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Using Viscosity Values for Determining Somatic Cell Count in Cow Milk

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ABSTRACT

This study was carried out to determine using possibility of viscosity values for determination of dairy milk quality. Bucket raw bovine milk samples collected from smallholder dairy farms were analyzed on five test days. While somatic cell count of milk samples (DMSCC) were obtained by direct microscopy, viscosity values (VMSCC) were assessed by a viscosty meter. In spite of relatively lower values had been recorded in VMSCC, no significant difference was found according to both methods. In subgroup evaluation by DMSCC and VMSCC, 22.4 and 34.0% of the samples were lower than the legal SCC limit for human consumption, respectively. Calculated high correlation ($r = 0.783$, $p<0.01$) between VMSCC and DMSCC shown reliable using ability of viscosity values in dairy enterprises for determination of SCC or raw milk quality.

Key words: Somatic cell count, viscosity, raw milk, milk quality, bovine

INTRODUCTION

Somatic Cell Count (SCC) is a recognized indicator of bovine udder health and milk quality. Although all milks include some level of somatic cells, SCC of milk drastically increases during bacterial infection, tissue damage or other inflammation processes affecting the mammary tissue (Najafi *et al*., 2009).

Determination of SCC in raw bovine milk has implications for milk quality, productivity, animal health and trade issues (Grillo *et al*., 2005). Besides, consumer demands in the field of food production have changed considerably in the last few decades. Consumers more and more believe that foods contribute directly to their health (Bhat and Bhat, 2011). Today, SCC values are routinely recorded in most recording systems and information on SCC is easily available on a large scale (Koivula *et al*., 2005). Normally, the milk from healthy cows at first lactation contains up to 100×10^3 cells mL^{-1}, up to 200×10^3 cells mL^{-1} in subsequent lactations and if these exceed 250×10^3 cells mL^{-1}, there is already an indication that an infection as taking place in the udder (Vasilev *et al*., 2007). In EU countries, the legal limit of SCC in tank milk for human consumption is 400×10^3 cells mL^{-1} (Erdem *et al*., 2010a). Previous studies (Norman *et al*., 2000; Miller *et al*., 2004; Fernandes *et al*., 2008) have reported that elevated SCC contents of raw cow milk indicates to intramammary infection and also poor milk quality. In spite of direct microscopy has been adopted by International Dairy Federation (IDF) as the reference method, much effort has been performed by many researchers (Grillo *et al*., 2005; Kamphuis *et al*., 2008; Koess and Hamann,

2008; Erdem *et al.*, 2010b) to reveal less time-consuming and less labour required techniques for SCC evaluation. Because of rapid methods and automation in food microbiology have become more and more common in recent years (Feng and Zheng, 2005), to control SCC values in raw milk, a reliable marker of milk quality, reliable alternative determination methods are still needed.

The purpose of the present research was to investigate using facility of milk viscosity features for measuring SCC of bovine milk.

MATERIALS AND METHODS

The data were obtained by collecting bucket milk samples as open milk from center selling points of Samsun province, located in the Black Sea region of Turkey. On each test day time, bucket milk samples (about 100 mL per farm) were taken from randomly selected ten farmers between March and April 2010. No preservative included samples kept in an ice-cooled box and immediately transported to the laboratory on the same day.

SCC tests were performed by direct microscopic cell counting method (Packard *et al.*, 1992). For each farm, five slides were prepared for recording Direct Microscopic Somatic Cell Count (DMSCC). In this test, used dye solution was composed of 0.6 g of certified methylene blue chloride to 52 mL of 95% ethyl alcohol, 44 mL of tetrachlorethane and 4 mL glacial acetic acid. Total number of fields counted per slide was 50 and the Working Factor (WF) was 10604.

To determine Viscosity Meter Somatic Cell Count (VMSCC) values for each farm, two measures were applied using a viscosity counter device (MT01, Pisoft, Šamorin, Slovak Rep.) The method was based on adding to the milk a substance which affects somatic cells and causes a change in viscosity of the milk proportional to the quantity of cells. The viscosity meter MT01 had a special ball and special glass tube for analysis. In this system, after the glass tube filled with milk sample (10 milk and 5 mL reagent), the tube declines for certain time from the horizontal position to the angle of 25° the ball moves downwards depending on the density of the milk. Thus, the value which could be read by the final position of the ball, indicated the number of somatic cells (VMSCC).

Due to wide ranges in the SCC data, SCC values were transformed to $\log_{10}$ for normality and homogeneity of variances. In this study Test Day (TD) was evaluated as independent variable. The data were examined by analysis of variance (ANOVA) and means were compared by Duncan's multiple range test. The model was as follows:

$$y_{ij} = \mu + a_i + e_{ij}$$

where; y_{ij} is observation value for DMSCC and VMSCC, μ is population mean, a_i is effect of test day (I = 1 to 5) and e_{ij} is the random residual effect.

