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THE INFLUNCE OF SEASON ON THE CASEIN CONTENT AND HYGIENIC QUALITY OF THE RAW MILK[1]

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ABSTRACT

Increased somatic cell count (SCC) and a total count of microorganism presented as a colony forming units (CFU) in milk are often associated with mastitis in dairy cows. Alterations appearing in milk with the increased totalcount of microorganism and somatic cell count are mainly addressed to increased pH value, the unfavorable ratio of casein fractions, changes in coagulation capability of milk, reduced yield, and cheese quality. Casein is participating with approximately 82% of the total milk protein, which makes it the most important part of the protein content. Numerous parameters impact on raw milk selection for cheese production, but the most important is thecasein content and hygienic quality of raw milk (total count of microorganism and somatic cell count).

During the research, in total of 1.440 raw milk samples were analyzed. The aim of the research was to determine the impact of the total count of microorganisms and somatic cell count, depending on the season, on changes in raw milk physical-chemical characteristics, with special attention on casein. Raw milk samples were tested with LactoScope FTIR Advanced (Delta Instruments).An obtained result indicates a significant correlation between raw milk microbiological quality and total casein content. Raw milk microbiological

[1] original scientific paper

quality depends mostly on farm conditions and GHP, and raw milk manipulation until processing. The results obtained from this research indicate the fact that seasonal changes have an impact on the quality and hygienic condition of raw cow's milk.It can be concluded that an increase in somatic cell count, rather than total count of microorganisms, resulted in a reduced protein and casein content in raw milk.

KEY WORDS: casein, total count of microorganism, somatic cells, season

INTRODUCTION

It is obvious that with the increasing of the world population, we will face even more difficulties providing sufficient food with proper balance appropriate for the health of people, communities, and the whole planet in total. Good nutrition means the quality of nutrients, which can be different regarding their source (animal or plant), and the quantity of nutrients. Applying the multiple "filters" noted above *(FAO, 2013*), milk and milk products should be endorsed as an integral component of healthy eating patterns. As foods they are**:**

- Nutritionally beneficial
- Environmentally sustainable
- Economically viable
- Culturally acceptable

A lot of stakeholders are included in milk production and processing: farmers, milk collectors, drivers, dairy companies, distributors and retailers, dairy business. Raw milk has to meet the basic quality and hygienic criteria in order to be processed in dairy products (Mijacevic Z., 1997).One of the most important quality criteria for raw milk is protein content. Milk proteins are the source of all essential amino acids (Miljkovic V., 1997) in an almost ideal ratio which is more appropriate compared with other animal-based products.

There are generally two types of milk proteins: casein, which is a dominant type of protein, and whey proteins. Their content within the raw milk depends on many factors: season, phases of lactation, animal health status and especially udder health status (Miljkovic V., 1997).Casein, as the dominant type of protein in raw milk, has the greatest changes in his content which is in relation with other milk components and hygienic quality. Casein content and stability

directly influence the production process, especially in fermented milk products and different types of cheese (Mijacevic Z., 1997). This milk protein is particularly important during cheese production, knowing that casein content is also affecting cheese yield, which is particularly important as companies' financial indicator. On that point of view, it is important to control casein content in raw milk in every batch.

THE AIM OF THE STUDY

The aim of the study was to analyze the influence of season on hygienic quality such as somatic cells count (SCC/ml), a total count of microorganism presented as a colony forming units (CFU) and casein content in raw milk.

MATERIAL AND METHODS

The subjects of analysis were samples collected from three regions (1, 2 and 3) in North Macedonia. Milk samples were taken for a period of one year. The results were systematized by regions during annual quarters i.e., seasons: Q1 as winter, Q2 as spring, Q3 as summer and Q4 as autumn. 30 samples per month were analyzed per region or in total 1.440 samples during the research period. Also, results were systematized by somatic cell count as: Group 1 (SCC $\leq$ 400 x 10^3 cells/ml), and group 2 (400 – 600 x 10^3 cells/ml) and for group 3 (above 600 x 10^3 cells/ml).

