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Efeito do tamanho e localização de rebanhos da raça holandesa sobre a contagem de células somáticas do leite*

Effect of herd's size and geographical location on somatic cell count of milk from Holstein cows

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Resumo

Oitenta e cinco rebanhos da raça holandesa sob controle oficial de lactação tiveram seus índices de Contagem de Células Somáticas analisados no período de março de 2009 a fevereiro de 2010. As coletas foram realizadas mensalmente durante este período, perfazendo um total de 1.020 amostras. Os rebanhos foram classificados de acordo com a localização geográfica no estado de Minas Gerais e número de vacas em lactação. Os dados de CCS foram transformados para escore linear e, então, as médias comparadas por análise de variância, utilizando-se o programa estatístico SPSS. Em relação à localização do rebanho, não houve diferença significativa quanto à variação da CCS (p>0,05). Quanto a variação de CCS em relação ao tamanho do rebanho, foi observado que aqueles com um número maior de vacas em lactação (de 21 a 40 e acima de 80) tiveram índices menores de CCS (p<0,05) que os com um número menor de vacas em lactação (até 20).

Palavras-chave: contagem de células somáticas, mastite subclínica, epidemiologia.

Abstract

Eighty-five Holland herds under control official lactation index were Somatic Cell Count (SCC) analyzed from March 2009 to February 2010. A total of 1,020 samples were collected monthly during this period. The herds were classified according to geographical location in the Minas Gerais State and number of dairy cows. The data were transformed to SCC linear score, and the average compared by the analysis of variance statistical analysis using the statistical program SPSS. This study did not find any association between location of the herd and CCS (p>0.05). It was also observed that herds with a greater number of lactating cows (from 21 to 40 and higher to 80) had lower rates of SCC (p<0.05) than those with smaller number of dairy cows (up to 20).

Keywords: somatic cell count, subclinical mastitis, epidemiology.

Introduction

Mastitis is an infectious disease that causes an inflammation of the mammary glands in dairy herds. Mastitis due to infections agents may be clinical or subclinical, depending on the degree of inflammation (Philpot and Nickerson, 1991). Clinical or subclinical cases of mastitis cause major losses due to interfere in either the milk yield, the milk quality, the costs of milk disposal, the possible loss of animals and the veterinary expenses (Halasa et al., 2007). Subclinical mastitis is frequently found in dairy herds, and the main economic loss is due to the decrease in milk production (Huijps et al., 2008).

The somatic cell count (SCC) is an indicator of subclinical mastitis and has been used to assess and monitor the health of mammary glands in dairy herds (Philpot and Nickerson, 1991; Schukken et al., 2003). The SCC of a given herd supplies an estimate of either the percentage of mammary quarters, the cows with subclinical infection and its relation to milk production losses (Philpot and Nickerson, 1991; Jayarao and Wolfgang, 2003; Schukken et al., 2003). Monitoring the SCC at the herd level requires longitudinal data over time, and it is important to follow the trends over time and intervene when the SCC appear to increase above a given threshold (Djabri et al., 2002; Schukken et al., 2003).

The main source of variation for the SCC is intramammary infection (Harmon, 1994; Djabri et al., 2002; Souza et al., 2009). Several factors are associated with new intramammary infections and the consequent increase of the SCC, including the stage of lactation, the number of lactations and the month and season of the year (Barkema et al., 1998, Barkema et al., 1999; Gibbons-Burgener et al., 1999; Ott and Novak, 2001; Karimuribo et al., 2006). Studies in herds located in Brazil have identified and quantified the risk factors for a high SCC that are associated with

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the number of cows in lactation, milking procedures and type of milking (Souza et al., 2005; Coentrão et al., 2008).

However, management practices to control and prevent mastitis may be different between regions. Indeed, differences in natural resources, cultural tradition, dairy farm structure, and market have caused different regions in the United States to implement different mastitis management systems (Oleggini et al., 2001). The SCC differed significantly among regions of United States, being found the lowest in the North and highest in the South (Oleggini et al., 2001; Ely et al., 2003). SCC variations and resistance to mastitis treatment differences between regions were observed in dairy herds in France and Norway (Saebo and Frigessi, 2004; Gay et al., 2006; Gay et al., 2007).

