

RESEARCH ARTICLE

(Open Access)**A Study of the Somatic Cell Count of Kosovo Bulk Milk Farm Management and Perspective**HYSEN BYTYQI^{1*}, PAMELA RUEGG², FILLOJETA RRUSETMAJ³, PAKIZE KASTRATI¹, SCOTT WELLS⁴.¹Faculty of Agriculture and Veterinary - University of Prishtina, Boulevard "Bill Clinton" nn. 10000, Prishtina, Kosovo.²Department of Dairy Science 1675 Observatory Dr. University of Wisconsin Madison WI 53706 USA.³Food and Veterinary Agency of Kosova, Industrial Zone, 10000, Prishtina, Kosovo.⁴Center for Animal Health and Food Safety College of Veterinary Medicine, University of Minnesota 136 Andrew Boss Laboratory, 1354 Eckles Ave, St. Paul, MN 55108 USA.*Corresponding author e-mail: hysen.bytyqi@uni-pr.edu**Abstract**

The aim of this study was to determine the effects of the somatic cell count (SCC) in bulk milk farm management and its commercial perspective according to the milk quality standards in Kosovo. A 2069 raw bulk milk samples were taken from a milk collection points in four regions of Kosovo, with two months visits throughout a year. All samples were analyzed by using "FossomaticMinor" equipment, while for the results obtained and identification of different variables effect of SCC on raw bulk milk a general linear model was used. The effect of all variables was considered as a fixed. The overall results show that herd, region, and month of the year ($P < 0.0001$), respectively, had a significant effect on the presence of SCC. Based on the country existing milk standards for raw milk, the results gained show about 29.6 % belong to extra class milk ($SCC/mL < 300.000$), followed by milk quality class III^d, Ist and II^d, 24.3%, 8.5%, 8.2% ($SCC/mL > 300.00 - < 600.000$), respectively. Of concern is the fact that about 29.5% of total bulk milk analyzed tend to be out of milk quality standards, poor quality ($SCC/mL > 600.000$). The overall mean of SCC on milk was high 772.475 per mL milk, indicating negative farm profit correlation, poor animal health and food safety. The result obtained can be used for assessing raw milk quality and controlling herd management programs.

Keywords: Raw milk, milk quality, standards, variables, general linear model.**Introduction**

In order to improve a milk quality and safety, a Kosovar and United States of America (USA) collaborative research project "Understanding and Mitigating Potential Food Safety Risks Associated with Smallholder Dairy Farms in Kosovo and the United States of America" involving milk industry representatives, Faculty of Agriculture and Veterinary of the University of Prishtina, University of Wisconsin-Madison and University of Minnesota, extension specialists was designed and implemented. Kosovo is a newly independent country ravaged by years of conflict. As its new government strives to rebuild its dairy industry, Kosovo will have to address serious issues of food safety associated with animal health, poor hygiene in milk harvest, handling and storage, which significantly reduces the quality of milk [1]. Currently, the Kosovar people consume an average of 339,600 tons of milk per year, with 257,000 tons being produced locally. A majority of milk is consumed directly on the farm or sold by

subsistence and semi-commercial farmers on the local Green Market, where there is no inspection for quality control. While larger commercial farms make up a smaller portion of the dairy market (about 5%), Commercial farmers mainly sell to processors who organize and collect milk from milk collection centers. One of the factors directly influencing the milk quality according to the national standards is also presence of high number of Somatic Cell Count (SCC) [2]. It has been well known that SCC are generally used to predict the mammary gland status of cows [3, 4, 5], the standard for determining of milk for human consumption [6, 7, 8, 9]. Increased SCC on milk is causes of farm economic losses due to mastitis and poor quality of milk [10, 11, 12].

The objectives of the study were twofold: Firstly to determine the effects of the SCC in bulk milk farm management and its commercial perspective according to the milk quality standards in Kosovo. Secondly, to conduct a risk assessment of milk quality at collection sites in Kosovo through collaborative process with the collection and distribution of milk

from small scale collection sites that can be used in Kosovo.