Raw milk samples were determined for the chemical composition (protein and casein) by LactoScope FTIR Advanced (Delta Instruments), somatic cell count (SCC) by the flow cytometry method by Bentley Somacount CC 150 (MKC EN ISO 13366-2:2010) and Bentley Bactocount IBC was used for the total count of microorganisms (CFU) (MKC EN ISO 21187:2011).

RESULTS AND DISCUSSION

The analysis of the milk composition, SCC and CFU per season are shown in Table 1. As a result of a balanced feeding of the cows, most of the parameters are stable during the year in all regions. The obtained results indicated that the highest protein content and casein were typical for the milk in the autumn season compared with other seasons. Surprisingly, the amount of the casein, during the winter season was at the lowest level in all regions (79,43 %) with average

somatic cell count 349 x 10^3 cells/ml. Raw milk obtained from Region 3 had higher SCC than a maximum allowed level for the first class milk (424 x 10^3 cells/ml), according to the Regulative for the special requirements for the safety and hygiene of milk and milk products (Official Gazette 197/2016).

Table 1. Milk composition, Somatic Cell Count (SCC), and the total count of microorganism (CFU)

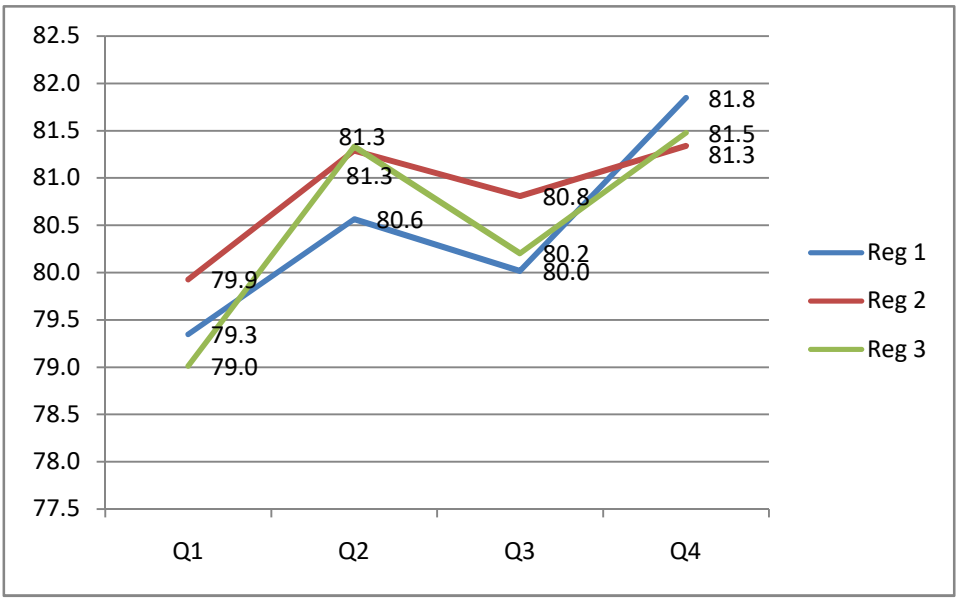
Region	Q1				
	Protein (%)	**Casein (%)**	**% of casein**	**SCC/ml x 10^3**	**CFU/ml x 10^3**
1	**3,13**	**2,49**	**79,35**	**316**	**1.620**
2	**3,07**	**2,41**	**79,93**	**307**	**2.372**
3	**3,11**	**2,40**	**79,01**	**424**	**5.670**
$\bar{x}$	**3,10**	**2,43**	**79,43**	**349**	**3.221**
Q2					
1	**3,03**	**2,48**	**80,56**	**335**	**1.581**
2	**3,03**	**2,44**	**81,29**	**346**	**2.413**
3	**3,04**	**2,41**	**81,33**	**746**	**7.038**
$\bar{x}$	**3,03**	**2,44**	**81,06**	**476**	**3.677**
Q3					
1	**3,03**	**2,51**	**80,01**	**467**	**1.632**
2	**3,01**	**2,43**	**80,81**	**437**	**2.269**
3	**3,04**	**2,44**	**80,20**	**641**	**6.344**
$\bar{x}$	**3,03**	**2,46**	**80,34**	**515**	**3.415**
Q4					
1	**3,33**	**2,73**	**81,85**	**301**	**1.110**
2	**3,21**	**2,61**	**81,34**	**402**	**1.810**
3	**3,24**	**2,60**	**81,48**	**510**	**6.083**
$\bar{x}$	**3,26**	**2,65**	**81,56**	**404**	**3.001**

