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# Statistical control of the suitability of milk obtained from different season for cheese yield and human consumption

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## Abstract

In this study, statistical control on somatic cell counts of milk obtained from the seasons performed for determination of suitability to cheese yield and human consumption standards. In the study, 30 Holstein cows were used as animal material. The Milk SCC was compared with the announced standards for cheese yield and maximum consumption level for human using one-sample t test. Milk SCC rates for all seasons (125,530, 125,000, 134,666, 137,660 cells/ml for autumn, winter, spring and summer, respectively) were lower than reference limit value of cheese yield (max. 500,000 cells/ml). Observed SCC levels for each season were lower than announced limits for human consumption (max. 400,000 cells/ml). Found SCC rates in the study were so suitable for both standards. Increased values in SCC for spring and summer season could be an undesirable level for extremely sensitive consumers although it is suitable for human consumption. Milk containing low SCC in autumn and winter season is more favorable in terms of flavor of milk and economic gain of producers.

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## Introduction

Somatic cells are basic parameters having economic importance, and somatic cell count (SCC) is a key indicator of raw milk quality, human consumption and consumer acceptability (Bansal *et al*., 2007). High SCC depends on udder inflammation, which leads to hygienic problems in milk, an alteration of milk content (Li *et al*., 2014).The high SCC (over 300,000 per milliliter) in raw milk can cause deficiencies in raw milk that result in its rejection by consumer. Many studies have shown that SCC of greater than 500,000 cells/ml have a detrimental effect on cheese yield and quality (Mistry and Kosikowski, 1988). Milk producers who want to increase to their products should minimize factors associated with SCC increase.

High SCC rate(greater than 400,000 cells/ml)is not suitable for human consumption (Anonymous, 1996).For human health, SCC values should be at a minimum level in raw milk. Somatic cell count of milk is influenced by some factors, such as machine milking, breed, hygiene, stage of lactation, and also animal and environmental factors (Rupp *et al*., 2000). All effective factors for obtaining low SCC should be controlled. Recent research has focused on the impacts of human health on milk. Differently from other studies, our research has tried to determine the risks posed for human health associated with alteration of somatic cell counts by season. However, studies that show the effect of seasonal variation of somatic cells on human health are not available in the literature. This study will be the first research to be done on the subject with the reason for this feature

Although the effect of season on milk biochemical parameters is known, the literature on the change of SCC according to seasons is sparse. On evaluation of existing literature, there were no studies associated with statistical control of the suitability of milk obtained from different season to human consumption and dairy standards. Although there are statistical studies on the changing of somatic cells according to environmental factors, there are no studies on the compatibility of somatic cells with reference values of various standards such as human health and product quality standards. In this article, statistical control on SCC rates of milk obtained from all seasons will be applied for determination of suitability to cheese yield and human consumption. If there is discrepancy between the seasons according to the standards, there will be an opportunity to get interesting interpretations.

## Material and methods

*Animal material and collection of data*

In the study, 30 Holstein cows were used as animal material. In the research, the individual milk samples were collected once monthly for each season.

*Milk analysis*

Hand milking was performed to sterilized vessels. Approximately 100 ml milk sample was taken for analysis and it was transferred to the laboratory in a short period. The SCC was obtained by the standard analysis (Microscopic count) method.

*Statistical analysis*

One sample t test for statistical analyses was applied to data (Norusis, 1993). The Milk SCC was compared with the standards (Mistry and Kosikowski, 1988) for cheese yield (max. 500,000 per milliliter) and maximum limit (Anonymous, 1996) for human consumption (max. 400,000 per milliliter)using one-sample t test. The results of statistical analyzes are interpreted by comparison with reference values. Statistical results were determined using SPSS Statistics 18 program (Çimen, 2015).

## Results and discussion

The interpretation of the results was made according to the seasons as shown below;

*Autumn season*

The statistical analysis results for milk SCC in autumn season is shown in Table 1. The observed milk SCC rates (125,530 cells/ml) in autumn season are compatible with reference values (max. 500,000 cells/ml) of cheese making standards, as shown in Table 1. As shown the Table 2, there was statistically significant difference between observed milk SCC rate

and announced maximum human consumption value (max. 400,000 cells/ml) for autumn season.

