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Relationship Between Somatic Cell Count And Physico - Chemical Qualities Of Raw Milk

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Abstract— The aim of our research was to establish the influence of the somatic cells on the physic-chemical composition of cow's milk. This study was conducted on 131 samples of raw milk from small farms. Sampling and testing was carried out in 4 stages, respectively in March, June, September 2015 and January 2016. Physico-chemical parameters tested include temperature, fat, protein, density, Solid Non Fat (SNF) and freezing point. Also, microbiological evaluation was conducted based on the definition of indicators cytological (SCC) and total bacterial count (TBC). Somatic cell count (SCC), proved to be negatively associated with changes in the composition of milk. These changes were reflected in the reduction of lactose and nonfat solids content in milk. Also higher values of total microbial load showed not only low- quality hygienic milk, and decrease its nutritional values. Analytical testing showed that 77/131 milk samples were above the allowed values of the legislation on the number of somatic cells and 77/131 showed values above the limits prescribed by law for the total bacterial load. 67/131 had the changes in the content of fat, decrease in density 61/131, 76/131 decrease of lactose, SNF decline 61/131, 9/131 percentage decrease in protein and 62/131 freezing point < -, 052. This situation proves the necessity of respecting and improving the quality of standard milk, where SCC can be used as an integral component of the control program.

Keywords—milk, SCC, lactose, protein, SNF, fat.

I. INTRODUCTION

Milk composition and microbiological characteristics are important factors for the dairy farmer (raw milk quality), dairy industry (technological process and quality of dairy products), and consumer (nutritional quality and safety). Milk composition varies according to factors such as breed, age, mammary gland health, lactation stage, nutritional management and season [8]. Mastitis, particularly the subclinical type, is one of the most persistent and widely spread disease conditions of importance to milk hygiene and quality among dairy cattle worldwide [2]. Mastitis influences the total milk output and modifies milk composition and technological usability. In cows, the somatic cell count (SCC) is a useful predictor of subclinical mastitis, and therefore, it is an important component of milk in terms of quality, hygiene, and mastitis control [7]. Increased SCC is associated with reductions in casein, milk fat, and lactose; increased enzymatic activity; and reduced quality and yield of dairy products. It is generally accepted that during mastitis, there is an increase in milk proteins that has been attributed to the influx of blood- borne proteins (such as serum albumin, immunoglobulin, the minor serum proteins, transferring, a- macroglobulin into the milk coupled with a decrease in caseins [1, 10, 11].

According to Auldist et al., many of the common mastitis-causing organisms are capable of fermenting lactose. The lower concentrations of lactose in mastitis milk may be partly due to the activities of these organisms [9].

In presence to Subclinical mastitis, the concentration of fat in the milk decreases in general. Sometimes, though, if the volume of milk produced decreases, more than the synthesis of lipids can be seen an increase in their relative, due to the effect concentration. In is an increase of lipolysis and thus of free fatty acids that can cause alteration and organoleptic defects in the product and its derivatives. The concentrations of many minerals are altered during mastitis, and these changes can play significant roles in determining the manufacturing quality of the milk and diagnosis of sub-clinical mastitis [2.4]. The largest negative consequences of the presence of SCC are related to shorter shelf life and less sensory content or un-desirable organoleptic characteristics of the final product, due to enzymatic activities of somatic cells [11, 12].

II. MATERIALS AND METHODS

2.1 SAMPLING

Sampling was conducted in 13 small farms by region Myzeqe, in the period March 2015 and January 2016, in parallel samples by SSH ISO 707: 1999, "Method of sampling for milk and milk-based products." Samples were transported to the cooling box within 2 hours from the time of collection, to be tested in the

Food Safety laboratory, Faculty of Veterinary Medicine and Food Microbiology Laboratory-Institute of Food Safety and Veterinary.

2.2 MICROBIOLOGICAL TEST

The total number of mezofile in milk samples was detected in accordance with *ISO 4833:*

2003 method "Microbiology of food/ animal feed by using the pour plate technique. Aliquots of 1 ml of each serial dilution were placed in sterile animal-side test, it gives an immediate response (less than one minute). Petri dishes, followed by the addition of the Plate Count Agar (PCA), and was incubated at 30^0 ± 10 C for 72 hours. Dishes which had a growth of 25 to 250 colonies were taken into consideration to be counted. The growing colonies were monitored and analyzed using electronic counter colonies. Results were stated in CFU / ml.