The herd size can also be considered a risk factor for mastitis (Oleggini et al., 2001; Souza et al., 2005). A study found that there was a interaction between region and herd size and the SCC (Oleggini et al., 2001; Ely et al., 2003). It was verified that smaller size herds (20 to 49 cows) had the highest SCC, and larger herds (> 499 cows) had the lowest SCC (Oleggini et al., 2001). The results of that study suggested associations between both seasonal and regional effects on SCC. Furthermore, the herd size, herd management and adoption of technologies were associated with mastitis in the southern region of Brazil (Martins et al., 2007).

Therefore, many factors can be responsible for differences in the SCC in dairy herds. However, the determination of the main risk factors and those regions with higher incidences of mastitis can be useful for decision makers and veterinarians in the establishment of a mastitis control program for a specific dairy herds. The objective of this study was to evaluate the variation in the SCC according herd size and geographic location (mesoregion) in dairy herds registered with the Association of Holstein Dairy Farmers of Minas Gerais State.

Material and methods

The study was conducted with 85 herds of the Holstein breed located in the State of Minas Gerais, Brazil, representing a population of 5,462 lactating cows. The dairy farms in this study were assisted by the Association of Breeders of Holstein Cattle. Milk samples from the milk-cooling tank were monthly collected for the evaluation of the SCC over 12 months (from March to February), comprising 1,020 milk samples. The samples were collected and subsequently conditioned in isothermic boxes with recycled ice and transported within 96 hours to the Laboratory of Milk Quality of EMBRAPA Dairy Cattle. The procedures of collection, sample storage and time between collection and analysis were performed in accordance with Internacional Dairy Federation (IDF) (2008). The SCC was assessed by cytometry flow using automated equipment (Bentley – Somacount 300) following the procedures of IDF (2006).

For the statistical analysis, the herd were classified according to their geographical location and the number of cows in lactation. The classification according to the geographical location was based on the mesoregions within the state of Minas Gerais, as reported by IBGE in four categories: Zona da Mata and Campo das Vertentes (22), Área Metropolitana de Belo Horizonte (12), Sul/Sudoeste (42) and Triângulo/Alto Parnaíba (9). The herds were classified into four categories according to the number of cows in lactation: up to 20 cows (20), from 21 to 40 cows (23), from 41 to 80 (21) and with more than 80 cows (21).

For each herd, the arithmetic mean of the SCC was calculated for a period of twelve months, and the average values were used to perform the descriptive statistics. The average values of the SCC were transformed into linear scores (LS) according to Philpot and Nickerson (1991), with the objective of comparing the means and evaluating the variation of the SCC among the locations and number of cows in lactation.

A comparison of the means was conducted using variance analysis (ANOVA) and the T test for independent samples was used, as described by Sampaio (1998). The SCC variation in the herd in relation to their location and number of cows in lactation was assessed using the generalized linear model (GLM) (Dohoo et al., 2003), as follows: $Y = b_0 + b_1X_1 + b_2X_2 + b_3X_1X_2$ in which Y is the outcome (LS of the SCC) and X_1, X_2 and X_1X_2 are the explicative variables (geographical location, number of cows in lactation and their interaction, respectively). The statistical analyses were performed using SPSS (Statistical Package for the Social Sciences, 1998).

Results and discussion

The descriptive statistics of the SCC in relation to the mesoregions and the number of cows in lactation are presented in Tables 1 and 2, respectively. As for the mesoregions, Zona da Mata and Campo das Vertentes displayed the highest averages when compared to the other mesoregions; the same result was observed for the values of the median. However, due to the great variation in the results for the SCC in relation to the averages, it is suggested that there was the presence of herd with low and high SCC values in all of the mesoregions.

In contrast, a difference between the means of the LS of the SCC in relation to the mesoregions (Table 2) was not observed in the variance analysis. We found that the LS varied between 4.77 and 5.81 (from 282,000 to 1,130,000 cells/ml), suggesting that there may be herds with high prevalence of contagious mastitis pathogens within the region studied, as observed by Souza et al. (2009).