The SCC in milk from our study mean was statistically lower than reference value of human consumption. According to statistical results, we can say that there was suitability to reference value for autumn season.

It is noteworthy that the autumn season is in line with the two standards. This result is an advantageous situation for the mentioned season. It can be said that the autumn season milk is not risky and also it has advantage.

*Winter season*

The important results were found in terms of observed values in winter season. The statistical results show that low SCC means in winter season are favorable for cheese making standards (Table 3). According to results from Table 4, The SCC level (125,000 cells/ml) in winter season was statistically lower than announced limits for human consumption. These low results in terms of SCC are positive in terms of human consumption threshold. According to findings obtained from study, similarly to the autumn season, the winter season also is characterized by its advantageous properties associated with low SCC.

**Table 1.** The suitability test for cheese making standards in autumn season.

| SCC | Mean | SD | Std. Error Mean | | |
|---|---|---|---|---|---|
| | 125,530 | 70,551 | 12,88 | | |
| One Sample Test | | | | | |
| | Reference value = 500,000 | | | | |
| | | | | 95% Confidence Interval of the Difference | |
| | t | df | P | Mean Difference | Lower | Upper |
| | -13,56 | 89 | ,000 | -174,666 | -201,01 | -148,32 |

**Table 2.** The suitability test for human consumption in autumn season.

| SCC | Mean | SD | Std. Error Mean | | |
|---|---|---|---|---|---|
| | 125,530 | 70,551 | 12,88 | | |
| One Sample Test | | | | | |
| | Reference value = 400,000 | | | | |
| | | | | 95% Confidence Interval of the Difference | |
| | t | df | P | Mean Difference | Lower | Upper |
| | 1,96 | 89 | ,000 | 25,333 | -1,01 | 51,67 |

**Table 3.** The suitability test for cheese making standards in winter season.

| SCC | Mean | SD | Std. Error Mean | | |
|---|---|---|---|---|---|
| | 125,000 | 63,177 | 11,53 | | |
| One Sample Test | | | | | |
| | Reference value = 500,000 | | | | |
| | | | | 95% Confidence Interval of the Difference | |
| | t | df | P | Mean Difference | Lower | Upper |
| | -15,1 | 89 | ,000 | -175,000 | -198,59 | -151,41 |

**Table 4.** The suitability test for human consumption of raw milk in winter season.

| SCC | Mean | SD | Std. Error Mean | | |
|---|---|---|---|---|---|
| | 125,000 | 63,177 | 11,53 | | |
| One Sample Test | | | | | |
| | Reference value = 400,000 | | | | |
| | | | | 95% Confidence Interval of the Difference | |
| | t | df | P | Mean Difference | Lower | Upper |
| | 2,16 | 89 | ,000 | 25,00 | 1,40 | 48,59 |

*Spring season*

The SCC mean of spring season are compatible with reference values of cheese making standards, as shown in Table 5.

These positive results are indicative of compatibility with the desired values. The milk SCC mean of spring season was found lower than announced critical limits for human consumption.

However, the producers should be careful against SCC rates during the spring season as well as during other seasons (Table 6). Spring season results have advantage for desired standards. For producers, there is no risk during this mentioned season and no additional measures are needed during this season in terms of high SCC.

*Summer season*

The obtained results from summer season show that low SCC mean are acceptable for cheese making standards (Table 7). As shown in the results from Table 8, there was statistically significant difference between SCC mean and announced reference value for human consumption. The SCC mean in summer season was lower than mentioned reference value for consumption. According to these results, we can say that there was suitability to announced limits for hot season. We can say that in the summer season there is no risk for high SCC despite the fact that it is generally a risky season for microbiological data.

