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A Study on Somatic Cell Count of Jersey Cows

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Abstract: This study was conducted to determine the effects of some factors on Somatic Cell Count (SCC) and to investigate the relationships between these factors by SCC in Jersey cows raised at the Karakoy State Farm, Turkey. Quarter milk samples were collected at 28 days intervals and analyzed by direct microscopy. Data were evaluated by stage of lactation, udder quarter, parity and season by SPSS packet program. While data obtained in the latest stage of lactation had the highest level, effects of parity were significant ($p<0.05$ or $p<0.001$). No statistical difference was found among udder quarters. Besides, significant differences ($p<0.01$ or $p<0.001$) were determined among months and log SCC reached to highest level in December. Also, significant relationships ($p<0.05$ or $p<0.001$) were estimated in stage of lactation, udder quarter or some month groups. Thus, dairy owners are advised to spend more time on their herds, especially in later lactation period and rainy seasons.

Key words: Somatic cell count, Jersey, parity, month, stage of lactation, udder quarter

INTRODUCTION

Culture dairy breeds have been imported to Turkey approx 50 years ago. Of these breeds, Holstein, Brown Swiss, Simmental and Jersey are the common ones reared in the different locations of the country according to geographic or climatic conditions (Anonymous, 2004). Such that, Jersey is considerable preferred breed in the Middle Black sea region due to its sufficient milk yield and lower feed consumption. Notwithstanding, genetic structure of cows is principally taken into consideration and importance of environmental factors is remained in second plan in many dairy operations of Turkey. However, today, some indirect parameters related to production quality or herd health are recorded routinely in dairy operations of many countries. Of these markers, Somatic Cell Count (SCC), which was adopted as a reliable reflector in milk quality (Moon *et al*., 2007) can be used to determine any disorders in the production cycles in an early time. Nevertheless, due to low level heritability (0.13-0.18) of SCC (Lund *et al*., 1994; Weller and Ezra, 1997) non-genetic factors markedly affected milk quality degree. In spite of some researches have been carried out in different culture breeds raised in Turkey conditions (Koc, 2004, 2007; Kul, 2006; Erdem *et al*., 2007) there is no sufficient report on factors affecting SCC of Jersey cows. Thus, determination of effective environmental factors on SCC and interrelationships between these factors by SCC can be seen important steps to reveal indications for dairy owners and for further investigators.

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The objectives of this study were to determine the effects of some factors on SCC and to investigate the relationships between these factors and SCC in Jersey cows.

MATERIALS AND METHODS

Sample Collecting

Jersey cows, raised at Karakoy State Farm of Samsun, located in the Black Sea region of Turkey, were examined between January and December 2005. According to farm records, lactating cows were allocated to 3 lactation stage groups (70±14, 140±14 and 210±14 days in milk) and a total of 5 parity groups (cows with parity more than 5 were evaluated into 5th group). Raw milk samples (about 30 mL) were taken from each udder quarter during the evening milkings with 28 days intervals. No preservative included milk samples kept in an ice-cooled box and immediately transported to the laboratory on the same day for SCC analysis. Thus, a total of 2330 samples were tested during the study period.

Somatic Cell Counting

In SCC analysis, direct microscopic counting method was performed. In this stage, used strain 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 40 and the Working Factor (WF) was 13255.

Statistical Analysis

Obtained SCC values were transformed to $\log_{10}$ for normality and homogeneity of variances. In the study; stage of lactation, parity, udder quarter and season were evaluated as independent variables. The data were examined by Analysis of Variance (ANOVA) and means were compared by Duncan's multiple range test. The model was as follows:

$$y_{ijklm} = \mu + a_i + b_j + c_k + d_l + e_{ijklm}$$

Where:

y_{ijklm} = Observation value for SCC
μ = Population mean
a_i = Effect of the stage of lactation (I = 1, 2, 3)
b_j = Effect of the parity (j = 1, 2,…, 5)
c_k = Effect of the udder quarters (k = 1,2,3,4)
d_l = Effect of the months (l = 1, 2,…., 12)
e_{ijklm} = The random residual effect

To compute interrelationships between factors by SCC, Pearson's correlation coefficient analysis was applied. All statistical analysis were performed using SPSS statistical package program (SPSS, 1999).

