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A study on bulk tank somatic cell counts in a Holstein dairy herd in Khozestan province, Iran

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Abstract

The present study aimed to identify factors affecting bulk tank somatic cell count (BTSCC), as one of the most important criteria of milk quality in a Holstein dairy herd at Khozestan province, Southwestern Iran. Fixed factors including year, season, temperature-humidity index (THI), and year-season interaction were fitted in the statistical model and the general linear model (GLM) procedure was used as the statistical tool for analysis of data. The overall mean of BTSCC was 347000 cells/ml. This amount is higher than acceptable range (<200,000) and it suggests bacterial infection and the prevalence of sub-clinical or clinical mastitis. The effect of seasonal timings on BTSCC changes was significant in which the low and high BTSCC were observed in spring and winter, respectively. Surprisingly, the effect of THI on BTSCC changes was not significant and there was not any positive relationship between BTSCC and THI. Generally, the somatic cell count has increased significantly across time and it was concluded that more effective policy is needed to control and reduce SCC in the studied herd.

Keywords: Somatic cell count; bulk tank; season; dairy; temperature-humidity index

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Introduction

Milk and its products are important to the diet of people of all ages. One of the most important indicators of quality of milk is somatic cell count (SCC). Somatic cell count is used for identifying the probable mastitis in dairy cows. Factors such as parity, stage of lactation, type of housing, access to pasture, management, environmental factors, air temperature, and seasons impact bulk tank SCC (BTSCC) (Morse et al., 1988; Faye et al., 1998; Berry et al., 2006; Olde Riekerink et al., 2006). Previous findings have revealed that there is a seasonal pattern in BTSCC (Schukken et al., 1993; Sargeant et al., 1998; Berry et al., 2006; Olde Riekerink et al., 2006). Although, high BTSCC does not affect human health negatively, it is an indicator of high stress in cows and could help to identify immunologically challenged cows (Eberhart et al., 1982; Wilson et al., 1997). Moreover, BTSCC indicates the prevalence of subclinical and clinical mastitis (Morse et al., 1988; Faye et al., 1998). Consequently, monitoring of SCC in an individual farm can provide useful information about the frequency of mastitis among dairy cows. An SCC <100,000 cells/ml is reported to be normal in a healthy mammary gland, whereas an SCC>200,000 cells/ml suggests bacterial infection (Green et al., 2008).

The goal of the present study was to investigate the seasonal patterns of BTSCC in a Holstein dairy herd located in south west of Iran (Khozestan province) during the years 2006 to 2008. There is little information about milk health parameters of Holstein dairy cows in Khozestan province because the climate of the region is not suited to cow breeding. The hot and humid climate during the summer makes it difficult for the industrial dairy farms to operate. The poor climate condition in the region provides an opportunity to study the relationship between BTSCC and temperature-humidity index (THI) in a hot environmental condition.

Materials and Methods

Data

For the purpose of this study, samples were collected for three consecutive years from bulk tank of

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an industrial dairy herd in Khozestan province. Samples were taken weekly from bulk tank within the three year period of the study. The somatic cell count was evaluated using Fossomatic 500 Basics. Information regarding the daily average temperature (mean temperature) and daily relative humidity (mean RH) was obtained from weather broadcast centre for the years 2006, 2007 and 2008 and were fitted to formula [1] (Garcia-ispierto et al., 2006).

$$THI = (0.8 \times meanT + \frac{meanRH(\%)}{100} \times (meanT - 14.4) + 46.4) \quad [1]$$

Statistical Analysis

The general linear model (GLM) procedure using SPSS 16 software was implemented for analysis of the data. THI was divided into equal groups from minimum to maximum with intervals of five units and was considered as a fixed effect in the model. Model [2] was fitted for analysis of data.

$$Y_{ijkl} = \mu + T_i + C_j + S_k + TC_{ij} + e_{ijkl} \quad [2]$$

In this model, the Y_{ijkl} is the observed BTSCC, μ is the mean of observations, T_i is the effect of year (3 levels), C_j is the effect of season (4 levels), S_k is the effect of THI (9 levels), TC_{ij} is the interaction effect of year-season (12 levels), and e_{ijkl} is the residual effect. Duncan's method was used for mean comparisons. Significant level was considered at P<0.05.

Results and Discussion

The results of the present work revealed that effect of year on BTSCC changes was highly significant (P<0.05). Moreover, the seasonal patterns were also observed to be important (P<0.05). By contrast, THI did not seem to have any major effect on BTSCC changes (P>0.05).

THI characteristics

Table 1 shows THI mean during the years 2006 to 2008 across seasons. Throughout the studied period, THI was greater than 55. In total, the minimum and maximum THI were recorded in winter (57) and summer (82), respectively. Whenever THI exceeded 72, a state of heat stress occurs (Armstrong, 1994). It indicates that cows were subjected to heat stress during spring and summer in the period of experiment.

The effect of year

Figure 1 shows the mean BTSCC in three years and overall mean. The count is <200,000 cells/ml which shows bacterial infection. The result shows that the BTSCC mean has increased significantly over the

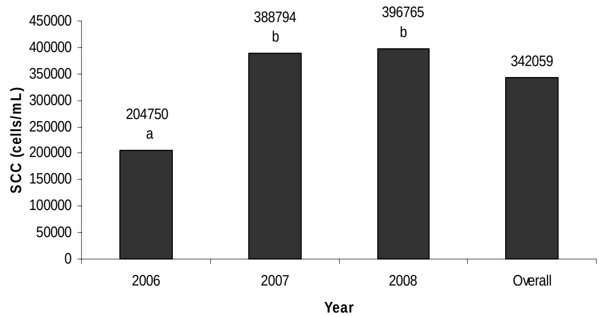

Fig. 1: Changes in BTSCC during the years 2006 to 2008. Bars with different letters differ significantly (P<0.05)

years. Higher BTSCC readings were obtained in 2008 in comparison with 2006. This means the quality of milk has been deteriorated over time.