Material and Methods

The eligibility for herd selection criteria was the sample unit consisting of about 200 dairy herds supplying milk to 2-4 collection centers from the regions: Skenderaj, Podujeva, Rahovec and Suhareka in Kosovo. Herds milked ≥ 5 cows, and had a plan to be milking cows commercially for at least the next 2 years and were willing to sign an informed consent document. The milk was collected in the same day by two dairy processing companies (ABI and Bulmeti). Despite the fact that there is no standard bulk tank milk (BTM) sampling and monitoring procedures, students were trained to conduct milk sampling.

The students of Faculty of Agriculture and Veterinary of the University of Prishtina) were responsible for milk sampling and farm data collection. The analyzes of SCC derived from 16

weekly milk samples collected in 4 months across the lactation period June – December, 2011 (Table 1). The daily test milk sample delivered to milk collection points amounted to 40-50 mL of milk which were pooled together in a sterile bottle containing azidol for sample preservation and were placed in a portable cooler at 4 °C. These samples will be transported to the National Veterinary Laboratory and assessed for SCC. In general, registration cards were used for cow data recording with: identification number, sample number, farm name, and some other information relevant to this study. In a few cases, incomplete or unclear data were excluded from the data.

Somatic cell content was analyzed at the Kosovo Veterinary and Food Agency (KVFA) laboratory using “FossomaticMinor” equipment. The results gained were compared according to the Administrative Instructions MA-nr. 20/2006 used to define milk quality standards and raw milk category (Table 2).

Table 1. Milk sampling schedule per farm.

Milk sampling*	June 2011	August 2011	October 2011	December 2011
Weekly milk samples collected for SCC *	4	4	4	4

*Milk samples were used to determine the Total bacterial Count (TBC) and residues, as well.

Table 2. Raw milk quality standards in Kosovo (SCC/milk).

Year	Extra class	Class I st	Class II nd	Class III ^d
2007	<400,000	<500,000	<600,000	>600,000
2008	<300,000	<400,000	<500,000	<600,000
2009	<200,000	<300,000	<400,000	-

Statistical analyzes. The data were analyzed using JMP- starter packet a business unit of SAS program, [13] by PROC- GLM procedure (General Linear Model). The Duncan test was used [14] to see the effect of different variables in SCC.

Results

Using general linear model, a statistically high significant relationship ($P < 0.0001$) has been found between numbers of SCC with milk collection points (Table 3). This relationship enables determining the probability of findings for the relevant mastitis incidents at different farms.

In this study, when the changes of month SCC means values by different were evaluated, it was observed that SCC means were highest in the June and the lowest in the October (Table 4), showing a high significance differences between them ($P < 0.001$). However, no statistical difference was determined among SCC means of raw milk samples in August, October and December). SCC values of milk samples decreased with advancing at colder season.

Analysis of the arithmetic mean-SCC values were assessed by regarding two dairies (ABI and Bulmeti) in the study (Table 5).

It can be seen that means of raw milk samples were relatively in high levels on both dairies

determining statistical difference ($P < 0.009$). Milk samples from ABI dairy were contaminated with about 814.200 SCC/mL compared to samples analyzed from Bulmeti dairy showing about 701.100 SCC/mL.

Table 3. Effect of dairy milk collection point on milk contamination with SCC/mL

Milk collection point	N	X±SE (in 000)	STDEV (in 000)
Podujeve	426	682.7±29.3 ^b	304.8
Rahovec	890	880.8±27.0 ^a	604.1
Skenderaj	415	671.6±36.8 ^b	538.9
Suharekë	338	724.4±38.6 ^b	404.4
Analyses of Variance	<i>Df</i>	Pr>F	
Milk collection point	3	0.0001	

Table 4. Effect of month on raw milk contamination with SCC/mL.

Month	N	X±SE (in 000)	STDEV (in 000)
Jun	859	916.7±27.4 ^a	413.0
August	446	721.0±34.1 ^b	404.5
October	289	626.7±40.0 ^b	308.3
December	475	649.6±29.7 ^b	402.2
Analyses of Variance	<i>Df</i>	Pr>F	
Month	3	<.0001	

Table 5. Raw milk quality standard per dairy unit (SCC/ mL)

Dairy	N	X±SE (in 000)	STDEV (in 000)
ABI	1305	814.2±22.0 ^a	492.0
Bulmeti	764	701.1±23.6 ^b	352.9
Analyses of Variance	<i>Df</i>	Pr>F	
Dairy	1	<.0009	