To compute correlations between DMSCC and VMSCC, Pearson's correlation coefficient analysis was used. All statistical analyses were performed using SPSS statistical package program (SPSS, 1999).

RESULTS AND DISCUSSION

Means of SCC levels by two different techniques are given in Table 1 and transformed values of those measured by DMCCC and VMSCC on TD are presented in Table 2. Average mean of SCC by direct microscopy (636473±31198) was higher than that determined by viscosity meter

Table 1: Means±SE of DMSCC and VMSCC values by SCC thresholds

SCC subgroups	No.	DMSCC	No.	VMSCC
1	56	302554±8441	56	212410±11470
2	163	563002±10573	34	538676±9296
3	31	1158992±80754	10	1835000±74554
General	250	636473±31198	100	485600±48706

Table 2: Log Means±SE of DMSCC and VMSCC values on test days

Test days	No.	DMSCC	No.	VMSCC
1	50	5.757±0.028	20	5.626±0.090
2	50	5.772±0.027	20	5.565±0.065
3	50	5.768±0.029	20	5.396±0.098
4	50	5.698±0.028	20	5.572±0.054
5	50	5.788±0.031	20	5.500±0.082
General	250	5.757±0.013	100	5.532±0.035

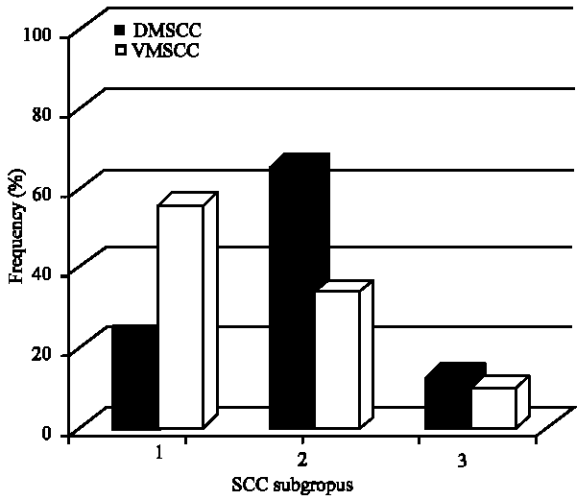

Fig. 1: Distribution of SCC values by SCC subgroups

(485600±48706). Also, log SCC means by DMSCC and VMSCC were estimated as 5.757±0.013 and 5.532±0.035, respectively. As seen that, especially VMSCC values on TD were shown an alternative trend but no statistical difference was found according to two different methods. Harmon (1994) and Miller *et al.* (2004) reported that SCC values have day to day variation. However, relatively small number of samples using in the present our study might be caused to obtained result.

While untransformed SCC values were evaluated within 3 subgroups according to SCC threshold, only 22.4% of whole samples had less than 400×10^3 cells mL^{-1} which is regarded as the legal limit of milk for human consumption in EU countries. In assessment with VMSCC method, this level was reached to 34%.

The diagram which reflects SCC threshold of the selected buckets, is given in Fig. 1. This indicates that farms those SCC levels over than 1000×10^3 cells mL^{-1} were the smallest subgroup. SCC means of DMSCC and VMSCC in log base were calculated as 5.757±0.013 and

Table 3: Correlations among log SCC values measured by two different methods

	V2	D1	D2	D3	D4	D5
V1	0.995*	0.790	0.772	0.935	0.888	0.863
V2		0.789	0.783	0.940	0.981	0.865
D1			0.731	0.826	0.918	0.948
D2				0.796	0.888	0.848
D3					0.933	0.909
D4						0.962

*Highly significant at $p<0.01$

5.532±0.035, respectively. SCC values were reported to be higher levels in some studies (Atasever and Erdem, 2008, 2009), however, lower in a study (Erdem *et al*., 2007) which had been carried out in the region. Estimated SCC levels of this work clearly indicates to a possibility to obtation lower SCC thresholds with proper controlling hygienic and managemental status of dairy cows.

Relationships among log SCC values are given in Table 3. Especially, estimated high correlation ($r = 0.995$, $p<0.01$) between VMSCC values apparently revealed that error ratio between measuring values is minimal in this method. Gonzalo *et al*. (2003) reported that the influence of certain SCC variation factors, such as the type of preservative used, the analytical temperature, storage conditions or milk age have importance on DMSCC of cow milk. However, while high correlations were determined among different samples in DMSCC method, these relationships were observed as relatively lower than those obtained in the earlier technique. In parallel to this finding, Faust and Timms (1995) and reported that error ratio may be high when compared to various automatic cell counting methods. Therefore, using more samples may be seen a logical approach, if DMSCC method is solely performed to determine raw milk quality.

Consequently, calculated high correlation ($r = 0.783$, $p<0.01$) between VMSCC and DMSCC which is suggested by International Dairy Federation (IDF) as the reference method to evaluate milk quality or subclinical mastitis case, indicated to reliable using ability of viscosity levels in dairy enterprises.

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