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The effects of stage of lactation, parity and calving season on somatic cell counts in Anatolian Water Buffaloes

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ABSTRACT

The present research was conducted to determine the effects of parity, calving season and stage of lactation on the somatic cell count (SCC) in Anatolian water buffaloes reared different herd conditions. In total, 2,736 SCC readings from 456 Anatolian water buffaloes were analyzed. Data were evaluated by the stage of lactation (early, mid, and late), calving season, and parity with the SPSS package program. Significant effects of calving season, parity, and stage of lactation on SCC were observed (P<0.05). The average SCC was 90,701±6,372 cells/ml. The results indicated that the SCC of buffaloes were in accordance with, even considerably lower than, the limits indicated in the related regulations of the Turkish Food Codex and those of the European Union Commission. Further studies are necessary to investigate the development of the appropriate threshold values under the conditions of Turkey.

Key words: Anatolian water buffalo, Calving season, Parity, Somatic cell, Stage of lactation.

INTRODUCTION

Milk SCC is a key component of international and national regulations for milk quality, and is an indicator of udder health and the prevalence of clinical and sub-clinical mastitis in dairy farming (Sharma *et al.*, 2011). Most of the somatic cells are white blood cells. The number of somatic cell in milk is increase when an infection occours. High SCC impacts several factors, such as decreasing milk yield, marked compositional changes, and shelf life of milk, and can cause considerable economic losses for dairy breeders. On the other hand, breeds, parity, calving age, stage of lactation, season, stress, milking interval, and environmental and managerial factors effect SCC in buffalo milk (Muggli, 1995; Singh and Ludri, 2001). Raw milk SCC should be within tolerable limits; otherwise it can cause important risks to animal and human health (Manlongat *et al.*,1998), and can also lead to the coming out of different problems in the processing of dairy products in terms of quality. SCC in milk has been assumed to be the most reliable parameter to determine milk quality and sub-clinical mastitis. For that reason more simple and rapid analysis methods are required to explore the farm land on which buffalo are raised. There are no enough reports on SCC in buffalo milk, especially for the Tokat district. Owing to human health and animal welfare concerns, several countries (EU nations and Switzerland) have established 400,000 cells/ml as the upper limit for SCC in milk (Sharma *et al.*, 2011). In Turkey, this value was at the threshold (<500,000 cell/ml) as specified in the Turkish Food Codex (Anonymous, 2000).

The present study was conducted to designate the number of somatic cells. Also, the effects of some factors on somatic cells was investigated.

MATERIALS AND METHODS

This research was carried out in the Tokat province in the Mid-Black Sea region of Turkey. Anatolian buffaloes raised in different herds of Tokat were examined from years 2012, 2013 and 2014. A total of 2,736 raw milk samples were tested during the research period. Lactating buffaloes were allocated to three lactation stage groups (early lactation (1): 30±15, 60±15, 90±15;mid lactation (2): 120±15, 150±15, 180±15; late lactation (3): 210±15, 240±15 and 270±15) and a total of 7 parity groups. Milk samples (approximately 50 ml) were taken from each buffalo during the morning milking on the test days. No chemical were added to the milk samples, which were kept in a cooler, and immediately transported to the laboratory on the same day for SCC analysis. A DeLaval cell counter (DCC) was used to determine the SCC in milk samples. Some researchers (Hamann *et al.*, 2010) declared that SCC can be most successfully detected with a DCC. Current research, the stage of lactation, parity and calving season were investigated as fixed effects. Season of calving were spring, summer, winter and autumn. All statistical analyses were performed using

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SPSS 11.00 (2002) statistical package program. The data were investigated with the analysis of variance (ANOVA). Based-10-logarithmic transformation was applied to the SCC data to create a normal distribution and the linear mixed model was applied.