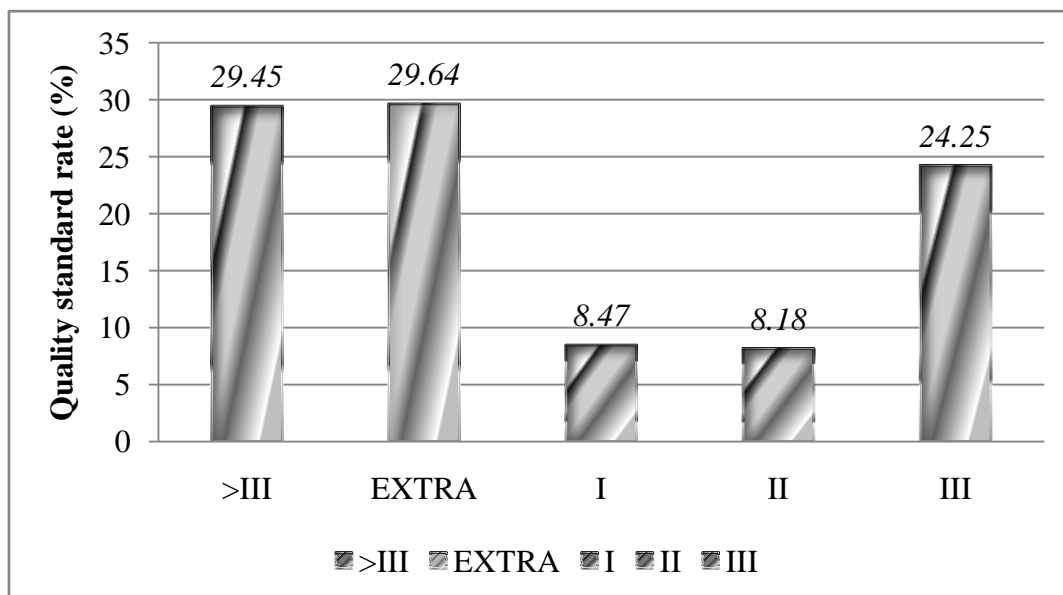


Figure 1. The proportion of quality milk during standards (SCC/mL) according to existing standards in Kosovo.

As demonstrate in Figure 1, only 29.6% of the bulk tank milk samples were free of contamination with SCC, considered at extra class for raw milk quality standard (<300,000 SCC/mL). Approximately 29.5% of the milk samples were contaminated with

more than <600,000 SCC/mL ranging at poor quality milk (>III class), 8.5%, 8.2% and 24.5 ranged between <400,000 and <500,000 SCC/mL milk, classified as I'st, II'd and III'd milk quality standard.

