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Relationships Between Milk Somatic Cell Count and pH in Dairy Cows

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Abstract: The objective of this research was to determine the relationships between Somatic Cell Count (SCC) and pH in bovine raw milk. Bucket milk samples were evaluated by direct microscopic method using methylene blue stain and a digital pH meter. SCC data were transformed to log 10 base and ANOVA was used to compute two parameters with SPSS. Overall mean log SCC and pH were estimated to be 5.747±0.0017 and 6.547±0.007, respectively. No significant differences were determined according to Test Days (TD) but effect of TD on pH was significant ($p<0.05$). When the data were assessed by SCC subgroups, 22.67% of those were recorded within elevated (750×10^3 cells mL^{-1}) SCC group. The findings show that pH records of raw milk are not suggested to determine subclinical mastitis or quality of milk.

Key words: Cow, somatic cell count, raw milk, mastitis tests, milk quality, pH, Turkey

INTRODUCTION

Subclinical mastitis is one of the most persistent and widely spread disease conditions of importance to milk quality among dairy cows worldwide (Ogola *et al*., 2007). While this economically important disease for dairy animals adversely affects milk yield and composition (El-Zubeir *et al*., 2006; Neelesh, 2007) the inflammatory reaction caused by infections in the mammary tissue is most commonly measured by Somatic Cell Count (SCC) in milk (Sloth *et al*., 2003). A number of diagnostic systems for detection of subclinical mastitis have been used including bacteriological examination of milk and assessment of udder inflammation using SCC which reflects the disease-combating response of the animal to pathogen (Ahmed *et al*., 2008). Elevated SCC in milk is also related with altered protein quality, change in fatty acid composition, lactose, ion and mineral concentration, increased enzymatic activity and a higher pH of raw milk (Ogola *et al*., 2007). In EU countries, the directive 92/46/EEC stated that bulk milk samples with SCC over 400×10^3 cells mL^{-1} may not be used for human consumption. Various investigations have revealed that subclinical mastitis is a prevalent disease in smallholder dairy farms in Turkey (Atasever and Erdem, 2009; Atasever, 2008). In spite of SCC in milk has been assumed as the most reliable parameter for determination of milk quality an subclinical mastitis, more simply and rapid analysis methods are needed to investigate in dairy area. Not with standing many studies have been conducted to explain the association of SCC with other components of milk (Pyorala, 2003; Ogola *et al*., 2007), no sufficient report has been revealed the correlation between SCC and pH. The aim of the present study was to investigate the relationships between SCC, the most reliable indicator of cow udder health and milk quality and pH in bovine raw milk.

MATERIALS AND METHODS

Data were obtained by collecting bucket milk samples from Ilkadim center bazaar of Samsun Province, Turkey. On each test day time, ten randomly selected bucket milk samples were taken from farmers. The small holder farms in which the milk samples of this study had been produced had similar conditions by feeding and dairy practices. Raw cow milk samples (about 100 mL per farm) were taken once a week between January and February 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 sample, three slides were prepared to analyses. Used dye solutuin 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. The pH of milk samples was measured at room temperature using a digital pH meter after calibration of the pH probe. All pH

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measurements were recorded between 21.30 and 21.57°C temperatures. Due to wide ranges in the SCC data, SCC values were transformed to $\log_{10}$ for normality and homogeneity of variances. In the 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} = Observation value for SCC and pH
μ = Population mean
a_i = Effect of test day (i = 1-5)
e_{ij} = The random residual effect

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

RESULTS AND DISCUSSION

In this study, the overall log SCC mean was estimated as 5.747±0.017 and no statistical difference was determined among TD groups (Table 1). Presumptively, transformed SCC using before statistical analysis and not wide ranges of the raw SCC values might be caused to this result. Millago *et al.* (2009) reported that SCC was linked to milk composition and influenced the day to day variation. Although, same conditions had been ensured by feeding and husbandrial applications in the small holder farms of which study milk samples were taken in the present study, TD variation among SCC values could be explained by the differences of the cows by stage of lactation or parity.