Table 1 shows that, when analyzed in relation to the geographical distribution, 25% (IQR25) of the herd display values for the SCC below 349,000 cells/ml; the same result was observed when the herds were analyzed by size (Table 1). Conversely, 25% (IQR75) of the herd are above 682,000 cells/ml, which represent a minimum loss in production of 7% and at least 26% of the animals with subclinical mastitis.

By analyzing the data of the descriptive statistics relative to the herds in relation to the number of cows in lactation (Table 1), we found that herds with up to 20 cows in lactation a higher average for the SCC when compared to the average of other herds. Herds with more than 80 cows showed the opposite trend, displaying a smaller average for the SCC; the variance analysis of the average of the LS confirmed these observations (Table 2). Clearly, the size of the herd was decisive for the SCC levels. This finding suggests that, even for smaller registered pure herds, the smaller the herd size is, the smaller would probably be their technological levels. On the other hand, those larger dairy farms would make more use of technological tools, with the goal of controlling the quality of the milk and associated procedures. Thus, more comprehensive studies are needed, including the use of questionnaires and on-site observation to assess the handling of the animals.

Table 1: Descriptive statistics of the arithmetic means of SCC (x1,000 cells/mL) in relation to the location of cattle according to the mesoregions of the state of Minas Gerais and categories of number of cows in lactation (from March/2009 to February/2010)

Variable	Categories	Number of Cattle	Average	Standard Deviation	IQR25	Median	IQR75
Mesoregion	Zona Mata and Campo Vertentes	22	673	364	368	606	1,022
	Metropolitana de BH	12	517	253	408	473	573
	Sul Sudoeste	42	507	268	311	466	660
	Triângulo and Alto Parnaíba	9	457	97	375	426	570
Cows in lactation	0 a 20	20	721	312	483	762	978
	21 a 40	23	498	312	234	436	589
	41 a 80	21	557	289	335	456	756
	> 80	21	421	131	332	426	502

IQR25 – First interquartile range; IQ75 - Third interquartile range

Gay et al. (2007) did not observe a significant difference in the levels of the SCC with relation to the differences in the herds size in France. However, due to the local characteristics (70% of dairy farms have more than 100 cows), this was not taken into consideration by the authors as a reliable factor because questionnaires were not used. Nevertheless, the distribution of the herds by the number of cows in lactation (Table 1 and 2) was similar in the present study.

Table 2: Averages of linear score of the somatic cell count of cattle according to the mesoregions of the state of Minas Gerais and categories of number of cows in lactation (from March/2009 to February/2010)

Variable	Categories	Number of cattle	Average	Standard deviation	CI (95%)
Mesoregion	Sul Sudoeste	42	5.14[a]	0.81	4.89 – 5.40
	Metropolitana de BH	12	5.25[a]	0.75	4.77 – 5.73
	Triângulo and Alto Paranaíba	9	5.33[a]	0.50	4.95 – 5.72
	Zona da Mata and Campo Vertentes	22	5.41[a]	0.91	5.01 – 5.81
Cows in lactation	> 80	21	5.00[a]	0.63	4.71 – 5.29
	21 a 40	23	5.04[a]	0.82	4.69 – 5.40
	41 a 80	21	5.29[ab]	0.72	4.96 – 5.61
	0 a 20	20	5.70[b]	0.86	5.72 – 6.00

Mesoregion : F=0.564 (value for Fisher Test); p=0.640 (significance level); Cows in lactation: F=3.625 (value of the Fisher Test) ; p=0.016 (signficance level); CI – Confidence Interval for the average for a significance level of 0.05

The average of the linear score of the SCC for the herds, when analyzed according to the geographical distribution, were not significantly different ($p>0.05$) (Table 2). Analyzing factors in the USA, Ely et al. (2003) noted an increase in the SCC levels in herds in southern regions and credited this to the environmental effects of heat-related stress. Two years prior, Oleggini et al. (2001) suggested that more humid and hotter environments positively influenced the higher levels of the SCC when compared with drier areas of the USA.