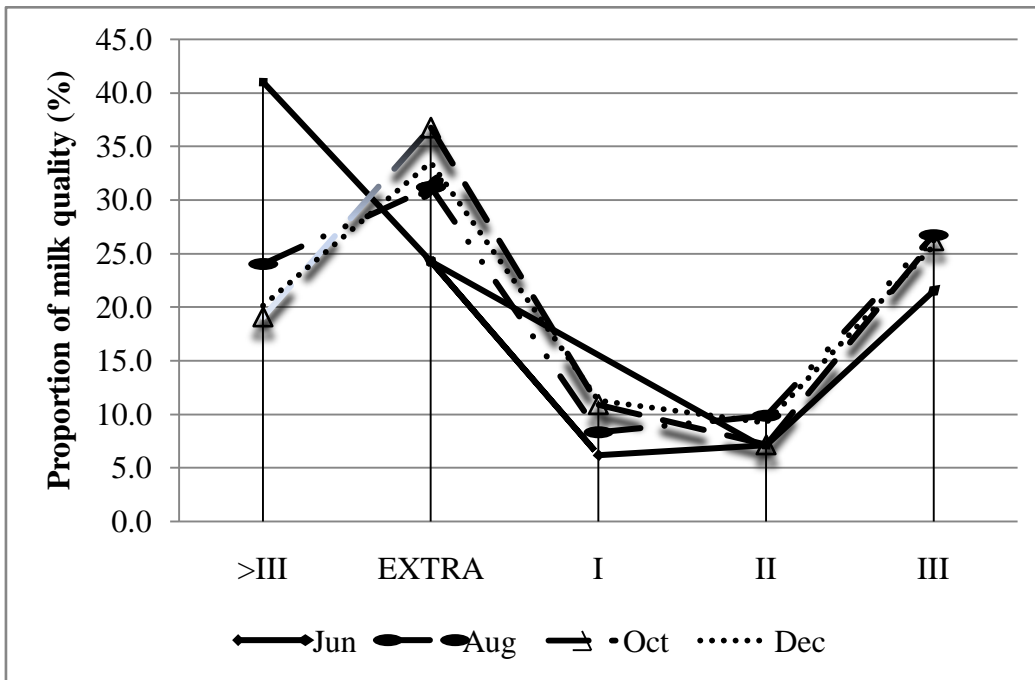


Figure 2. The proportion of quality milk standards (SCC/mL) during the sampling period.

The proportion of quality milk during standards during the sampling period were presented in Figure 2. The proportion of extra milk according to SCC was the highest in October 36.7% and the lowest in June 24.3%. In August and December about 33.5% and 31.2% of milk respectively ranked under this milk quality standard. Raw milk under the quality standard Ist and IInd ranged between proportion 6.2-11.3%

and 7.1-9.9%, while III^d class milk proportion sampled in about 21.5% in June increasing at 25.8% of milk samples in August. Poor milk quality considered under >III^d class milk milk quality was the highest in milk sampled in June, about 41.0%, dropping at 24.0% in August, 19.1% in October and 20.1% in December, respectively.

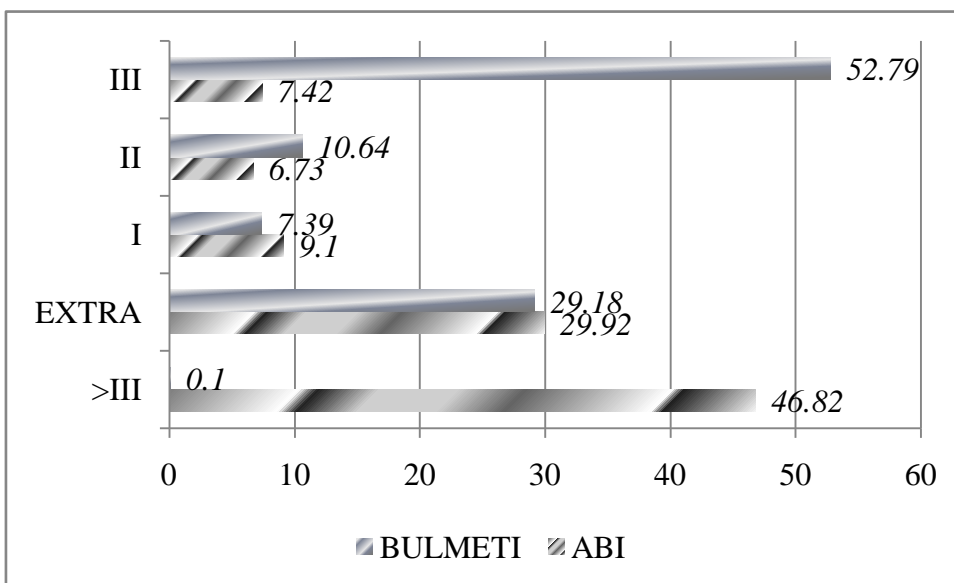


Figure 3. The proportion of quality milk during standards (SCC/mL) according to dairy unit.

The proportion of quality milk during standards (SCC/mL) according to dairy unit were depicted in Figure 3. At ABI dairy, the proportion of extra milk

was about 29.9%, Ist class milk proportion was about 9.1%, IInd class was 6.7%, about 7.4% of milk ranked under the III^d class, while the other

proportion of 46.8% was of poor quality considered under the >III'd class standard. For Bulmeti dairy, the proportion of extra milk was about 29.2%, I'st class

milk proportion was about 7.2%, II'nd class was 10.6%, while the other proportion of 52.8% ranked under the III'd class standard.

Table 7. Economic effects* for milk according to the SCC/mL raw milk quality standard.

