

# Somatic cell counts in bulk milk and their importance for milk processing

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**Abstract.** Bulk tank milk somatic cell counts are the indicator of the mammary gland health in the dairy herds and may be regarded as an indirect measure of milk quality. Elevated somatic cell counts are correlated with changes in milk composition. The aim of this study was to assess the somatic cell counts that significantly affect the quality of milk and dairy products. We examined the somatic cell counts in bulk tank milk samples from 38 farms during the period of 6 months, from December to the May of the next year. The flow cytometry, Fossomatic was used for determination of somatic cell counts. In the same samples content of total proteins and lactose was determined by Milcoscan. Our results showed that average values for bulk tank milk samples were 273,605/ml from morning milking and 292,895/ml from evening milking. The average values for total proteins content from morning and evening milking are 3,31 and 3,34%, respectively. The average values for lactose content from morning and evening milking are 4,56 and 4,63%, respectively. The highest somatic cell count (516,000/ml) was detected in bulk tank milk sample from evening milk in the Winter and the lowest content of lactose was 4,46%. Our results showed that obtained values for bulk tank milk somatic cell counts did not significantly affected the content of total proteins and lactose.

## 1.Introduction

Bovine mastitis is the most prevalent and costly disease, affecting dairy farms worldwide. Economic losses associated with mastitis derive mainly from a decrease in milk production and to a lesser extent, from the culling of chronically infected cows, cost of veterinary treatment, and penalties on milk quality [1]. Bovine mastitis is characterized by inflammation of the mammary gland. The inflammation severity depends on the causative agent and the host response. Resident and recruited cells together play an essential role in immediate defense against local infection [2]. Somatic cells are therefore a reflection of the inflammatory response to an intramammary infection. The somatic cell counts (SCC) for an uninfected quarter is approximately 70, 000 cells. There is variation around this mean, so its value can increase with age, decreasing milk production and days in milk period [3]. Bulk tank SCC is a general indicator of the udder health in a herd and it is also regarded as an indirect measure of milk quality [4]. Elevated SCC, are correlated with changes in milk composition, casein and more serum-derived whey proteins, as well as increased proteolytic and lipolytic activities [5]. Researches has defined the "gold standard" somatic cell counts up to 100,000 cells / ml, and values greater than 100,000 cells / ml are considered to result in the reduction of production and quality of milk during processing [6]. The increase in the number of somatic cells in the milk is followed by change in the chemical composition of milk by lowering casein, lactose, calcium, and an increase of



sodium, chloride and serum proteins. In dairy herds, where the somatic cell counts are greater than 300,000/ml milk, are proposed to be present a mastitis problem in herd, and such milk is less suitable for the processing [7] Due to the reduced secretory capacity of the mammary gland cells in mastitis, the percentage of lactose in milk is decreased. In addition, milk with high somatic cell counts can contain microorganisms whose presence in milk can pose a risk to human health especially to vulnerable population [8] The aim of this study was to assess the number of somatic cells that significantly affect the quality of milk.

## 2. Materials and methods

The material represented 38 bulk milk samples of morning and evening milking from 38 farms during the period of 6 months, from December to the May of the next year. The samples were taken from the tank, not preserved and the analyses started in the laboratory in 6 hours after sampling. The content of total proteins, lactose and somatic cell counts were determined in the samples. Somatic cell counts were determined by flow-cytometry by Fossomatic 5,000. The total content of proteins and lactose in bulk tank milk samples were determined by Milcoscan.

## 3. Results and discussion

The results of determination of total proteins, lactose content and SCC counts from morning milking and evening milking are presented in the Table 1 and 2.

