Milk quality and subclinical mastitis detection through somatic cells counting

Luís Carlos Vinhas Ítavo[1]*, Geraldo Tadeu dos Santos[2], Vagner de Alencar Arnaut de Toledo[2], Camila Celeste Brandão Ferreira Ítavo[1] and Newton Phol Ribas[3]

*[1]Departamento de Zootecnia, Universidade Católica Dom Bosco-UCDB, Av. Tamandaré, 6000, 79117-900, Campo Grande, Mato Grosso do Sul, Brasil. [2]Departamento de Zootecnia, Universidade Estadual de Maringá, Av. Colombo, 5790, 87020-900, Maringá, Paraná, Brasil. [3]Departamento de Zootecnia, Universidade Federal do Paraná, C.P. 2959, 80001-970, Curitiba, Paraná, Brasil. *Author for correspondence. e-mail: itavo@icdb.br*

ABSTRACT. The somatic cells counting (SCC) is a tool to detect sub clinical and assistant infection in the evaluation of milk quality. The main purpose of this research was to evaluate the degree of the sub clinical mastitis of the dairy herd at Universidade Estadual de Maringa by controlling the milk of 306 data, carried out by the Associação Paranaense dos Criadores de Bovinos da Raça Holandesa. The data was collected from 35 cows in 5 calving orders (CO), from 1993 to 1996. The result of SCC for the first CO was the smallest ($P<0.05$), while the results for the 5th CO were the largest. The high value of SCC suggests that the quality of the milk produced could be affected and that some cows of the herd can be with sub clinical mastitis, and thus, Some tests should be accomplished to confirm the infection: the mastitis tests, Wisconsin Mastitis Test (WMT) or the California Mastitis Test (CMT).

Key words: fat percentage, mastitis, milk production, protein percentage, sub clinical mastitis.

RESUMO. Qualidade do leite e detecção de mastite subclínica através da contagem de células somáticas. A contagem das células somáticas (CCS) é uma ferramenta para detectar infecção subclínica e auxiliar na avaliação da qualidade do leite. Objetivou-se avaliar o grau de mastite subclínica do rebanho leiteiro da Universidade Estadual de Maringá (UEM) através de 306 dados coletados do controle leiteiro, no período de 1993 a 1996, realizado pela Associação Paranaense dos Criadores de Bovinos da Raça Holandesa (APCBRH), de 35 vacas em 5 ordens de parto (OP). O resultado da CCS para a 1ª OP foi o menor ($P<0,05$), enquanto que os resultados para a 5ª OP foram os maiores. O elevado valor da CCS sugere que a qualidade do leite produzido poderia estar afetada e que algumas vacas do rebanho podem estar com mastite subclínica, devendo ser realizados os testes de mastite, "Wisconsin Mastitis Test" (WMT) ou "California Mastitis Test" (CMT), para a confirmação da infecção.

Palavras-chave: gordura, mastite, produção de leite, proteína, mastite subclínica.

Mastitis has been the disease that causes the high costs in the milk production resulting in significant loses. This illness is described as being very complex, because it is caused by several types of agents. There is not a program that involves the effective treatment of all cows of the herd too. However, those herds that have effective control of contagious pathogens produce high-quality of milk, with low counting of somatic cells, but they can still suffer losses due to the occurrence of infections caused by environmental pathogens (Harmon and Reneau, 1993)

Mastitis is considered an illness that most frequently affects milk cow and most economical loses brings to producers and their milk company (Monardes, 1994). According to Torres (1985), it is possible to diagnose the illness in all parts of the world, even in those places where there are not efficient programs for its control and prevention. Moreover, it is a complex illness once it can be caused by various species of microorganisms, such as bacteria, fungus, alga and virus.

Among other factors, the different levels of infection of the herd have made it difficult to estimate the loss deriving from mastitis. Such losses may be recognized in areas such as: reduction in the production, discarded milk, depreciation of nutritious quality, drugs, medicine veterinary

assistance, cow reposition and extra time lost with drug management and application (Embrapa, 1984).

With the arising of the electronic counting of somatic cells and its spreading in Brazil, dairy producers in Paraná State, by means of APCBRH, started having an important tool to control mastitis in the herds. The combination of these data with the results of the bacteriological cultures and with the tests of mastitis detection, "Wisconsin Mastitis Test" (WMT) or "California Mastitis test" (CMT), the producers will have a result of infection, once the control of mastitis in the milk herd has always consisted of insufficient tests.

The somatic cells of milk are mainly leukocytes, which include macrophages, lymphocytes and neutrophilus (Harmon and Reneau, 1993). The goal of the leukocytes is to embody and digest the invading microorganism of the mammary gland. Thus, the counting of somatic cells (SCC) is a tool to detect the increase of leukocytes in the blood.