Parameters	Period			
	June	August	October	December
No. farms	200	200	200	200
No. cows per farm	10	10	10	10
Average milk production (kg/cow)**	17.0	17.0	17.0	17.0
Production per lactation length 305 d	51.850	51.850	51.850	51.850
Extra class milk SCC/mL (%)	24.3	31.2	36.7	33.5
Butterfat content (%)	4.2	4.2	4.2	4.2
Price per butterfat unit (€)	0.09	0.09	0.09	0.09
Price with premium (€/kg)	0.43	0.43	0.43	0.43
Price without premium (€/kg)	0.38	0.38	0.38	0.38
Total milk (kg/d)	34000	34000	34000	34000
Total milk with premium extra class (kg/d)	8262	10608	12478	11390
Total milk without premium (kg/d)	25738	23392	21522	22610
Revenue for milk with premium (€d)	3552.7	4561.4	5365.5	4897.7
Revenue for milk without premium (€d)	9780.4	8889.0	8178.4	8591.8

* No cost for milk production were calculated (feed, health, etc); ** Milk average (kg/d) per cow were based on [15].

Milk revenues for milk according to the presence of SCC in milk are given on Table 7. Kosovo dairies, including those two involved in the study (Bulmet and ABI), apply 10% premium price for extra quality milk delivered for total bacterial count (TBC) and SCC. According to this results, the calculated milk produced of about 34000 kg/d from about 200 farms included in the study and considering average milk production from previous study 17.0 kg/d milk per cow [15], only 8262, 10608, 12478, and 11390 kg/d milk belongs to premium price milk for the respective months of June, August, October and December, respectively.

Discussion

In this study, our goals were to improve the safety of milk produced from small-holder dairy farms in the emerging market of Kosovo using methodologies that can be adapted for use on farmstead dairy production and processing facilities. Improvement in milk safety will be achieved by developing a clear assessment tools to identify risks

related to current practices, including SCC presence in raw milk.

According to the results attained, lead us to the conclusion that the amount of somatic cells (SCC) in raw milk identified from the dairy farms included in this study is relatively high according to the standard in the country. This could be explained if taking into consideration the large managerial differences from farm to farm, breed structure, farm infrastructure, and the present structure of animal health control in the country. Using the same raw milk quality standard, the overall SCC milk contamination situation tend to be negative (about 29.5% (SCC/mL<400.000) if compared with the results from the previous study in Kosovo by [15] reporting smaller portion of SCC in raw milk compared to standards for raw milk quality, 11.3% (SCC/mL<400.000) not met the standards for raw milk in 2009. This could be due to by herd somatic cell numbers were assessed based on a bulk tank sample that represents the whole herd compared to the early result of testing individual cows.

A part of direct milk economic impact related to premium price, it is crucial to understand the fact the somatic cell are inevitably part of mastitis health problems. Knowing this, a several important points must be considered, as the source and function of somatic cells, SCC concentration in raw milk and relationship to physiologic factors of milk production, following impact on quality of milk and milk products, etc.

Considering that SCC's are the indicator of herd health, it is essential the implementation of a typical SCC testing program for individual cows and on bulk tank bases in a country level. Nowadays, a key health and economic element of dairy herds is also a mastitis control that involves bacteria control. Maintaining a clean environment limiting exposure to different pathogens, minimizing transfer of contagious mastitis during milking time, etc, are key factors in effective dairy farming. Best practices should be identified and applied to improve milk quality, animal and public health in Kosovo. Identification of high presence of SCC from the study can be used for the development of management strategies to reduce the SCC at farm level, implementing best farm management practices, as: clean milk system, sheds, milking routine, parity, lactation phase, etc. Introducing, milk recoding at national level will support early identification of mastitis, reduce economic losses and improve milk quality.

Conclusions

In order for Kosovo to modernize its dairy industry it must ensure a higher standard of milk quality from milk originating at farm level and collection centers. The research conducted in this study develops current knowledge on bulk milk SCC in small and semi-extensive dairy system in Kosovo, from management and production perspectives. The study includes various associations with bulk raw milk quality and presence of SCC i.e. Economic effects producing a premium price milk, farm management practices, association with milk quality, sampling period, etc. Interpreting results from the milk analyses based on SCC, the study provides knowledge on the management practices for a representative sample of farms in Kosovo, and emphasizes the important relationships between effective farm management strategies, SCC and animal and public health.

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