









# Economic and production aspects of milking management in dairy farming

## *Aspectos econômicos e produtivos do manejo de ordenha na pecuária leiteira*

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**ABSTRACT:** The Brazilian dairy sector is important for the world agricultural production; however, it presents problems in production efficiency and milk quality, since the occurrence of mastitis in the herds can reach 47%. The present study analyzed data from a rural property with 100 lactating cows in a semi-intensive breeding system, which did not adopt adequate hygiene management for milking processes. Corrective measures were proposed, such as daily strip cup test, biweekly California Mastitis Test, formation of a new milking line, and daily pre dipping and post dipping and cleaning of teat cups. Milk samples from 10 animals with positive clinical mastitis, 10 animals with positive subclinical mastitis, and from the cooling tank were collected at one day before and 90 days after the implementation of the proposed measures and sent to a laboratory for analysis of somatic cell counting (SCC) and total bacteria counting (TBC). An increase of 17% in milk production and decreases of 64% and 40% in clinical and subclinical mastitis, respectively, were found after 90 days, with a consequent decrease in SCC and TBC. The milking duration after this period denoted an adaptation of the employees to the new procedures. The production financial yield was calculated based on the implementation costs of the adopted adequations and increases in milk production, representing a profitability increase of 10.4%. The implemented adequations were efficient for the control of mastitis and increase in milk yield and quality, resulting in a positive economic return.

**KEYWORDS:** mastitis, milking, SCC, milking cows

**RESUMO:** O setor lácteo brasileiro possui grande relevância na produção agrícola mundial e apesar disso, ainda são encontrados problemas na eficiência produtiva e na qualidade do leite, onde a prevalência de mastite nos rebanhos pode chegar a 47%. Neste estudo, foram analisados dados de uma propriedade rural com 100 vacas lactantes e sistema de criação semi-intensivo, que não adotava manejo higiênico adequado na ordenha. Foram propostas medidas de correção como execução diária do teste da caneca telada e teste quinzenal do CMT, formação de nova linha de ordenha, adoção diária do pré dipping e pós dipping e higienização das teteiras. Foram coletadas amostras de leite de 10 animais positivos para mastite clínica, 10 positivos para mastite subclínica e do tanque de resfriamento um dia antes e 90 dias após a implementação das novas medidas e enviadas ao laboratório para análise da CCS e CBT. Após 90 dias, houve aumento na produção de leite em 17% e redução dos índices de mastite clínica e subclínica em 64% e 40%, respectivamente, com consequente diminuição dos valores de CCS e CBT. A duração da ordenha após esse período indicou adaptação dos colaboradores aos novos procedimentos instaurados. Por fim, calculou-se o rendimento financeiro da produção baseado nos custos de implantação das correções e no aumento da produção de leite, que reverteu-se em lucratividade 10,4% maior. Conclui-se que as adequações implementadas foram eficazes no controle de mastite e no aumento da produtividade dos animais e da qualidade do leite, resultando em retorno econômico positivo.

**PALAVRAS-CHAVE:** mastite; ordenha; CCS; vacas leiteiras

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## INTRODUCTION

Searching for improvements in production processes and obtaining of milk is a need in the world, since the dairy sector growth forecast is 1.6% a year over the next 10 years (FAO, 2020). However, Brazil is predominantly an importer of dairy products, with inversion of this position only in periods when the surplus of production was favorable (GOMES et al. 2020).

Despite the economic importance of the Brazilian dairy sector, studies have shown a high occurrence of mastitis in the herds, which can reach 47% (WINCKERL, 2019), causing significant changes in milk composition and decreases of up to 79% in dairy production (DEMEU et al. 2016; SILVA; ANTUNES, 2018).

Inadequate hygiene of facilities and equipment used and sanitary management of animals are among factors that favor for occurrence of mastitis (ACOSTA et al. 2016). Thus, the adoption of hygiene measures and formation of a new milking line generate a positive cost-benefit for milk producing farms (COSER; LOPES; COSTA, 2012).

Few studies have evaluated economic costs and effects of implementation of mastitis control measures on producing units (LOPES et al., 2012; COSTA et al., 2019). In addition to diagnosis and monitoring practices for this disease (LANGONI, 2013), the economic perspective of the implementation of preventive measures also integrates an efficient control program.

In this context, the objective of the present work was to analyze economic aspects of the implementation of hygiene measures for milking and their effects on mastitis indexes and milk yield and quality in a dairy farm.

## CASE REPORT

The data analyzed were from a rural property with 100 lactating Girolando cows under a semi-intensive breeding system, with mechanical milking twice a day, monitored by the Animal Health Extension Project of the Federal Fluminense University (UFF). The animals were maintained under rotation in paddocks with a diet based on the *Megathyrsus maximus* grass and supplementation consisted of concentrate (during milking) and silage of sugarcane (*Saccharum officinarum*) after milking.

The critical aspects of milking management were evaluated based on good production practices and the Normative Instruction no. 77 (IN77) of the Brazilian Ministry of Agriculture, Livestock and Supply (BRASIL, 2018b). Despite these specific standards, the farm did not perform basic sanitary managements for milk production, according to the Brazilian current legislation (BRASIL, 2018a). The lack of cleaning of the milking environment and hand washing by employees when managing the animals, and lack of diagnosis, treatment, and control of mastitis in cows are among the flaws found.