RESULTS

As can be seen from Table 1, log SCC values of udder quarters calculated in 3rd stage of lactation were statistically different ($p<0.001$) from those determined in the other stages, except for RH quarters. Besides, when the data were evaluated by cow bases, overall mean of log SCC of last period (5.56±0.01) was higher than those obtained in the other stages.

Table 1: Quarter log SCC values by stage of lactation

Stage of lactation (SL)	Udder quarter: LF n	LF log SCC	RF n	RF log SCC	LH n	LH log SCC	RH n	RH log SCC	Overall log SCC
1	238	5.48±0.01A	237	5.45±0.01A	232	5.47±0,01A	231	5.46±0,01A	5.48±0.01A
2	195	5.48±0.01A	195	5.48±0.01A	203	5.48±0.02A	201	5.49±0.01AB	5.50±0.01A
3	150	5.55±0.02B	150	5.55±0,02B	149	5.54±0.01B	149	5.54±0.01B	5.56±0.01B
Overall	583	5.49±0.01	582	5.48±0.01	584	5.49±0.01	581	5.49±0.01	5.51±0.01

A, B: p<0.001, SL1: 70±14 days, SL2: 140±14 days, SL3: 210±14 days, LF: Left front quarter, RF: Right front quarter, LH: Left hind quarter, RH: Right hind quarter

Table 2: Quarter log SCC values by parity groups

Parity	Udder quarter: LF n	LF log SCC	RF n	RF log SCC	LH n	LH log SCC	RH n	RH log SCC	Overall log SCC
1	102	5.48±0.02	103	5.48±0.70	104	5.46±0.01A	101	5.47±0,02a	5.49±0.01AB
2	132	5.47±0.01	133	5.46±0.01	130	5.46±0.01A	131	5.47±0.01a	5.48±0.01A
3	108	5.52±0.02	101	5.47±0.01	110	5.47±0.01A	111	5.48±0.02a	5.49±0.01AB
4	104	5.49±0,02	103	5.51±0.02	102	5.55±0.02B	101	5.53±0.02b	5.54±0.02B
5	137	5.51±0.01	142	5.50±0.02	138	5.53±0.02AB	137	5.49±0.01ab	5.53±0.01AB
Overall	583	5.49±0.01	582	5.48±0.01	584	5.49±0.01	581	5.49±0.01	5.51±0.01

a, b:p<0.05, A, B: p<0.001

Table 3: Log SCC values by udder quarters

Udder quarter	n	log SCC
LF	583	5.49±0.01
RF	582	5.48±0.01
LH	584	5.49±0.01
RH	581	5.49±0.01
Overall	2330	5.51±0.01

LF: Left front quarter, RF: Right front quarter, LH: Left hind quarter, RH: Right hind quarter

In evaluation data by parity groups, no statistical difference was found between LF and RF quarters (Table 2). However, values of LH and RH quarters were different at the level of p<0.001 and p<0.05, respectively. Also, log SCC values tended to elevate with later parities. However, when data were assessed by cow bases, log SCC means had an alternative trend in this study. Such that, average log SCC of 2nd and 4th parity cows were different from each other, statistically (p<0.001).

There was no statistically difference among quarters (Table 3). While approximately same amount data were assessed in each quarter group (581 to 584), log SCC values were not affected by udder quarters. Such that, only log SCC of RF was relatively different from the other groups.

Log SCC value of LF according to months was statistically different at the level of p<0.01 and also, other quarters and overall mean were different at the level of p<0.001 (Table 4). In all groups, relatively low log SCC values of May were notable and interestingly, in all groups, quarter SCC values reached to peak level in December.

Correlations of log SCC values by stage of lactation are shown in Table 5. While negative and significant (p<0.001) correlation was observed between first and second stage of lactation, relationships among the others were not significant, statistically. Besides, significant correlations (p<0.001) were estimated between overall log SCC and log SCC values of each stage.