**Table 1** Results of determination of total proteins, lactose content and somatic cell counts from morning milking

Stat. param.	Total proteins (%)	Lactose (%)	SCC/ml
Average	3,31	4,56	273,605
Standard dev.	0,11	0,05	80,357
Min	3,02	4,49	75,000
Max	3,47	4,67	446,000
Varition (%)	3,21	1,03	29,370

Stat. param.	Total proteins (%)	Lactose (%)	SCC/ml
Average	3,31	4,56	273,605
Standard dev.	0,11	0,05	80,357
Min	3,02	4,49	75,000
Max	3,47	4,67	446,000
Varition (%)	3,21	1,03	29,370

The obtained results showed that the average value for SCC in the winter from morning milking was 273,605 cells per ml, and the content of total proteins and lactose was 3.31% and 4.56% respectively. The somatic cell counts ranged from 75 to 446,000/ml. Nineteen bulk tank milk samples had lower somatic cell count from 250,000 cells /ml and only 1 sample had a value of less than 100,000 and 3 samples of over 400,000 (Table 3).

**Table 2** Results of determination of total proteins, lactose content and somatic cell counts from evening milking

Stat. param.	Total proteins (%)	Lactose (%)	SCC/ml
Average	3,34	4,63	292,895
Standard dev.	0,19	0,23	72,743
Min	3,06	4,47	168,000
Max	4,41	5,56	516,000
Varition (%)	5,89	4,97	24,836

Stat. param.	Total proteins (%)	Lactose (%)	SCC/ml
Average	3,34	4,63	292,895
Standard dev.	0,19	0,23	72,743
Min	3,06	4,47	168,000
Max	4,41	5,56	516,000
Varition (%)	5,89	4,97	24,836

The obtained results showed that the average value for SCC in the winter from evening milking was 292.895 cells per ml, and the content of total proteins and lactose was 3.34% and 4.63% respectively. The somatic cell counts ranged from 168 to 516 cells  $\times 10^3$  / ml. Twelve samples of raw milk had lower somatic cell count of 250,000 cells /ml. in no one sample the number was lower than 100,000., and in four samples the number was higher than 400,000/ml. Total protein content ranged from 3.06 to 4.41, and lactose from 4.47 to 5.56.

The content of total proteins and lactose is slightly higher in bulk tank milk samples from evening milking as result in season variation [3],[9] reported a significant decrease in casein content when either Holstein or Guernsey milk exceeded SCC of 500,000; depression was greater above one million SCC. SCC above 500,000 has been associated with poor quality cheese because of increased rennet to cutting time and lower curd firmness. The mastitis or elevated SCC is associated with a decrease in lactose,  $\alpha$ -lactalbumin, and fat in milk because of reduced synthetic activity of mammary tissue [10]. With higher SCC, the concentrations of serum albumins and immunoglobulins increase which reduces heat stability of mastitis milk, causing coagulation, or flocculation during pasteurization. [11] investigated the relationship between SCC and composition (total solids, fat, protein and lactose content) of milk from individual Holstein cows and indicated that SCC of individual cow's milk significantly correlated with a decrease in milk constituents only under conditions of average SCC in bulk milk above 1,000,000 /ml. Negative correlation between lactose and chloride content was detected in cows diagnosed with subclinically mastitis with high SCC [12].

In Table 3 are presented the results of somatic cell counts in bulk tank milk samples from the morning and evening during six months-

**Table 3** The results of somatic cell counts in bulk tank milk samples from the morning and evening during six months

Stat. param.	December m	January e	February m	March m	April m	May e
Average	273,605	292,895	270,026	254,974	256,316	295,895
Standard dev.	80,357	72,743	87,765	93,736	93,310	74,539
Min	75,000	168,000	101,000	111,000	58,000	142,000
Max	446,000	516,000	499,000	483,000	463,000	496,000
<100	1	0	0	0	1	0
<250	19	12	18	21	16	10
>250	15	22	16	13	18	24
>400	3	4	4	4	3	4
Varition	29,370	24,836	32,502	36,763	36,404	25,191

Legend: m-morning milking; e-evening milking

The highest value for SCC (516,000/ml) was in bulk tank milk samples from evening milking in the Winter (the January) and the lowest (58,000/ml) in the April.