Although sub clinical mastitis does not present apparent signal, it limits the economical exploration of the cow. It can develop into an acute mastitis if there is a decrease in resistance, and its detection depends of laboratory tests. (Torres, 1985). The occurrence of environmental mastitis may be related to the type of housing, bed and time of the year. Confined animals are under higher risk to have environmental mastitis than animals free in the field. Nevertheless, the agglomeration of animals in areas with shade in the field during summer results in a concentration of ambient pathogenic greater than 10.000.000/ grams of dry material of the soil (Harmon *et al*., 1992). Organic material used as bed in those systems of free stall, such as straw, saw dust or wood shavings result in a higher concentration of ambient pathogenic than inorganic beds such as sand and lime.

There are two groups of bacteria that are responsible by most infections of the mammary gland. The group of the contagious organisms, said to be the main group, are readily transmitted among the animals and/or their teats. This group consists of *Staphylococcus aureus*, *Streptococcus agalactiae* and *Streptococcus dysgalactiae*, all of them being able to cause clinical mastitis and a series of other secondary pathogenic that include other species of the type *Staphylococcus* and *Corynebacterium bovis*. The secondary pathogenic group is responsible by the sub clinical infections or not very severe clinical illnesses. Another group that can be relatively more important, in developed milk industries, consists of opportunist bacteria, associated to the ambient, which are normally fecal organisms such as *Streptococcus uberis, Escherichia coli* and other coliforms and gram-negative bacteria (Hillerton, 1996).

Nicolau *et al*. (1996) studied the influence of *Staphylococcus* sub clinical mastitis on milk cellular and physical-chemical characteristics of 5 herds, producers of type B milk and concluded that there was an increase in the counting of polymorph nuclear leukocytes. Thus, it justifies the broad use of auxiliary methods for diagnosing bovine mastitis that is based on the evaluation of the contents of milk leukocytes. That is, the counting of somatic cells.

The SCC level considered normal is under 200.000 cells/ml of milk, although it may be less in the first lactation. Generally, SCC increases with the age and number of lactation in groups of infected cows. The SCC in udder, which is not contaminated, does not seem to vary with the age (Monardes, 1984). The status of infection is determined and influenced by the level of the lactation. All the animals, free from infection, have elevated SCC immediately after giving partum; so, a fast decrease is observed after birth in non-infected animals or quarters (Monardes, 1994; Harmon and Reneau, 1993). Sheldrake *et al*. (1983) showed that the SCC from milk of non-infected animals increased from 83.000 on the 35th day after the birth to 160.000 cells/ml of milk on the 285th day. However, in infected animals by *S. aureus*, it increased from 234.000 to 1.000.000 cells/ml of milk in the same period.

Branco and Santos (1993) in their review comment about the positive influence of adequate nutrition of the dairy cattle, which may directly influence the resistance and susceptibility to contagious disease.

In order to have mastitis evaluated in the herd, the use of SCC values is a technique that may be useful as a tool in the prevention and diagnose of sub clinical mastitis. Based on these information, it was evaluated the evolution of the counting of somatic cells (SCC) during the partum to help the management of dairy cows, in the herd of State University of Maringá (UEM), Paraná. Brazil.

Material and methods

The present experiment was conducted at the Experimental Farm of State University of Maringá (UEM), state of Paraná. Brazil. It was collected milk samples of 35 Holstein cows monthly, during the milk collection for milking control, distributed in 5 calving orders, from 1993 to 1996, performing a total of 306 pieces of information. The production system in which the animals were kept was semi-

confined, where the animals practically received all the food in the form of total diet mixed three time a day, being liberated to Coast-cross pasture area.

The milking management consisted of two milking a day (morning and afternoon), where the teats of the cows were cleaned, dried with individual paper towel and lately submitted to mechanical milking system. The milk produced was then cooled down and later bagged without any manual contact.

Adequately bagged in plastic tubes appropriate for the milking control, the milk samples were sent to Paraná Association of Holstein Bovines Farmers (APCBRH) to be controlled and have the milk composition determined and the somatic cells counted by the Universidade Federal do Paraná, APCBRH, based in Curitiba, Paraná, Brazil.

For the statistic analysis of data, it was used a method of minimum squares. In the statistical model it was considered the SCC effects, milk production, fat percentage and protein percentage versus the calving order.

Results and discussion

It is possible to verify, in Table 1, the mean values of the somatic cell counting (SCC), milk production, protein percentage and fat percentage, from the 5 calving orders of the cows of the milk herd at UEM, from 1993 to 1996.