In the regions of the state of Minas Gerais comprised in this study (Sul/Sudoeste, Triângulo/Alto Paranaíba, Zona da Mata and Campo das Vertentes and Área Metropolitana Belo Horizonte), the difference in climate is due more to the variations in elevation than in the latitude. Furthermore, regional differences are correlated with the distribution of the number of herds in which the mesoregion Sul/Sudoeste is traditionally known for milk production, whereas the mesoregion Triângulo/Alto Paranaíba is more famous for meat.

The mesoregion of Zona da Mata and Campo das Vertentes is characteristic for having the lowest level of technology when compared to Sul/Sudoeste, but this discrepancy may have been overlooked because the herds studied are registered with the Association of Holstein Cattle of Minas Gerais, and it can therefore be deduced that standard husbandry procedures are followed.

Gay et al. (2007) found a correlation between the highest levels of the SCC with areas sparsely occupied by dairy farms, concluding that this result coincided with the fact that these areas traditionally specialized in the production of meat and grains. This finding also suggests that dairy specialization is favorable for controlling the SCC, which is also verified by Martins et al. (2007) and Souza et al. (2005).

The data presented in Table 2 show significant differences ($p<0.05$) between the averages of the herd size, it was also observed that herds with a greater number of lactating cows (from 21 to 40 and higher to 80) had lower rates of SCC ($p<0.05$) than those with smaller number of dairy cows (up to 20). Citing Barkema et al. (1998), the size of the herd was recognized as a factor that influences the SCC levels by Gay et al. (2007). Ely et al. (2003) also reached this conclusion, noting that larger herds had lower SCC values than smaller herds but that the SCC reduction rate was larger in smaller herds, diminishing the difference between these herds over time. A possible explanation for this phenomenon is that the herds from 21 to 40 cows may been reared using programs to control the SCC levels.

A multivariate linear regression model was performed to analyze the effect of each factor on the SCC (Table 3). It was verified that the model confirmed the findings shown in Table 2. This model was statistically significant (p<0.05) and explained 25.3% of the SCC variance levels in the herds.

In this model, it was analyzed the independent effects of localization and size of herds on the SCC. We found that the SCC variation in relation to the localization was not significant (p=0.334) and was responsible for only 4.6% of the whole variation. However, in relation to the number of lactating cows, the data were statistically significant (p<0.01), explaining 15.3% of the SCC variation. The interaction between the localization and size of herds was not significant (p=0.239), explaining 11.8% of the SCC variation. This model indicated that the larger association occurred between the number of lactating cows and the SCC, as was observed by other authors (Oleggni et al., 2001; Ely et al., 2003; Souza et al., 2005; Gay et al., 2007).

The methodology used in the study to selected the herds according areas and the statistical methods used to evaluate the difference between the SCC may not be sufficient to identify clusters of herds with high bulk tank SCC. The methods that seek to associate geographical coordinates of dairy herds (latitude and longitude) with the average of SCC, as described by Gay (2007), are more accurate in identifying clusters of herds with high SCC.

Table 3: Variance Analysis of SCC in cattle classified in accordance with geographical location and number of lactating cows

Source of Variation	df	SS	F	P	EE
Model	13	13.62	1.851	0.050	0.253
Intercepto	1	1,488.45	2,629.479	<0.001	0.974
MESO	3	1.96	1.154	0.334	0.046
NLC	3	7.26	4.279	0.008	0.153
MESO X NLC	7	5.36	1.353	0.239	0.118
Error	71	40.19	-	-	-
Corrected Total	85	2,394.00	-	-	-

NLC – Number of Lactating Cows; MESO – mesorregion of the State of Minas Gerais; df – degrees of freedom; SS – sumo of squares; F – value for the Fisher Test; p – significance level; EE – Effect Estimate

Conclusion

The size of herds was associated with the SCC. Dairy management is changing with the development of new technologies, and the degree of adoption of these technologies may be changing according to the herd size. Differences in the incidence of mastitis, the herd management and the herd size may help define possible future approaches for research and application. The results obtained in this study may be useful for decision makers and veterinarians involved in national mastitis control programs.

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