2.3 DETERMINATION OF SOMATIC CELLS COUNT

For the counting of somatic cells was used DeLaval somatic Cell Counter-DCC, a portable optical cell counter. The DCC counts somatic cell nuclei stained with the DNA specific fluorescent probe, (Propidium Iodide). The milk is collected and the nuclei stained inside a cassette containing small amounts of the fluorescent stain. As little as 60 µl of milk sample is needed for the count. By means of a piston, approx. 1 µl of milk is carried toward a measuring window. The nuclei are then exposed to a LED light source and their fluorescent signals recorded and used to determine the SCC. Once the cassette has been loaded and inserted in the instrument, the counts of somatic cell are shown in the display of the instrument, [5, 6, 9]. Advantages of the instrument are that is a battery operated portable device and can be used as an Advantages of the instrument are that is a battery operated portable device and can be used as an animal-side test, it gives an immediate response (less than one minute). The DCC provides farmers with real time information on udder health and milk quality of their flock [7].

2.4. PHYSICO-CHEMICAL ANALYSIS

Analyses were performed in the Food Security Lab at the Agriculture University of Tirana, Faculty of Veterinary Medicine. Milk composition analysis was carried out using a LACTOSCAN S_L Milk Analyzer (50 W, Milkotronic Ltd., Bulgaria) for the following milk constituents: milk fat, density,non-fat solids, milk protein, lactose, and total solids and freezing point.

III. RESULTS

The results of the present study indicate that 77/131 milk samples were above the allowed values of the legislation on the number of somatic cells and 77/131 showed values above the limits prescribed by law for the total bacterial load. 74/131 had the changes in the content of fat, decrease in density 61/131**,** 78/13 decrease lactose, SNF decline 61/131 , 9/131 percentage decrease in protein and 78/131 freezing point < -, 052. Results of the study also showed that mesophile microbial load were higher in the first phase (late spring) and the second phase (summer).

Table 1. Results of Analyzes by Regions and Stages in study

STAGE I - March 2015								
No samples	REGION	Fat	Density	Lactose	SNF	Protein	Freez. P.	SCC
11	I	5	5	6	3	0	4	8
13	II	10	6	7	6	1	6	10
14	III	5	6	8	5	0	8	14
38	TOTAL	20	17	21	14	1	18	32
STAGE II - June 2015								
No samples	REGION	Fat	Density	Lactose	SNF	Protein	Freezing p	SCC
13	I	6	7	9	7	0	9	6
11	II	6	6	8	5	2	7	6
13	III	9	4	10	4	1	9	5
37	TOTAL	21	17	27	16	3	25	17
STAGE III – September 2015								
No samples	REGION	Fat	Density	Lactose	SNF	Protein	Freezing p	SCC
6	I	3	3	4	1	0	3	6
11	II	9	5	6	8	0	5	6
13	III	5	7	8	6	1	8	5
30	TOTAL	17	15	18	15	1	18	17
STAGE IV - Janary-Febrary 2016								
No samples	REGION	Fat	Density	Lactose	SNF	Protein	Freezing p	SCC
5	I	3	3	3	5	2	4	4
8	II	5	2	3	2	1	5	0
13	III	8	7	8	6	1	8	6
26	TOTAL	16	12	14	13	4	17	11

3.1 CORRELATION AND ANOVA OF PARAMETERS

The graph of samples of SCC with values above the allowed numbers and parameters, fat, density, lactose, freezing point, figure 1. The SCC parameter can affect other physic- chemical qualities of raw milk. From the correlation table we see a strong correlation between SCC and Density, (0.7), and a moderate correlation between SCC and Fat (0.58). More samples with SCC above the allowed values, more samples we have with milk chemical qualities with values out of optimal.

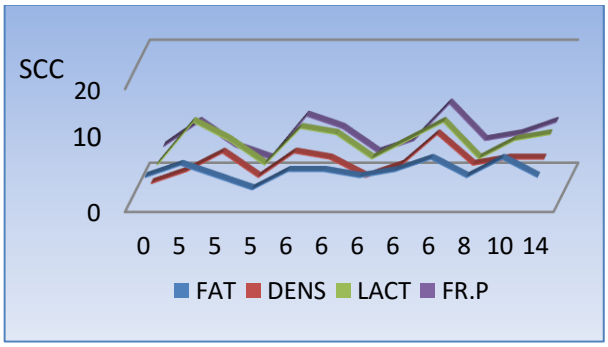

Fig1. SCC and some parameters of milk composite.

