SOMATIC CELL COUNT OF MILK FROM DIFFERENT GOAT BREEDS

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Abstract

There is no standard limit value for somatic cell count (SCC) of raw goat milk in EU despite the excellent hygienic quality milk is needed for the manufacture of fermented milk products or cheese varieties. Mastitis often results such high SCC - besides the potential risk for humans - that the clotting of milk will not be perfect resulting slack curd with higher whey releasing, furthermore, wrong structure, ripening, bad sensory properties of cheeses can be its' consequences. In this paper, we report the SCC of milk samples from five different goat breeds bred in Hungary, measured with two fast methods compared with the results from reference method. Furthermore, we investigated the applicability and the accuracy of the MT-02 02 (Agro Legato LTD., Hungary) instrument was used. We determined that the White Side test and the instrument MT-suitable for the estimation of possible risks and consequences in the case of the use of high SCC milk – before the product making. The general summarized average milk SCC was $6.64*10^5$ ml^{-1}. The highest difference between the results from MT-02 and fluoro-optical (reference) method was $5*10^5$ ml^{-1} but it was a lonely extreme value. The r^2 of the calculated linear calibration equation was 0.7819; consequently, this method seems to be applicable for the measurement of SCC with MT-02 instrument. Furthermore, the SCC of samples did not differ by genotypes and by seasons (spring: $5.85*10^5$ ml^{-1}; autumn: $6.22*10^5$ ml^{-1}).

Key words*:* SCC, goat milk, fast test

INTRODUCTION

The popularity of milk products - mainly cheeses – made from goat milk associated with high physiological value shows a rising tendency. Mainly soft cheeses are made from goat milk and they show a high variety by shape, size, and flavouring. Usually, the goat milk is processed in small creameries (farmer creameries) by hand on the base of the traditions regarding the consumers' demands.
The fermentation ability of milk is a very important criterion of cheese making. Both the fermentation ability of milk and the quality of cheese are also decisively influenced by the hygienic quality of raw milk [18]. Somatic Cell Count (SCC) is a representative of these hygienic properties regulated trough strict directives giving limit value in many countries (e.g. $4x10^5$ ml^{-1} for cow milk). But most of countries there is no regulation for SCC of raw goat milk. However, SCC of milk has been strongly investigated also by many Hungarian researchers in the past so nowadays we possess important knowledge related to the adverse effects of Mastitis, and Subclinical Mastitis on cheese making [11], [7], [20].
More researchers published close relationship between high SCC of milk and cheese yield and losses of constituents in whey [2], [14], [12]. Similar observation was also published by some researcher investigating goat milk proved that the fast determination of SCC of raw goat milk is essential for making fermented milk products and cheeses [9], [21], [13], [3]. Well, there is a need fast methods - due to the specialty of small scale milk processing and the lack of regulation – in order to select of very high SCC goat milk because this poor quality milk is not suitable for cheese making.

Our objective was the SCC monitoring of raw milk samples from different goat breeds and from different lactation period. Whiteside test and MT-02 instrument (Agro Legato, Budapest, Hungary) were used for SCC determination. Additionally, we evaluated the applicability, and the precision of MT-02 instrument - fast test for SCC determination. Data also came from official

fluoro-optical method (Fossomatic instrument) for this objective.

MATERIALS AND METHODS

Materials

The samples was collected from two farm existed on the Great Hungarian Plain. Kidding was scheduled for spring (February-March) in both farms. Farm A: the samples were collected three times from ten Alpine and ten Saanen goats at spring and at autumn. Samples of Hungarian White goat came from 10 goats collected three times during July, August and September. Farm B: the samples were collected from 10 Alpine and from 10 Alpine x Saanen crossbred goats also at spring and autumn seasons but only at autumn from 10 Domestic (Native) goats (Farm B). Goats were milked by hand twice a day. Samples were prepared by mixing of morning and evening individual milks and were stored at 5 °C until classification. The samples were investigated at the laboratory of Department of Food Engineering, Faculty of Engineering, University of Szeged, Hungary. The samples used for the calibration of MT-02 instrument were also investigated at the Hungarian Dairy Research Institute (HDRI) Ltd., Budapest, Hungary.

Methods

Whiteside test

Whiteside test is based on the complex molecule formation between the Sodium hydroxide and DNA of somatic cells and then the denaturation phenomenon. The evaluation is based on the ratio of visible denaturation with naked eyes [16]. Milk is accepted (test is negative; ("-") if there is no change in any visible milk properties including the consistency. Result is positive ("+") if visible small (clumping) particles appear in the sample (approx. 0.5 mm diameter, like semolina). In this case, the SCC is between $2.5*10^5$ ml^{-1} – $1.0*10^6$ ml^{-1}. We used samples only representing this two classification groups in the evaluation.

MT-02 instrument

The principle of this test is very similar to Whiteside test. The SCC determination based on the change of the viscosity of milk sample.