In pH assessment, significant differences ($p<0.05$) were found among TD groups, statistically. In other words, logSCC and pH means according to TD were not in harmony with each other in this study (Table 1). While overall mean for pH was determined as 6.547±0.005, differences between TD1 and TD2 or TD3 were statistically significant ($p<0.05$). In parallel to earlier finding, untransformed data using for pH might be effective on this result. Descriptive values of SCC according to thresholds are shown in Table 2. As seen that SCC values ranged from 212080-3260606 cells mL^{-1} with a mean value of 636473±31198 cells mL^{-1}. Estimated overall mean logSCC was higher than the mean (5.46×10^3 cells mL^{-1}) calculated by Ogola *et al.* (2007). However, a great part of the tested samples (77.33%) ranked into first two groups (0-750 000 cells mL^{-1}). Also, only 22.67% of the samples involved in the third group. This case could be reflected that SCC ingredients of

Table 1: Means±SE of logSCC and pH values on test days

Test day	logSCC	pH
1	5.791±0.037	6.506 ±0.021[a]
2	5.719±0.042	6.561±0.009[b]
3	5.736±0.040	6.545 ±0.016[ab]
4	5.737±0.041	6.551±0.016[ab]
5	5.755±0.031	6.573±0.011[b]
General	5.747±0.017	6.547±0.007

Within the columns the numbers with different superscripts differ significantly ($p<0.05$)

Table 2: Descriptive values on SCC subgroups

SCC subroups	n	Min	Max	Mean (±SE)	Frequency (%)
1	36	212080	397650	302254±8441	24.00
2	80	563002	747054	563002±10573	53.33
3	34	1158992	3260606	1158992±80754	22.67
Total	150	212080	3260606	636473±31198	100.00

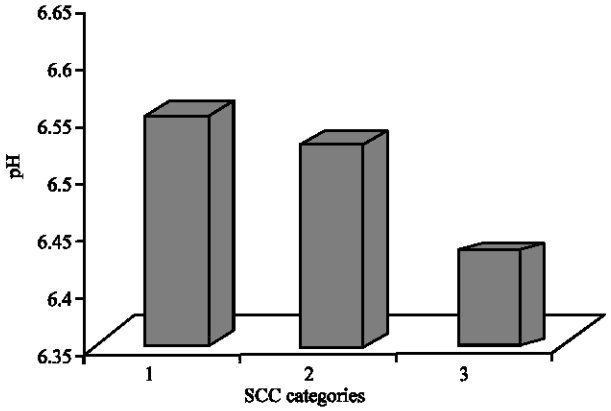

Fig. 1: Distribution of pH values of milk samples by SCC categories

bucket raw milk samples collected from Samsun region were partly higher than EU directives (400,000 mL^{-1}). In other words, subclinical mastitis cases have substantially effect on milk SCC increments or milk quality decrements in small holder dairy farms of the region. So that, Hospido and Sonesson (2005) and Ogola *et al.* (2007) emphasized that SCC of milk is highly correlated with subclinical mastitis frequency in dairy herds. In this context, Przysucha and Grodzki (2004) clearly indicated that better care of production hygiene, proper milking technique, feeding and tending of animals in farms has a reflection in better milk quality.

The mean pH value of all raw milk samples tested was 6.547±0.007 ranging between 6.20 and 6.67. In normal, pH of bovine raw milk ranges between 6.6 and 6.8 and this value was found as lower than that calculated by Tsioulpas *et al.* (2007). Changes in pH values by SCC subgroups are shown in Fig. 1. As seen that, pH values declined with elevated SCC. Actually, estimated negative correlation ($r = -0.523$, $p<0.01$) between SCC and pH in this study clearly supports this event. This finding was evaluated to be opponent with the results of Auldist *et al.*

(1996) and Coulon *et al*. (2002). The changes on reduced secretory activities of mammary cells might lead to variation in pH levels (Ogola *et al*., 2007). Fundamentally, elevation in SCC and decline in pH cause an augmentation in acidity of milk. Thusly, this case apparently point out that more severity results about dropping milk quality and considerably financial losses due to discarded milk can be encountered.

CONCLUSION

In this study, consequently determined negative relationship of SCC and pH in this study suggests that pH tests which inform dairy farmers for early detecting subclinical mastitis can not be used as a good milk quality analysis method. However, combining these records with SCC is thought more beneficial for dairy owners. Also, further investigations using more data are needed to confirm reached results in the present study.

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