On the other hand, the bacteriological quality of milk is one of the basic markers for hygiene. The obtained results show that none of the raw milk samples fulfils the parameters from Regulative for the special requirements for the safety and hygiene of milk and milk products (Official Gazette 197/2016) i.e., the CFU per ml milk is significantly higher than 100.000 CFU/ml. According to Akam, D.N., et al.,(1989)the milk contact surfaces of milking and cooling equipment are a main source of milk contamination and frequently the principal cause of consistently high bacterial countsthe handling procedures. Also, bacterial contamination form the external surface of the udder and teats and from mastitis organisms from within the udder can be related with bacterial contaminations (Olechnowicz, J., and Jaskowski, M.J., 2012).

The average percentage of milk casein based on somatic cells count was 2,51 % for Group 1 (SCC $\leq$ 400 x 10^3 cells/ml), and group 2 (400 – 600 x 10^3 cells/ml) and for group 3 (above 600 x 10^3 cells/ml) was 2,43 % (table 2). Increased somatic cells count in milk changes the milk composition and influence on milk yield (Trajkovska B., et al. 2011). Presented data suggested that an increase of somatic cells was associated with the reduction of casein content in raw milk. Contrary to our findings, Barbano et al., (1991) and Tripaldi et al., (2003) suggested that to obtain a better value of casein content in raw milk somatic cell count should not exceed 200 x 10^3 cells/ml. Tripaldi et al., (2003) also found that the casein content decreased when somatic cells increased in milk. Instead, Musayeva KR., et al., (2016) noticed that increased somatic cell count is related to increasement of casein content and found a positive correlation between these parameters.

Table 2. Categories of raw milk based on somatic cell count and average casein content

Parameters	Group 1	Group 2	Group 3
Casein (%)	**2,51**	**2,51**	**2,43**
SCC/ml x 10^3	**321**	**448**	**694**
Coefficient of correlation (r)	**-0,53**	**0,29**	**-0,90**



Graph 1. Casein percentage in raw milk per regions in all sessions

According to the California Dairy Research Foundation, the average casein content, in normal milk, is approximately 82% of total protein and approximately 18% is whey protein. Considering these facts, all milk that was obtained during the year had lower casein content, except for the autumn season, where the casein content was approximately close to the reference. Such data are disappointing for the dairy industry, especially for cheese production. We have to take into account that the SCC during the whole year is >300.000 cells/ml. That is still the satisfactory level according to Macedonian cut-off of 1st class milk. If we consider the reference for classifying a cow's mastitis status for individual cows, in New Zealand the accepted SCC cut-offs is ≥150.000 cells/ml, ≥200.000 cells/ml in the European Union and ≥250.000 cells/ml in Australia, (Ebrahimie et al. 2018), we can see that all of the milk samples all year around could be classified as a mastitic, regardless their fulfillment of the legislative criteria. Since the results show a slight increase of the SCC regarding

cut-offs for mastitis, the results for casein content are according to that, with a slight decrease indicating disrupted mammary milk production (Kochoski et al., 2011).

CONCLUDING REMARKS

According to the obtained results in our research, it can be concluded that the casein content is stable in all investigated regions and ranged from 2,40to 2,73 andappears to be the highest during the autumn season. On the other hand, casein content decreases with increasing of somatic cell count. Another study should be done to make a correlation between casein and somatic cells on the farm level because the bulk tank milk is less variable than individual milk.There is a negative correlation between casein content and raw milk hygienic quality, taking into accounts both somatic cell count and the total count of microorganism.

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