The model was as follows:

$Y_{ijkl}=\mu+a_i+b_j+c_k+e_{ijkl}$

Where:

Y_{ijkl} : observation value for SCC
μ : mean
a_i : calving season (i: winter, spring, summer, autumn)
b_j : parity (lactation number) (j: 1, 2, …….7+)
c_k : stage of lactation (k = 1: early lactation, 2: mid lactation, 3 : late lactation)
e_{ijkl} : the random residual effect

RESULTS AND DISCUSSION

This research mean SCC value was 90,701±6,372 cells/ml. The results obtained from the preliminary analysis of the mean SCC for parity, stage of lactation and calving season are presented in Figures 1, 2, and 3, respectively. The statistical analysis of the data showed that the effects of parity, stage of lactation and calving season were significant for SCC (P<0.05).

As shown in Figure 1, the SCC level was the highest in the first parity (186,110 cells/ml). The SCC level decreased in the later parities. The smallest average values obtained during the third lactation (50,014 cells/ml). The average of somatic cell counts for first, second, third, fourth, fifth, sixth and seventh lactation numbers was determined to be as 186,109 cells/ml, 71,373 cells/ml, 50,014 cells/ml, 56,197 cells/ml, 64,984 cells/ml, 80,986 cells/ml and 147.180 cells/ml.

The stage of lactation on SCC was statically important (Figure 2; P<0.05). While the mean SCC values were high (P<0.05) in the early stage of lactation (96,134 cells/ml), they decreased during the mid-stage of lactation (68,966 cells/ml), and then increased once again during the later stage of lactation (103,776 cells/ml).

The mean SCC values for autumn, winter, spring and summer seasons were 84,400 cells/ml, 78,180 cells/ml, 105,780 cells/ml and 128,130 cells/ml, respectively (Figure 3). Results show that buffaloes calving in summer and spring had the highest SCC, while, winter and autumn calves had the lowest SCC. The SCC was the lowest in the winter season (78,180 cells/ml). The comparison of data for the four seasons confirms that summer season had the highest mean SCC value (128,130 cells/ml).

The mean value obtained from this research (90,701±6,372 cells/ml) was within those values for healthy animals (without mastitis). This study obtained results which were not in agreement with the findings of a great deal of the previous research (Dhakal *et al.*,1992; Singh and Ludri, 2001), which determined that the SCC recorded for buffaloes varied from 50,000 to 375,000 cell/ml. It was notified that the somatic cell average value of Mediterranean buffaloes is 169,000 cells/ml (Esposito *et al.*,1997); in another study on water buffaloes, the SCC value was reported as 309,000/ml (Tantillo *et al.*, 1997). Tripaldi *et al*. (2003) reported that the SCC of a high percentage of samples was included between 50,000 to 300,000 cells/ml and the average value was 221,280 cells/ml. The SCC mean value was 137,000 cells/ml for Murrah and Mediterranean buffaloes (Coelho *et al.*, 2004), and 134,731 cells/ml for Anatolian Buffaloes (Sahin *et al.*, 2016). Lopes (2009) stated that a SCC mean value of 269,590 cells/ml in buffalo milk Brasil. The SCC mean value was 50,222±24,952 and 112,765±75,269 cells/ml for the Mediterranean breeds and Murrah, respectively (Damé *et al*. 2010). Dhakal (2006) reported that the SCC of

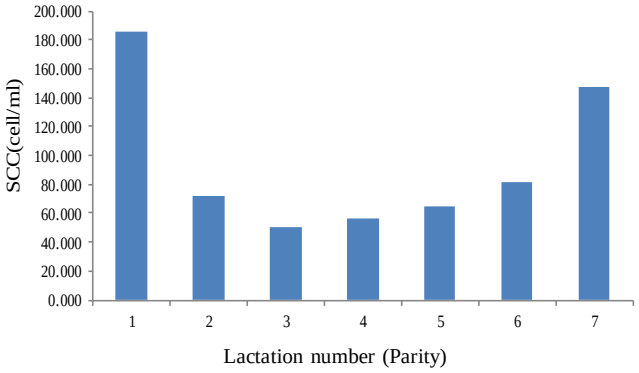

Fig 1: Changes of the SCC according ot lactation number.