10 ml milk sample (37°C) has to be mixed with 5 ml 20% reagent (diluted with distilled water) rapidly then it has to be filled into the funnel and the measure has to be start immediately. The structure of instrument is very similar to a Höppler viscometer, the viscometer pipe is forced to rotate to an adjusted angle after 20 sec. The results can be read from the scale built in the pipe. The measuring range is between $10*10^3$ – $2*10^6$ ml^{-1}. This method developed for cow milk measuring so we had to make a calibration using goat milk samples with known SCC came from HDRI. For this purpose, first, twenty Saanen goat milk samples were investigated both with MT-02 instrument and with official fluoro-optical method.

RESULTS AND DISCUSSION

Estimation of the applicable of MT-02 Instrument, calibration

In order to the evaluation of the precision of data from MT-02 Instrument, we measured 20 raw milk samples from Saanen goats. Samples were measured first by MT-02 Instrument and then the suitable 10 samples were sent to the HDRI laboratory. After receiving data, we looked for the correlation between data groups came from different methods. Our hypothesis was that if the correlation is sufficiently close, using this correlation equation and data from MT-02 instrument, we can create similarly precise data as come from the reference method. Fig. 1 shows the correlation between the official data and MT-02 instrument's data. The acceptable determination coefficient of presented trend line gave us a chance to obtain more precise evaluation of SCC of goat milk compared to Whiteside test. This correlation equation was used for SCC determination in the further investigations.

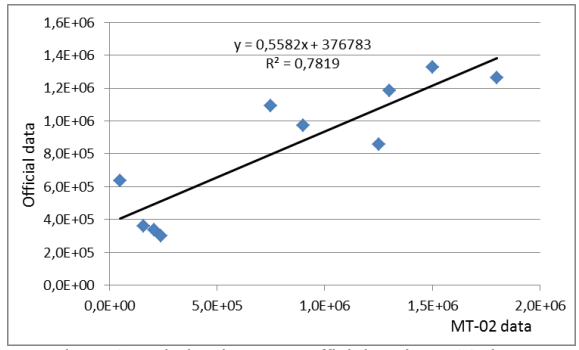

Fig. 1 Correlation between official and MT-02 data.

Results from different goat breeds

The summarized average of measured samples determined with MT-02 was 5.69*103 ml-1 but the values varied in a very wide range. Summarized data of all measured samples are presented in Table 1.

Table 1 Comparison of the original MT-02 and modified data using explored calibration (n=116)

"Method"	Average (10^3 ml^{-1})	Variation (10^3 ml^{-1})	CV (%)
Original MT-02 data	569	669	117.5
Data from calibration	665	365	54.9

30% of all samples didn't fit in the measurement range was 1.0*103 ml^{-1} – 2.0*106 ml^{-1} may be due to the abnormal composition of milk samples causing extreme low or extreme high milk viscosity. We have not investigated the reasons of this phenomenon; consequently, we cannot to give correct explanation of it. By our results, the SCC values from MT-02 were underestimated. The calibrated SCC average was "only" 9.5*105 ml^{-1} higher than the original MT-02 value, but the difference between the data pairs from different methods showed a very high variation (5.0*104 – 5.0*105 ml^{-1}).

The precision of MT-02 instrument has already investigated using cow milk and 1.18*105ml^{-1} average difference was determined from the official data [1]. Our calculated difference is standing very close to his data suggesting that MT-02 can be used also for measuring of SCC of goat milk but mainly for SCC value below 1*106ml^{-1}. We explain this limited applicability with the special resolution of the scale of the instrument because of the resolution is enough fine only below value of 1*106ml^{-1}, and with the use of only a few number of samples for calibration. The smallest difference between official and MT-02 data was explored in the range of 5.0*105ml^{-1} – 8.0*5*105ml^{-1}. We strongly suggest taking into consideration of these comments reviewing of our detailed results.

Alpine goats

The milk samples from Alpine goats were measured in spring and in autumn in both goat farm (Table 2). In addition, the first sampling was managed during suckling period at the farm "A". SCC averages of Farm B from both of two seasons were very similar.

Table 2 SCC of milk samples from Alpine goats ($10^5$$ml^{-1}$) n=120

	Farm A		Farm B	
	Autumn	Spring	Autumn	Spring
Min.	3.80	4.90	3.90	2.60
Max.	11.00	14.00	8.60	12.00
Average	**7.28**	**9.25**	**5.90**	**5.78**
Variation	3.50	4.76	2.69	3.02
CV%	48,08	51,46	45,59	52,25
[1]WST (%)	**67.90**	**63.40**	**70.80**	**68.80**

[1]: data represent the result of Whiteside tests and they show the summarized ratio (%) of negative and + samples. Estimated SCC<1.0*$10^6$$ml^{-1}$.

We notice that one sampling was managed before kid's separation. Furthermore, the SCC average of milk samples from this sampling was lower than the summarized average of data this farm, consequently the suckling had no adverse effect on SCC of milk, and did not cause SCC increase. The average SCC values in the farm A were higher than in farm B but any of averages did not exceed $1*10^6ml^{-1}$ threshold. This result differs from Varga (2008) who explored higher SCC than $1*10^6ml^{-1}$ in the case of all investigated samples from refrigerated storage [20]. In our investigation, 28% of Alpine goats' milk samples reached this limit. This result can be mentioned as quite good result regarding the large number of samples exceeded the measuring limit of MT-02 instrument.