The process of using bulk tank milk analysis in useful tool in improving milk quality and herd mammary health. It should be kept in mind that although individual cow samples for milk culture and SCC are more definitive for diagnosis and monitoring of udder health, Bulk tank milk analysis is less expensive, more convenient, and faster than testing milk samples from individual animals or groups of cows. When the SCC of bulk tank milk is interpreted within the context of the farm's management practices, this information provides a basis for evaluating current and potential milk quality and mastitis problems in a herd.

#### 4. Conclusions

The process of using bulk tank milk analysis in useful tool in improving milk quality and herd mammary health. Our results showed that average values for bulk tank milk samples was 273,605/ml from morning milking and 292,895/ml from evening milking. The average values for total proteins content from morning and evening milking are 3,31 and 3,34%. The average values for lactose content from morning and evening milking are 4,56 and 4,63%. The highest SCC (516,000/ml) was detected in bulk tank milk sample from evening milk in Winter. The highest SCC (516,000/ml) was detected in bulk tank milk sample from evening milk and the lowest content of lactose was 4,46%. The obtained values of bulk tank milk somatic cell counts did not significantly affect the content of total proteins and lactose.

Proper milking techniques, improved sanitation, effective use of teat, dipping and dry period therapy and improvement in management may reduce SCC by reducing the spread of new infections.

#### References

- [1] Seegers H, Fourichon C and Beaudeau F 2011 Production effects related to mastitis and mastitis economics in dairy cattle herds. *Vet. Res.* **34** 475–491
- [2] Rainard P, Riollot C. 2006 Innate immunity of the bovine mammary gland. *Vet. Res.* **37** 369–400

- [3] Schepers AJ, Lam, TJGM, Schukken YH, Wilmink JBM & Hanekamp WJA 1997 Estimation of various components for somatic cell counts to determine the threshold for uninfected quarters. *Journal of Dairy Science* **80** 1833–1840
- [4] Schukken, YH, Wilson, DJ, Welcome, F, Garrison-Tikofsky L and Gonzalez RN 2003 Monitoring udder health and milk quality using somatic cell counts. *Veterinary Research*. **34** 579-596
- [5] Auldis MJ and Hubble IB 1998 Effects of mastitis on raw milk and dairy products. *Aust. J. Dairy Tech* **53** 28-36.
- [6] Hamann J 2002 Relationships between Somatic cell counts and milk composition. *Bulletin of the IDF* **372** 56-59.
- [7] Pitkala A, Haveri M, Pyorala S, Myllys V and Honkanen-Buzalski T. 2004 Bovine Mastitis in Finland 2001—Prevalence, Distribution of Bacteria, and Antimicrobial Resistance. *J. Dairy Sci.* **87** 2433–2441 American Dairy Science Association
- [8] NMC Board of directors report 2005 Human health risks associated with high somatic cell count milk. Symposium summary *website: www.nmconline.org*.
- [9] Haenlein G FW, Schultz LH and Hansen, LR 1973 Composition of proteins in milk with varying leukocytes counts. *Journal of Dairy Science* **56** 1071-1024
- [10] Harmon R J 1994 Physiology of mastitis and factors affecting somatic cell counts. *Journal of Dairy Science* **77** 2103-2112
- [11] Fernandes AM, Oliveira CAF, Tavolaro P 2004 Relationship between somatic cell counts and composition of milk from individual Holstein cows. *Arq. Inst. Biol. Sao Paulo* **71** 163-166.
- [12] Ahmad J, Hussain I., Mahmood N. and Munir R. 1988 Lactose determination as an aid to subclinical mastitis diagnosis. *Pakistan Vet. J.* **8** 25-28
- [13] Sharif A. and Muhammad G 2008 Somatic cell count status as an indicator of udder health status under modern dairy production: a Review. *Pakistan Vet. J.* **28** (4) 194-200
- [14] Jayarao BM, Wolfgang DR. 2003 Bulk-tank milk analysis. A useful tool for improving milk quality and herd udder health. *Vet Clin North Am Food Anim Pract.* **19** (1):75-92.