



Time Series Analysis of Somatic Cell Count from Dairy Herds in Minas Gerais - Brazil

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Abstract. *The objective of this study was to analyze the temporal variation of somatic cell count (SCC) in milk of dairy cows from the state of Minas Gerais, Brazil. The Holstein Livestock Breeders Association of Minas Gerais provided data collected from 128 dairy farms located in the state of Minas Gerais between the years of 2000 and 2016. The database contains the SCC average of a total of 91,851 305-day lactations of Holstein animals. The annual SCC average was calculated as well as the percentage of observations above 400,000 cells/ml (%> 400 – established as the limit by Brazilian regulation). Linear regression analysis was performed adopting a 5% significance level. A quadratic relationship ($P < 0.001$) was found between annual SCC average and the years, which increased between the years 2000 until the end of 2014, followed by a decrease until the end of period evaluated. A positive linear relationship ($P < 0.001$) was found for %>400 and the years evaluated. We, therefore, concluded that dairy herds from Minas Gerais presented a reduction trend of annual SCC average, but there was a trend of increasing number of observations above the limit of 400,000 cells/ml.*

Keywords. *Bovine mastitis, Brazil, milk quality, Minas Gerais, SCC.*

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Introduction

Milk supply chain employs millions of Brazilians, being of great importance to the country's economy (Alvim et al. 2002). In order to ensure milk quality, the Ministry of Agriculture, Livestock, and Food Supply (MAPA) published the Normative Instruction No. 51 (IN 51) in 2002 (Brasil 2002). It established threshold of different milk quality parameters such as total bacterial count and somatic cell count (SCC), as well as protein, fat, lactose, solids-not-fat, and total solids (Brasil 2002).

SCC is a widely used parameter to identify animals infected with clinical or subclinical mastitis. Such infectious disease leads to substantial economic losses, mainly due to the reduction in milk production caused by lesions of secretory epithelial cells of the infected mammary gland (Langoni 2013). Time series analysis of SCC variation is helpful in assessing infection occurrences over the years. Therefore, SCC analysis provides insightful information regarding mammary gland health as well as milk quality, helping to reduce production losses (Wickström et al. 2009).

Therefore, the objective of this study was to analyze the temporal variation of SCC in milk of dairy cows from the state of Minas Gerais, Brazil.

Materials and Methods

The time series data used in this study were part of a pre-existing data set; therefore, approval was not required from the Animal Ethics Committee of the Federal University of Jequitinhonha and Mucuri Valleys in order to carry out this study.

The Holstein Livestock Breeders Association of Minas Gerais collected the data from 128 dairy farms located in the state of Minas Gerais between the years of 2000 and 2016. The database contains the SCC mean of a total of 91,851 305-day lactations of Holstein animals. The percentage of observations that were above the 400,000 cells/ml threshold (%>400) imposed by IN 51 was then determined over the assessed period.

Linear regression analysis was conducted using the statistical software R (R Core Team 2017) adopting the level of 5% of significance. The annual average of SCC and %>400 were considered as the dependent variable (y) and the years as the independent variable (x). The normal distribution of residues was confirmed using the Shapiro Wilk test. First, second, and third degree polynomial models were tested and the best-fit model was selected based on residual standard error and coefficient of determination (R^2).

Results

A quadratic behavior was observed for SCC over the evaluated years ($P < 0.05$), which suggests that producers became more aware regarding mastitis and caused a reduction in infections after the year of 2015. On the other hand, a positive linear relationship ($P < 0.05$) was observed for %>400 and the period evaluated (Table 1).

Table 1. Descriptive statistics and linear regression of the annual mean somatic cell count (SCC x 1000 cells/ml) and the percentage of observations above 400,000 cells/ml.

Variable ¹	N ²	Average	SD ³	Linear Regression	P-value	RSE ⁴	R ²
SCC x 1000	17	260.30	82.89	$\hat{Y} = 105.91 + 30.94 X - 1.05 X^2$	< 0.001	38.93	0.81
%>400	17	15.75	5.72	$\hat{Y} = 7.60 + 1.02 X$	< 0.001	2.61	0.80

¹ SCC x 1000: Average somatic cell count in 305-day lactation; %>400: Percentage of observations that were above the 400,000 cells/ml threshold. ² N: Number of years on time series data. ³ SD: Standard deviation of mean. ⁴ RSE: Residual standard error.

Discussion

High SCC values are associated with milk yield loss and decreased shelf life of processed

product, while low SCC indicates good mammary gland health (Ribeiro Neto et al. 2012). The positive linear result found for the percentage of observations with SCC above 400,000 cells/ml may indicate an increase in the number of animals affected by mastitis over the evaluated years. The observed mean of 15.75% of animals with elevated SCC is relatively high and undesirable, since it should not exceed 2%. Increase in SCC may also be related to the increase of fat, protein, minerals, and total solids yield, which should not be considered favorable to milk quality, but rather a negative effects of subclinical mastitis (Vargas et al. 2015).

Reduction in SCC is closely related to the adoption of correct milking and animal handling practices. It is important that producers use good production practices and monitor critical points involving contamination and the presence of residues in milk (Pires Neto et al., 2012). The microbiological quality of the milk is a good indicator of overall mammary gland health as well as handling and hygiene practices adopted by dairy producers (Gomes 2001). Erroneous perception about the sanity of the mammary gland and the lack of knowledge about sanitary measures to control the disease incidence are the main bottlenecks on mastitis control (Jansen et al. 2010). The results found in our study indicate that retrospective analyses of SCC generate knowledge of bovine mastitis incidence over the years that can be used to implement control practices.

Conclusion

We conclude that dairy herds from Minas Gerais presented a reduction trend of SCC annual average; however, there was a trend of increased number of observations above the limit of 400,000 cells/ml.

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