Other breeds

The SCC averages of samples from Hungarian White goats presented quit higher values (Table 3). Mastitis was explored most frequently in this breed. Higher SCC values were typical, and we found more samples having extreme high SCC at each sampling. Extreme viscosity increase and stickiness was visible in mentioned samples after adding the reagent into milk avoiding the measure.

Results of samples from Native, Saanen and Alpine x Saanen crossbred goats is presented in Table 4. Domestic goats showed a wide variation regarding the horn and colour. There were black&white, fawn-coloured, grey and white goats as well. Results from Domestic (Native) goats showed the highest variation.

Table 3 SCC of milk samples from Hungarian White goats (10^5ml^{-1}) n=90

	July	**August**	**September**	**Average**
Min.	3.60	5.80	5.60	5.00
Max.	9.30	11.00	17.00	12.40
Average	**6.93**	**9.05**	**11.2**	**9.06**
Variation	3.54	2.94	5.07	3.85
CV%	51.08	32.49	45.27	42.49
***WST**	**71.80**	**63.20**	**57.40**	**64.10**

*: data represent the result of Whiteside tests and they show the summarized ratio (%) of negative and + samples. Estimated SCC < $1.0*10^6ml^{-1}$.

Evaluating our results, we can mention these results are very similar to the results have cited from Hungarian and from some foreign authors [17], [6], [15]. However, our SCC averages didn't not reach results published by others [5], [4]. Furthermore, many authors, including us, agree that SCC of goat milk is higher than that of cow milk, even though goats do not suffer in mastitis. This observation also implies that close relationship between the SCC of goat milk and goat's health status is not as clear, as in the case of cow milk. MT-02 instrument seemed most precise between the SCC range of $4.0\text{-}8.0*10^5ml^{-1}$.

Table 4 SCC of samples from Native, Saanen and Alpine x Saanen crossbred goats (10^5ml^{-1}) n=150

	Domestic		**Saanen**		**Alpine x Saanen**	
	Autumn	**Spring**	**Autumn**	**Spring**	**Autumn**	**Spring**
Min.	2.10	nd	4.90	1.80	1.60	5.90
Max.	8.20	nd	8.10	8.80	9.20	9.60
Average	**6.87**	**nd**	**6.22**	**5.85**	**5.91**	**8.87**
Variation	3.24	nd	2.95	3.10	3.17	2.63
CV%	47.16	nd	47.43	52.99	53.64	29.65
***WST**	**48.20**	**nd**	**73.40**	**75.10**	**69.80**	**61.10**

*: data represent the result of Whiteside tests and they show the summarized ratio (%) of negative and + samples. Estimated SCC< $1.0*10^6ml^{-1}$. nd= There is no data.

The results of Whiteside tests are also proved that SCC of goat milk seems good quality can exceed remarkably the SCC of cow milk. It can be explained by the different physiology and different milk secretion mechanisms of goat and cow [10]. As an example, in the USA the action limit (threshold) refers to SCC of goat milk is

$1*10^6 ml^{-1}$. Regarding our results came from Whiteside tests we can presume that the "negative" and "+" samples give 60-70% of all goat milk of a typical goat farm. It can be mentioned, that the milk samples represent "++" or "+++" of Whiteside test classification have limited value, (SCC exceeds $1*10^6 ml^{-1}$) they are usually not homogenous, and they are very often contain sticky and mucous precipitations. We can confirm that goat milk having with very high SCC mentioned above is not fit for making fermented goat milk products. Furthermore, it is sure that goat milk has very high SCC (with serious precipitations) is not fit for making any kind of milk products. Additionally, based on our result, we agree the suggestion of some researcher to use standards made from goat milk and not from cow milk for the calibration of SCC measuring instruments measuring goat milk [22]. The producer of MT-02 instrument would create a new scale of MT-02 for measuring of goat milk samples. Furthermore, there is a need to investigate a huge number of samples in the future research to refine the precision of this method and we suggest to use it only in the range of $2.0*10^5 ml^{-1} – 1.5*10^6 ml^{-1}$ in order to the highest reliability.

CONCLUSIONS

Demand of the industrial consumers and that of gastronomy related to importance and necessity of extra quality goat milk – including low SCC – become stronger and stronger. The correct threshold of SCC is strongly discussed that's why there is no requirements for goat milk SCC in many-many country neither in European Union. In this current work, SCC of the investigated milk samples from different goat breeds shown a wide range confirming data from literature. But the judgement of the applicability of goat milk batches have SCC above $10^6 ml^{-1}$ for making high quality milk products is very uncertain and can result milk products with bad sensory and texture properties. Furthermore milk has higher SCC than $10^6 ml^{-1}$ probably come from goat suffers subclinical Mastitis. Fast tests can help breeders to produce low SCC goat milk and the standardization process to determine a limit value in order to the selection of high quality goat milk. We can state that the MT-02 Instrument (Agro legato Ltd, Hungary) can be used the evaluation of goat milk SCC using our correlation equation. This method is more precious than Whiteside test but there is a need more data to develop a reliable and more precise instrument version.

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