Table 4: Quarter log SCC values by months

	Udder quarter								
	LF		RF		LH		RH		Overall
Month	n	log SCC	n	log SCC	n	log SCC	n	log SCC	log SCC
1	37	5.50±0.01abcd	37	5.52±0.02AB	35	5.51±0.02AB	36	5.49±0.01AB	5.51±0.01A
2	32	5.43±0.03a	35	5.48±0.04A	32	5.48±0.03AB	35	5.43±0.03A	5.48±0.03A
3	37	5.54±0.02bcd	36	5.51±0.03AB	37	5.49±0.02AB	36	5.56±0.03AB	5.54±0.02AB
4	62	5.52±0.03abcd	55	5.49±0.02A	62	5.52±0.03AB	58	5.48±0.02AB	5.53±0.02AB
5	59	5.45±0.02ab	58	5.42±0.02A	58	5.43±0.02A	59	5.45±0.02A	5.45±0.02A
6	63	5.50±0.02abcd	60	5.48±0.02A	64	5.53±0.02AB	60	5.52±0.02AB	5.53±0.02A
7	57	5.50±0.02abcd	58	5.50±0.02A	55	5.50±0.02AB	57	5.50±0.02AB	5.52±0.02A
8	76	5.50±0.02abcd	76	5.45±0.02A	78	5.46±0.02A	78	5.46±0.02A	5.49±0.02A
9	63	5.46±0.01abc	68	5.47±0.01A	67	5.46±0.01A	67	5.46±0.01A	5.47±0.01A
10	33	5.46±0.03abc	32	5.44±0.02A	31	5.44±0.02A	31	5.45±0.02A	5.51±0.02A
11	35	5.56±0.02d	36	5.54±0.02AB	34	5.55±0.02AB	36	5.54±0.02AB	5.51±0.02A
12	29	5.56±0.04cd	31	5.62±0.04B	31	5.61±0.04B	28	5.60±0.04B	5.63±0.03B
Overall	583	5.49±0.01	582	5.48±0.01	584	5.49±0.01	581	5.49±0.01	5.51±0.01

a, b: $p<0.01$, A, B: $p<0.001$

Table 5: Correlations among stage of lactation

Stages	SL2	SL3	Overall
SL1	-0.26***	-0.03	0.58***
SL2		-0.07	0.45***
SL3			0.65***

***$p<0.001$, SL1: 70±14 days, SL2: 140±14 days, SL3: 210±14 days

Table 6: Correlations among quarter log SCC values

Quarter	RF	LH	RH	Overall
LF	0.36***	0.34***	0.31***	0.66***
RF		0.35***	0.41***	0.70***
LH			0.32***	0.70***
RH				0.67***

***$p<0.001$

Table 7: Correlations among monthly log SCC values

Months	2	3	4	5	6	7	8	9	10	11	12	Overall
1	0.24	0.20	0.16	-0.18	-0.01	0.34*	-0.13	0.22	-0.04	-0.13	-0.11	0.31
2		0.06	0.17	-0.16	0.03	0.47***	0.05	0.57***	-0.14	0.19	0.33	0.70***
3			-0.20	0.20	-0.04	0.27	0.06	0.10	0.04	-0.10	-0.08	0.36*
4				0.05	0.20	0.26*	0.02	0.01	-0.27	-0.05	-0.27	0.54***
5					0.02	-0.13	-0.01	-0.15	-0.23	-0.06	0.19	0.25
6						-0.18	0.15	-0.11	0.04	-0.01	-0.10	0.40***
7							0.27*	0.54***	-0.28	0.11	0.04	0.53***
8								0.10	-0.17	0.05	-0.18	0.67***
9									-0.17	0.10	0.10	0.29*
10										-0.21	-0.19	-0.17
11											0.27	0.33*
12												0.37*

*$p<0.05$, ***$p<0.001$

In quarter evaluation (Table 6), statistically significant ($p<0.001$) correlations (0.31 to 0.41) and significant ($p<0.001$) relationships were found between overall mean log SCC and each quarter log SCC value (0.66 to 0.70).