**Table 5.** The suitability test for cheese making standards in spring season.

| SCC | Mean | SD | Std. Error Mean | | |
|---|---|---|---|---|---|
| | 134,666 | 55,257 | 10,09 | | |
| One Sample Test | | | | | |
| | Reference value = 500,000 | | | | |
| | | | | 95% Confidence Interval of the Difference | |
| | t | df | P | Mean Difference | Lower | Upper |
| | -16,3 | 89 | ,000 | -165,333 | -185,96 | -144,70 |

**Table 6.** The suitability test for human consumption in spring season.

| SCC | Mean | SD | Std. Error Mean | | |
|---|---|---|---|---|---|
| | 134,666 | 55,257 | 10,09 | | |
| One Sample Test | | | | | |
| | Reference value = 400,000 | | | | |
| | | | | 95% Confidence Interval of the Difference | |
| | t | df | P | Mean Difference | Lower | Upper |
| | 3,43 | 89 | ,000 | 34,66 | 14,03 | 55,29 |

**Table 7.** The suitability test for cheese making standards in summer season.

| SCC | Mean | SD | Std. Error Mean | | |
|---|---|---|---|---|---|
| | 137,660 | 124,03 | 22,64 | | |
| One Sample Test | | | | | |
| | Reference value = 500,000 | | | | |
| | | | Mean | 95% Confidence Interval of the Difference | |
| | t | df | P | Difference | Lower | Upper |
| | -8,0 | 89 | ,000 | -182,333 | -228,65 | -136,02 |

**Table 8.** The suitability test for human consumption in summer season.

| SCC | Mean | SD | Std. Error Mean | | |
|---|---|---|---|---|---|
| | 137,660 | 124,03 | 22,64 | | |
| One Sample Test | | | | | |
| | Reference value = 400,000 | | | | |
| | | | Mean | 95% Confidence Interval of the Difference | |
| | t | df | P | Difference | Lower | Upper |
| | ,78 | 89 | ,034 | 17,66 | -28,65 | 63,98 |

*Seasonal effects*

On the basis of study findings, it can be concluded that milk SCC rates for all seasons were compatible with reference values (max. 500,000 cells/ml) of cheese making standards. Also, SCC levels for each season were statistically lower than announced limits for human consumption. As known, high somatic cell rates negatively affect milk production, cheese yield and sensory quality. High somatic cell count can adversely affect the quality of cheese and reduces its storage period (More, 2009). When somatic cells devastate bacteria, enzymes are involved in process. These enzymes are resistant to cheese process and can cause damage of protein and fat. This can result in bad taste in milk that consumers find objectionable (Mikulec *et al.*, 2012).

For this reason, high somatic cell counts in milk are not desirable in terms of taste of dairy products such as cheese.

As can be seen from the results in tables, SCC rates are higher in spring and summer season than autumn and winter seasons. High SCC rates in spring and summer season are possibly related to the influence of higher temperature and humidity on intramammary infection risk. During hot season, the number of negative bacteria is increased in the bedding material due to suitable temperature and humidity (Harmon, 1994).

Although the results of spring and summer seasons are higher than the other two seasons, there is no risk in terms of mentioned standards. For dairy cows, monitoring the dam is basic in spring and summer season, despite low somatic cell count, and producers should be careful about udder hygiene at announced periods. Although the SCC rates in the research are not above consumer acceptability, the increasing rates especially in humid and hot periods pose a risk for milk taste. The high free fatty acids in milk having high somatic cell count may produce a rancid taste (Sharma *et al.*, 2011).

Rancid taste has a negative effect on the saleable of milk. As known, consumer behavior affects milk sales (Klein *et al.*, 2016). Increased values in SCC for spring and summer season could be an undesirable level for extremely sensitive consumers although it is suitable for cheese production, general consumer acceptability and health. Milk containing low SCC is more advantageous in terms of health, taste and economic gain of producer. High SCC reduces the quality of both milk and dairy products, and also affects milk shelf life and flavor of products (Koç, 2008).

Although the findings obtained from wet (spring) and hot (summer) periods are higher than the other two periods, there is no risk in terms of associated standards. The results from our study were similar with this information that milks samples were not negative in terms of product quality and consumer health. To sum up we can say that there is no risk associated with the reference values in question.

**Conclusion**

The obtained results from all season show that low SCC mean are acceptable for cheese production and human health. However, we found that humidity and heat stress can adversely impact quality of milk in spring and summer season. Based on this information, we can say that autumn and winter seasons are more suitable for consumer preference and economic profit of dairy producers. However the high levels of SCC obtained from spring and summer season were not higher than mentioned standards. Milk producers wanting to maximize their profits should pay attention to especially these periods. New and striking results obtained from statistical control are needed for dairy sector.

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