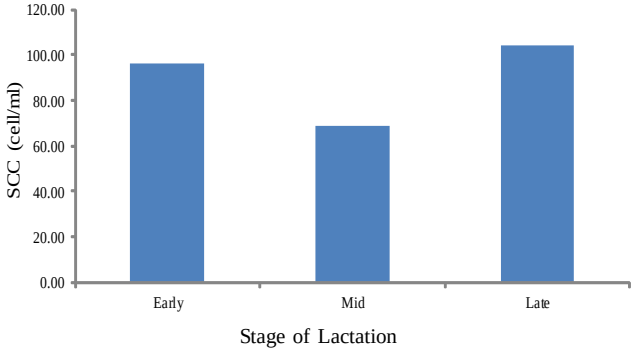

Fig 2: Changes of lactation according to lactation stage.

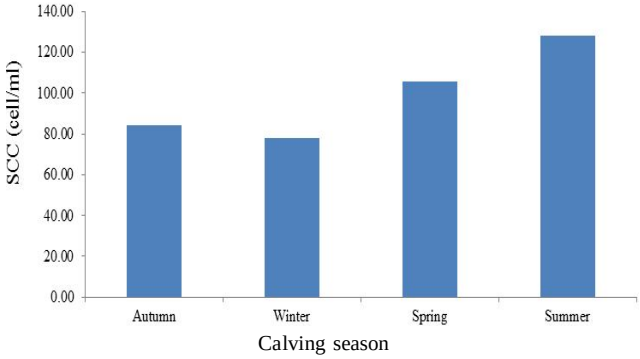

Fig 3: Changes of the SCC according ot Calving season.

milk from clinically normal Murrah buffaloes was 151,000 cells/ml for 400 mammary quarters of 60 buffaloes under conditions in Nepal and India. On the other hand, Thomas (2004) stated that thus far, a reliable threshold value for a normal SCC in buffalo milk has not been possible to establish; however, according to these studies (Singh and Ludri, 2001; Dhakal, 2006), it seems probable that a SCC>200,000 cells/ml is indicative of mastitis. SCC is a measure that is widely used to assess mammary health. It has been reported that a raw buffalo milk SCC of 200,000 cells/ml or greater can be used as the threshold for the early diagnosis of sub-clinical mastitis (Tripaldi *et al.*, 2010). An SCC over 200,000 cells/ml can be an indicator of mastitis, whereas values lower than 100,000 cells/ml may mean healthy mammary quarters (Fagiolo and Lai, 2007). Hamann *et al.* (2010) stated that milk SCC may be defined to assess milk quality/udder health in buffaloes, and SCC can be best determined directly by a DeLaval cell counter (DCC). Raw buffalo milk SCC ranged between 200,000 and 400,000 cells/ml and a DCC was used to determine SCC in the milk of the Anatolian water buffalo. Therefore SCC is an important criterion in milk to detect sub-clinical mastitis, as well as determine the animal's age, breed, lactation period, estrus cycle, feeding regime, and other infections in the animal's body. Furthermore, it was influenced by many factors, such as the type of bacteria that cause mastitis (Risvanli and Kalkan, 2002).

On the other hand, De *et al.* (2010) stated that buffaloes possess a powerful defense mechanism against mastitis due to their tight teat sphincter and long narrow teat canal, which can be expected to effectively prevent microorganisms from invading the udder. It is also possibly because of the smaller cisternal fraction of buffaloes compared to dairy cattle.

The variation in SCC for all parities were significant ($P<0.05$; Fig. 1). The SCC was the maximum in the first parity (186,109 cells/ml) than the SCC decreased linearly with third and fourth parity, and increased in other parities. The SCC was in the range of 50,014±9,211 to 186,109±25,415 cells/ml for all parity. In the present research, the effect of parity on SCC was significant, which indicates that with increasing number of lactations, the secretion of somatic cells in milk changes. This situation could be explained SCC lactation changes with parity. The SCC significantly changes by parity being high during the first than in later parities (Muggli, 1995). The higher SCC level for first and seventh parities may be resulted from different defense mechanisms against mammary infection in different parities.