It can be clearly understood from Table 7, only 7th, 8th and 9th months had correlated with other months. Such that, significant correlations were estimated between 7th and 1st month ($p<0.05$), 2nd month ($p<0.001$), 4th month ($p<0.05$), 8th month ($p<0.05$) and 9th

month ($p<0.001$), respectively. However, it was estimated significant correlation ($p<0.001$) between 2nd and 9th months. Also, significant relationships ($p<0.05$ or $p<0.001$) were determined between overall mean and log SCC values obtained in the different months, except for 1st, 5th and 10th months.

DISCUSSION

Table 1 apparently indicates that the latest stage of lactation group had the highest log SCC value. This result was parallel to some study results (Bielfeldt *et al.*, 2004; Klaas *et al.*, 2004) in which reported SCC tended to increase with advancing lactation stage. However, this indication was inconsistent with the study results of Ikonen *et al.* (2004). Despite data belong to 3rd stage of lactation had relatively small numbers, elevated SCC calculated in this stage can be explained by the elevation of corroded or injured udder cells towards end of the lactation.

In normal, enhancing milk production level and a rise in SCC amount passed from blood to milk of cows with later parities are expected results. Also, in an earlier study, Oltenacu and Ekesbo (1994) reported that deformations in the udder gland and increase in milk production capacity are the main reasons of elevated SCC. In spite of relatively higher log SCC values were determined with advancing parity in the present study (Table 2), it was not observed clear difference among the parity groups. Thus, obtained findings were inconsistent with the results of Cerón-Muñoz *et al.* (2002) and Kuczaj (2003). Possibly, effects of different milk production levels and examining breeds different from Jersey in the previous studies had played an important role on this case.

In normal conditions, milk amount produced in rear quarters is dominant in total production and milk flow rate is relatively higher (Weiss *et al.*, 2004). That's why, distances of teats to floor are relatively short and thus, SCC is expected to high due to injuries and tissue damages. Besides, no statistically different values of this study (Table 3) were contradictive with the study results of Kuczaj (2003) and Berry and Meaney (2006), but in agreement with the findings of Lindmårk-Mansson *et al.* (2006).

In this study, log SCC values in all quarter groups and also overall log SCC values reached to highest level in the 12th month and assessed as low level in 5th month. Effect of mild weathers in 5th month in regard to Summer months, at which high temperatures are effective, might be caused to this result. In addition, more exposure of teats with muddy or drenched floor in December, at which rain density attains to maximal level in the region and, effect of relatively lower rainy weathers in May when compared to Winter months might also be played a role on this case. Indeed, Biffa *et al.* (2005) reported that in rainy seasons, subclinical mastitis risk increased 3-fold when compared to other seasons. Thus, it can be noted that exposing teats to muddy floor was one of the important environmental factors for subclinical mastitis or increased SCC in milk. However, in some studies (Przysucha and Grodzki, 2004; Joshi and Gokhale, 2006) highest SCC values were found in the Summer seasons. In this view, differences of the findings between present study and the others could be explained by regional and climatic variations. In addition, open barn system of the farm in which the current study had been conducted may also be added to effective factors on this result.

In this study, we observed significant relationship between stage of lactation groups and overall mean of lactation (Table 5). In fact, this case could be assumed as an expected result and this finding clearly indicated that SCC values obtained any stage of lactation were not independent from overall mean SCC value reflecting whole lactation periods.

In spite of separately structure of each quarter, estimated correlations among SCC of quarters or overall SCC value were in nearby levels (Table 6). Such that, obtained proximate SCC values by quarters support this finding.

In monthly evaluation (Table 7), relationships were determined between SCC values obtained in the different months. Besides, estimated correlations between overall mean and multitudinous months apparently revealed that SCC had harmonic levels in each monthly measuring time. This finding indicates that beneficiating SCC records throughout production cycle is a key step to observe milk quality degree in dairy farms.

Consequently, due to abnormal SCC thresholds reflect inadequate managemental or hygienic applications in dairy operations (Atasever and Erdem, 2009), herd owners are suggested to spend more focus on their cows, especially in advanced lactation stages or rainy seasons.

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