Table 2. Correlation matrix of milk parameters

	Fat	Density	Lactose	Fr. Point	SCC
Fat	1				
Density	0.91	1			
Lactose	0.94	0.87	1		
Fr. Point	0.75	0.59	0.905	1	
SCC	0.58	0.72	0.346	-0.075	1

ANOVA of SCC.

We build a table with the numbers SCC samples with higher values (>400.000cell/ml), table 3. The aim was to study if there is difference in samples for Region or Stages. From the result of ANOVA, we have no differences for Regions, but we have differences for Stages. That means,

the time of experiments is important for the SCC numbers. This is supported from the everyday routine; there are more cases with infected cows during the cold and wet seasons than during the hot seasons. There are random factors, too, table 4.

Table 3. SCC data samples, above the allowed values.

SCC				
	S1	S2	S3	S4
R1	8	6	6	4
R2	10	6	6	0
R3	14	5	5	6

Table 4. ANOVA of SCC number of samples, above the allowed values.*SUMMARY*

	Count	*Sum*	*Average*	*Variance*		
R1	4	24	6	2.66		
R2	4	22	5.5	17		
R3	4	30	7.5	19		
S1	3	32	10.66	9.33		
S2	3	17	5.66	0.33		
S3	3	17	5.66	0.33		
S4	3	10	3.33	9.33		
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Regions	8.66	2	4.33	0.86	0.47	5.14
Stages	86	3	28.66	5.73	0.034	4.76
Error	30	6	5			
Total	124.67	11				

ANOVA OF LACTOSE:

From the data of Lactose samples with values out of allowed, table 5, we have the result of ANOVA, for Lactose, table 6.

Regions and Stages under the study have effect on physic- chemical values of samples, producing different number of samples above the allowed values. The samples means are not equal.

Table 5. Lactose data, out of the allowed values.

LACTOSE				
	S1	S2	S3	S4
R1	6	9	9	3
R2	7	8	8	3
R3	8	10	10	8

Table 6. ANOVA of Lactose data.

SUMMARY	*Count*	*Sum*	*Average*	*Variance*		
R1	4	27	6.75	8.2		
R2	4	26	6.5	5.6		
R3	4	36	9	1.3		
S1	3	21	7	1		
S2	3	27	9	1		
S3	3	27	9	1		
S4	3	14	4.67	8.3		
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Regions	15.17	2	7.58	6.067	0.04	5.14
Stages	38.25	3	12.75	10.2	0.01	4.76
Error	7.5	6	1.25			
Total	60.92	11				

ANOVA OF PROTEIN

From the Protein data, table 7, we have the results of Anova, table 8. The conclusion for Protein is that there is no difference in groups of data, by Region or by Stage. The data have the same means. Neither the Region, either the Stages have effect on Protein samples data.

Table 7. Protein data, out of the allowed values.

	S1	S2	S3	S4
R1	0	0	0	2
R2	1	2	0	1
R3	0	1	1	1

Table 8. ANOVA of Protein data.

SUMMARY	*Count*	*Sum*	*Average*	*Variance*		
R1	4	2	0.5	1		
R2	4	4	1	0.66		
R3	4	3	0.75	0.25		
S1	3	1	0.33	0.33		
S2	3	3	1	1		
S3	3	1	0.33	0.33		
S4	3	4	1.33	0.33		
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Regions	0.5	2	0.25	0.43	0.67	5.143
-Stages	2.25	3	0.75	1.29	0.36	4.757
Error	3.5	6	0.58			
Total	6.25	11				

IV. DISCUSSION

Milk composition or some parameters can be affected generally by Stages or by Regions; due to many factors. In case of serious and professional attention for the health of animals, you may have no effect or a non significant on milk parameters. They can be affected by random factors, also. It can also by be affected by other factors such as age, lactation stage and nutritional practices [4]. However, these factors were not controlled in the present study. In a previous study, Dobranié et al., [3] suggested that high SCC might cause changes in milk composition because milk samples with a SCC of > 200,000 cells/ml undergo greater alterations in milk chemistry characteristics than samples with low SCC (≤ 200,000 cells/ml). Similarly, our results indicated that SCC affects milk composite, some factors are more affected than the others. This situation proves the necessity of respecting and improving the quality of standard milk, where SCC can be used as an integral component of the control program.

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