Similar changes across years in SCC have been reported previously by other researchers. Berry et al. (2006) reported changes in SCC in Irish dairy herds in which decline in SCC was observed during the years 1994 to 2000, followed by an annual increase thereafter. Furthermore, Sampimon et al. (2005) reported two different trends in BTSCC in Netherlands, namely, a downward movement from 600000 in 1976 to 200000 cells/ml in 1999, and an upward movement from 200000 in 1999 to 227000 cells/ml in 2003. These alterations are mainly because of great restriction placed on BTSCC in different countries. Positive trend in BTSCC in this research shows that more penalty limits is necessary to reduce BTSCC in the studied region.

Seasons and THI effect

The effect of seasons on somatic cell count was significant (P<0.05). Table 2 shows the mean somatic cells count in different seasons. The minimum and maximum BTSCC were recorded in summer, 2006 (177000 cells/ml) and winter, 2007 (517000 cells/ml), respectively. The BTSCC mean exceeded the acceptable maximum in the winter seasons except for year 2006. Based on the overall observations, the yearly minimum and maximum BTSCC occurred in springs and winters, respectively. The result showed that there is a significant seasonal pattern in BTSCC variation and it increases in cold seasons compared with hot seasons. The GLM result showed that the effect of THI on BTSCC changes was not significant. While the THI mean in spring and summer were very high, BTSCC was in the minimal level in these seasons. Therefore, BTSCC was not influenced by the environmental changes such as temperature and/or humidity.

Significant seasonal pattern was recorded in BTSCC changes in which it increased in fall and winter and decreased in spring and summer. THI did not have any significant effect on BTSCC changes. This means

Table 1: Mean (±SE) of temperature humidity index in different seasons

	Spring	Summer	fall	winter	Total
2006	72.5±0.58[c]	82.5±0.31[d]	66±1[b]	55.5±0.6[a]	69±0.56
2007	72±0.63[c]	82±0.21[d]	67±0.7[b]	55±0.6[a]	68±0.52
2008	75±0.4[c]	83±0.25[d]	68±0.9[b]	58±0.4[a]	70±0.49
Total	73±0.31[c]	82±0.2[d]	67±0.49[b]	57±0.3[a]	68±0.5

Values with different superscripts differ significantly in each row (P<0.05)

Table 2: The mean (±SE) of somatic cell count in different seasons across years

	Spring	Summer	Fall	Winter	Total
2006	198300[a]	177000[a]	244000[a]	197600[a]	204750
2007	212916[a]	377500[b]	522444[b]	517363[b]	37765
2008	384200[ab]	331700[a]	358785[ab]	497384[b]	24995
Total	261875[a]	314000[ab]	366482[bc]	415676[c]	18174

Values with different superscripts differ significantly in each row (P<0.05)

that heat of summer did not affect BTSCC. Many researchers reported higher somatic cell count in the summer (Norman et al., 2000; Green et al., 2006; Skyzypek, 2006). De Haas et al. (2002) showed that the heat of summer was the cause of increased somatic cell count. Najafi et al. (2009) reported the highest total bulk milk somatic cell count in July in Khorasan province of Iran. Olde Riekerink et al. (2006) stated bulk tank somatic cell count peaked in August to September in Dutch dairy farms and revealed that the season has a significant effect on somatic cell count changing. Based on the mentioned studies, many researchers reported the maximum and minimum level of somatic cell count in hot and cold months, respectively. The changes of somatic cell count in the present research do not confirm the results of the above studies. In contrast to others, Berry et al. (2006) reported similar temporal trends in bulk tank somatic cell count in Irish dairy herds during the years 1994 to 2004 and showed that SCC was at its lowest in April and highest in December. They stated that significant seasonal patterns observed was an artifact of seasonal calving in Ireland. Also, the SCC mean was reported between 150000 and 450000 cells/ml in different herds. They stated that highly seasonal change in SCC was a function of seasonal calving and lactation. The SCC tends to be highest in very early and late lactation and at a minimum in mid-lactation (Schepers et al., 1997; Djabri et al., 2002).

It seems high THI in the summer of Khozestan province (mean of THI=82) drives herds to seasonal calving, however, there was no record of calving frequency in this herd to confirm this idea. The conception rate of cows decreases significantly under severe heat stress in the summer. For instance, conception rate was 48% after insemination at 21.1°C in cattle as compared to 0% at 32.2°C (Ulberg and Burfening, 1967). Consequently, vast majority of cows become pregnant in the fall. The higher conception rate in the autumn resulted in increased calving in the summer. In addition to lactation, other reasons like incidence of mastitis or malfunction of milking machine can increase the BTSCC in milk.

Conclusions

The main aim of the present work was to access the temporal changes of somatic cell count in a Holstein dairy farm in south west of Iran. The effect of factors like year, season and THI were investigated on BTSCC changes. Significant annual and seasonal patterns were observed. Generally, the results showed that in the studied period the somatic cell count has increased significantly. It is concluded that there is a need for more effective policies to decrease the somatic cell count. This might be achieved by penalizing the farmers against high somatic cell count until the BTSCC average become less than 200000 cells /mL in all seasons.

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