Table 1. Averages of somatic cells counting (SCC), milk production (PL) fat percentage (FP) and protein percentage (MP) of the milk, versus the calving order (CO)

CO	N	SCC	PL	FP	MP
1	97	243.34	15.97	3.81	3.37
2	83	393.28	19.10	3.95	3.27
3	72	463.83	21.44	3.90	3.30
4	37	366.70	22.89	4.11	3.31
5	17	521.18	23.33	4.25	3.36
CV	-	118.34	25.93	16.17	9.73

CO= Calving Order n=number of observations; SCC = somatic cell counting (x1000 cells/ml of milk); PL= milk production (Kg/day); FP=fat percentage (%); MP=milk protein percentage (%); CV= coefficient of variation

The average of milk production during this period was 20.55 Kg/day, suggesting that the herd could be classified as having a medium production, according to Santos *et al*. (1993). Nevertheless, it is important to point out that the production system used and the nutritional management could present higher levels of production, which implies in classifying the animals as of average-low capacity for milk production. It was observed an increase in the milk production followed by the calving order (CO), which was expected, once the cows of the first partum would still be growing/ in development/, consequently not being able to express its maximum potential production.

The behavior of the milk production versus the calving orders (CO) was presented in quadratic form, which makes clear that, with the increase in the deliveries, the milk production tends to decrease after reaching a peak. This peak would be between the third and fifth lactation, time/season considered ideal to start a recycling program of the cows. It is important to point out that the SCC behavior was linear positive, that is to say, it increases proportionally with the increase of the partum order, interfering in the quality of the milk produced.

The results have shown that there was a SCC increase, followed by an evolution of the orders of partum, confirming the results obtained by Sheldrake *et al*. (1983) who verified that the milk of non- infected animals present a tiny change in the SCC with the increase of the lactation days and order of partum, keeping the quality of the milk produced. The SCC increases with the age and number of lactation in infected milk herds (Monardes, 1994), which can be verified by the values in Table 1.

The mean SCC of the herd was 397.666 cells/mL of milk, obtaining a score 4, according to Raubertas and Shook (1982), suggesting that the herd or some of these animals could be infected with sub clinical mastitis. However, according to Harmon and Reneau (1993), the isolated use of counting cells to classify the herd or animals individually, infected or not infected, could result in errors due to the false negative and positive results. These errors occur due to SCC normal floatation, observed by means of an infection. Such fact would be relevant for the milk classification, in terms of cell numbers by ml of milk, once any alteration in the management and /or any stress caused to the animals could increase the score of the herd.

The percentage of the milk protein did not vary among the calving orders (CO), being against the results obtained by Shultz (1977), who mentioned that there is a decrease in the milk fat and casein associated to high SCC. Such discrepancy could be explained by the high quotient of data variation, making it difficult to precise the comparative analysis.

The regression equation for the milk fat versus the calving orders (Table 2) was linear positive, contradicting again the Shultz (1977) results. It was observed that with the increase of the calving orders (CO), there is a linear increase in the percentage of milk fat. However, there is no significant variation in the percentage of milk protein, suggesting that the SCC increase is proportional to the increase of milk

fat versus calving order, but they do not influence the percentage of milk protein.

Table 2. Regression equation adjusted to the counting of somatic cells (SCC), milk production (PL), milk fat percentage (FP) and milk protein percentage (MP) versus the calving order (CO).

	Equation of regression	R^2
SCC	Y= 223,205 + 61,4737**CO*	0.63
PL	Y= 11,9094 + 4,37628**CO* - 0,412707**CO*^{2}	0.99
FP	Y= 3,74405 + 0,0914079**CO*	0.79
MP	Y= 3,32	NS

SCC = somatic cell counting (x1000 cells/ml of milk); PL= milk production (Kg/day); FP=fat percentage (%); MP=milk protein percentage (%)

According to Monardes (1984), the factors that influence the SCC are the differences among the herds, among the order of partum, among lactation phases and among breed. The results presented in Table 1 agree with those registered in the literature, but, there are still factors related to the sanitary management that may directly influence on SCC, according to Dohoo and Meek (1982), which have pointed out that an increase in SCC is related to the increase of infection prevalence.

An elevated value for SCC means that there may be, in the herd, some cows with sub clinical mastitis, and the sanitary management should be verified together with the WMT and CMT mastitis tests to confirm the infection and subsequent treatment. Such elevation in the score of counting of somatic cells in the milk could be interfering directly in the quality of the milk produced. If the number of cells/ml of milk exceeds 500.000 cells/ml, decisions should make related to the milking procedure and milk destiny.

A broad program of mastitis control based on the prevention may cause a decrease in loses associated to mastitis, improve of milk quality and to increase the production. The magnitude of the answer in SCC to the presence of mainly pathogens *Staphylococcus aureus, Streptococcus agalactiae*, *Streptococcus spp* and coliforms is variable for each cow and it would be impossible to identify different strains, basing only on SCC. Thus, the milk evaluation could be impaired.

It is necessary further researches about the validity of SCC as a tool in the prevention of cases of mastitis and evaluation of milk quality.

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