At the start of lactation, SCC is high; thirty days later it decreases, then upon the completion of lactation it increases again. The findings of the current study support the previous research in this field (Muggli, 1995; Singh and Ludri, 2001).

However, the results of the current study do not support the previous research (De *et al.*, 2010) that determined that milk SCC did not significantly increase from the 1st to the 4th parity; SCC varied according to the parity. SCC means for parity were between the lowest value of 50,014±2,354 cells/ml in the third lactation, and the highest value of 186,109±27,296 cells/ml in the first parity.

The changes in SCC at different stage of lactation are presented in Fig. 2. As shown in Fig. 2, the mean SCC values were high ($P<0.05$) for early lactation (96,134±10,573 cells/ml), decreased to a low value during mid-lactation (68,966±11,871 cells/ml), and increased marginally during late lactation (103,776±10,542 cells/ml). The conclusions of the present study are consistent with those of Singh and Ludri (2001), who found that the mean SCC values were high ($P<0.05$) in early lactation of 90 days (range: 110,000 to 127,000 cells/ml), decreased to a low value during mid-lactation of 90-120 days (90,000 to 99,000 cells/ml), and increased marginally during late lactation (97,000 to 107,000 cells/ml). The milk SCC increased towards the end of lactation because of the higher prevalence of mastitis, normal involution of the udder and reduced milk production, which causes less dilution of the milk leucocytes (Managuli *et al.*, 2014).

It was concluded that Anatolian water buffalo bred in the Tokat region had lower levels of SCC than those of previous studies, and their milk was of high quality with a low level of SCC (90,701±6,372 cells/ml). It was revealed that the herds were managed well, according to the results.

As seen in Fig. 3, the differences of the SCC averages among calving seasons were statistically significant ($P<0.01$). The SCC means for calving seasons were between 78,176±11,908 cells/ml in winter, and 128,131±28,558 cells/ml in Summer. Buffalo raw milk SCC's showed a large variation when evaluated according to seasons (Fig. 3).

In terms of SCC values, because there were significant differences between calving seasons, it was revealed that the differences in seasons are an important factor. The milk processing firms operating at various capacities should take into account the issue of SCC when they purchase buffalo milk in the region. Breeders living in rural areas should also adopt SCC as a method of control, as it better for production, as well as being healthier.

The high somatic cell count in this research during the summer season could be due to harsh climatic contidition of high humidity and ambient temperature leading to stress condition and increase in the susceptbility to infection (Singh and Ludri, 2001). Alternativelly high values of SCC during summer season conditions might be due to great exposure

of teats ends to pathogens rather than the temperature cold seasons stress.

Nelson *et al*. (1969) reported that there was a positive relationship between high summer environmental temperature and SCC in milk. The low SCC during cold season were probably due to the better feeding and congenial environmental conditions leading to minimal stress on the buffaloes.

The low SCC for buffaloes can be attributed to a higher resistance to mastitis of the species. This resistance could be related to the anatomic features of the udder and teats, mammary gland immunology and milk composition. Buffaloes of high parity, producing more milk, and those exposed to summer stress require proper care and management to maintain milk production. Moreover, it is necessary to prevent stress and irritation of the teats caused by the lack of milk flow, deviations from a normal set of teats, and erroneous hand milking. It has been reported that milk production should be stimulated prior to milking in all buffaloes (Thomas, 2004). Furthermore, Thomas (2004) stated that the milking management system significantly influenced the frequency of quarters with increased SCC. The SCC of high percentage of samples was included between 9,000±1,155 cells/ml to 428,500±19330 cells/ml, and the average value was 90,701±6372 cells/ml.

CONCLUSION

The SCC should be low in raw milk. The SCC is one of the most important criteria that determine the quality of milk. Also, SCC is commonly used to detect quality payments to dairy farmers. In devoloped countries, SHS high milk not used in dairy factory. Unlike earlier studies in Turkey, lower average SCC values were identified in this investigation. Fundamentally, a lower SCC shows that better buffalo health, as SCC occur in inside the buffalo's udders. As a result of the present study, the further studies should be conducted in this field.

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