactam antibiotics penicillin, ampicillin, amoxicillin, cloxacillin, and cephapirin.

The obtained results were statistically processed with the usual variation and statistical methods in Microsoft Office Excel. The arithmetic mean value, the variation index and standard deviation were calculated and with a t-test the statistical significance of the differences between the seasons was determined at the level of $p < 0.05$ between the SCC and CFU. The results are shown in the tables below.

Results and discussion

Pologregion is under the influence of Mediterranean and continental climate which is quite variable with very cold winters and hot summers. The average temperature in winter is around 0,5^{0}C, spring 10,2 ^{0}C, summer 19,8 ^{0}C and autumn 11 ^{0}C (Mustafi, M., and S. Aliu., 2011).

The effect of seasons on milk fat, protein and dry matter are shown in table 1. The mean value for milk fat, protein and dry matter were significantly higher during the winter months. On the other hand the statistical significance of the occurrencewas not determined.

The milk fat, although it is the most variable component in milk (Trajkovska B., 2015),but in our studies was quite equal in all season and with low coefficient of variationThe amount of milk fat in summer and winter months was reported as 3,65% and 3,88 % respectively, and statistically significant difference (p>0,05) was not registered. However, the fat content in milk produced in summer had slightly decreased value. Obtained results have shown as compatible withKabil et al., (2015), Ayub et al., (2007), Nam T.K., et al., (2009).

The protein content of the milk produced in summer and winter months, statistically did not show any significant difference (p>0,05). The mean value of protein (%) in four seasons (spring, summer, autumn and winter) were 3,40; 3,33; 3,4; 3,47 respectively.

As a constant parameter for determining the quality of milk in all official regulations concerning dairy solids-non-fat has been used. Its averages ranged from 8,56; 8,50; 8,57; 8,65 for spring, summer, autumn and winter, respectively, which should be noted that the legal minimum is 8,50%. Active acidity values and also the temperature (T ^{0}C) of the milk samples were in accordance with the Statute for special requirements for safety and hygiene method and procedure of conducting official controls of milk and dairy products (Official Gazette of the RM no. 26 of 02. 21. 2012)

Table 1 Average values of the chemical composition of the raw milk during four seasons (N=383)

Chemical composition	Season			
	Spring	**Summer**	**Autumn**	**Winter**
Milk fat%	3,77 ± 0,05	3,65 ± 0,03	3,80 ±0,07	3,88 ± 0,03
CV%	1.42	0.87	2.04	0.85
Protein%	3,40 ± 0,01	3,33 ± 0,04	3,4 ± 0,03	3,47 ± 0,03
CV%	0,50	1,35	1,05	1,03
SNF%	8,56 ± 0,01	8,50 ± 0,03	8,57 ± 0,07	8,65 ± 0,05
CV%	0,19	0,44	0,78	0,54
pH	6 ± 0,004	6,01 ± 0,012	6,02 ± 0,02	6,01 ± 0,008
CV%	0,08	0,21	0,39	0,14
T (^{0}C)	5,09 ± 0,25	5,83 ± 0,29	5,22 ± 0,45	5,75 ± 0,23
CV%	4,88	4,99	8,53	4,08

Table 2 Average values of the hygienic parameters in raw cow milk during four seasons (N=383)

	SCC x 10^3 cells/mL^a				**CFU x 10^3 cells/mL^b**			
Season	**Spring**	**Summer**	**Autumn**	**Winter**	**Spring**	**Summer**	**Autumn**	**Winter**
Mean	244,96	238,32	237,22	246,11	373,51	383,24	365,31	358,16
Min	129	108	120	116	134	135	138	120
Max	395	418	382	389	637	769	704	719
SD	62,2	69,8	73,8	69,7	141,3	163,4	130,7	133,8
CV%	25,39	29,31	31,12	28,32	37,84	42,65	35,77	37,36

*The difference in the values with different superscripts are statistically significant at the level of p < 0,05: a:b

In Table 2 the average valuesofthe milk hygienic parameters of the milk samples collected from the milk producers-cooperators during the study periodare presented. The SCC is influenced by seasonal temperature. Allore et al. (1997) reported that SCC in milk decreased in summer season.The highest average value for SCC was observed in winter 246,11 x 10^3 cells/mL, the same results has been obtained byLudovic T., et al (2012), while the lowest was observed in autumn, 237,22 x 10^3 cells/mL.There was no statistical

difference between the SCC and the seasons. However, many studies have shown that SCC increased during summer season (Harmon, 1994; Green et al., 2006). Complying with the SCC standards,(Official Gazette of the RM no. 26 of 02. 21. 2012) in this region approximately15 farms from the total number of 18 have produced raw milk within the accepted limits constantly.

The bacteriological quality of the milk is a basic marker of the hygiene in the primary production. Nonstandard sanitation procedures in milk production contribute to the great variability and the high variation index of CFU/mL within the all seasons (Trajkovska B., et al., 2015). The average CFU in bulk tank milk was not within the accepted limits in all season (Official Gazette of the RM no. 26 of 02. 21. 2012) (Table 2). During the winter season the average CFU was lower compared with the other season; 358,16x 10^3 CFU/ml vs, 373,51 x10^3 CFU/ml in spring, 383,24 10^3 CFU/ml in summer and 365,31 x10^3 CFU/ml in autumn, respectively suggesting that winter milk was produced under more favorable hygienic conditions.In the summer time the highest variation of this trait was observed, from 135 x 10^3 CFU/ml to 769x 10^3 CFU/ml.Primary microbial contamination of bulk tank milk (BTM) occurs via 3 main sources: bacterial contamination from the external surface of the udder and teats, from the surface of the milking equipment, and from mastitis organisms from within the udder (Olechnowicz, J., and Jaskowski, M.J., 2012). Microbial load of summer milk was significantly higher than that of winter milk as the microbial load of summer and winter milks were 383,24 x 10^3 CFU/mL and 358,16 x 10^3 CFU/mL.)

Conclusion

Climatic factors such as air temperature often limit animal performance and influence on milk composition and hygienic safety. Different management practices and the application of corrective measurements largely influence the total number of microorganisms and somatic cells in bulk milk and this also increases the raw milk quality.

The obtained results show that there was a statistical significance between SCC and CFU ($p<0.05$) and on the other hand there was not any statistically significance on chemical composition registered. The highest average value for SCC was observed in winter 246,11x 10^3 cells/mL, while the lowest was observed in autumn, 237,22 x 10^3 cells/mL. During the winter seasons the average CFU was lower compared with the other season; 358,16x 10^3 CFU/ml vs, 373,51 x 10^3CFU/ml in spring, 383,24 x 10^3 CFU/ml in summer and 365,31 x10^3 CFU/ml in autumn. During the summer time the highest variation of this trait was observed, such as from 135x 10^3 CFU/ml to 769 x 10^3 CFU/ml.

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