After the irregularities were identified, corrective measures were proposed, such as a daily strip cup test before milking;

biweekly California Mastitis Test (CMT); milking line formation with positive-mastitis cows milked last; hand washing for operators before the milking of each cow; adoption of pre dipping and post dipping; individual drying of the cow teats using disposable papers; cleaning of teat cups before the milking of each animal through immersion in water followed by immersion in 1% sodium hypochlorite solution; and immediate treatment of cases of clinical and subclinical mastitis at the time of teat drying. No changes were proposed for equipment cleaning methods after the milking.

Milk samples from 10 animals with clinical mastitis, 10 with subclinical mastitis, and from the cooling tank were collected at one day before and 90 days after the implementation of the new hygiene measures. The samples were maintained under refrigeration and sent to a laboratory for electronic somatic cells counting (SCC) and microbiological analysis through total bacterial counting (TBC). Mastitis indexes were calculated at 30, 60, and 90 after implementation of the new measures, based on results from the strip cup tests and CMT. No addition or removal of animals and no change in diet occurred in the herd evaluated during this period.

The implementation costs of the new measures were calculated considering daily mean values of chlorine for cleaning of milking machines between the milking of each cow (R\$ (BRL) 15.00), disposable paper sheets for drying of teats (R\$ (BRL) 20.00), iodized alcohol for pre and post dipping (R\$ (BRL) 20.00), and detergent for hand washing of operators (R\$ (BRL) 10.00), corresponding to a daily total value of R\$ (BRL) 65.00.

The parameters analyzed were used to evaluate and monitor the adaptation of the employees to the new hygiene measures, changes in the mean milking time, mean milk production (L day<sup>-1</sup>), clinical and subclinical mastitis indexes, milk microbiological quality, and economic returns due to the implementation of the corrective measures.

Regarding the implementation of the new measures by the employees, initially they presented resistance to comply with the proposed phases; however, after daily monitoring and assistance, on the 20<sup>th</sup> day the employees were performing the actions spontaneously. The mean milking time at the beginning of the study was 1 hour and 45 minutes; the mean milking time in the first 30 days of implementation of the measures was 2 hours and 45 min; however, the mean milking time returned to 1 hour and 45 minutes after 45 days (Table 1).

The milk production at the beginning of the study was 727 L day<sup>-1</sup>; it reached 850 L day<sup>-1</sup> after 90 days of implementation of the proposed management, representing an increase of 17%. The clinical mastitis indexes at 30, 60, and 90 days after implementation of the corrective measures were 1.5%, 1.2%, and 0.5%, respectively, denoting a 64% decrease in the occurrence of the disease; subclinical mastitis indexes were 30%, 21%, and 18%, respectively, denoting a decrease of 40%. SCC in the cooling tank decreased from 800,000 cells

mL<sup>-1</sup> to 500,000 cells mL<sup>-1</sup> (37%), and TBC decreased from 1,000,000 UFC mL<sup>-1</sup> to 300,000 UFC mL<sup>-1</sup> (70%) (Table 1).

The cost with treatment of mastitis at the beginning of the study was R\$ (BRL) 45.00 a day, which decreased to R\$ (BRL) 26.47 a day after 90 days due to the decreases in mastitis indexes. Considering the increase of 123 L day<sup>-1</sup> in milk production and the milk average price (R\$ (BRL) 1.93) (GRIGOL, 2021), there was an additional gross gain of R\$ (BRL) 237.39 a day. These calculations denoted that the adoption of the new measures generated a net profit of R\$ (BRL) 145.92 a day and R\$ (BRL) 4,377 a month, representing a 10.4% increase in the profitability of the production (Table 1).

## DISCUSSION

Focusing on biosecurity and impact of food quality on human health is important. However, unfamiliarity and adoption of inadequate measures of sanitary management in milk producing units are common (TISCHER et al., 2018). Educational and technical assistance actions focused on employees are essential to ensure a profitable production of safe foods, as described by McConnel; Garry (2018), and Days; Beloti; Oliveira (2020).

Educational measures combined with economic incentives are important factors for the profit of dairy production (GARCIA; OSBURN; CULLOR, 2019). According to Matysková et al. (2020), as a habit is formed by adaptations, its force varies according to the new parameters of the environment. In this case, the increases in animal yields and adequacy of employees to the milking time denoted an adaptation to the new techniques and procedures established. Milking time is a critical point in this context; the longer the process, the greater the stress and discomfort of the animals, which can reduce the production performance in up to 30% (LEIRA et al., 2018).

The increases in production found in the present study confirm those described in the literature, since it is known that the dairy production of cows affected by mastitis can be 20% to 40% lower than that of healthy cows, and that the control of this disease promotes higher yields (RODRIGUES et al., 2018). The functional loss of the breast gland is a

consequence of the multiplication of microorganisms and production of toxins, which damage the glandular secretor tissue and reduce milk production (ACOSTA et al., 2016; MASSOTE et al., 2019).

The clinical and subclinical mastitis indexes were high, but were stabilized at lower percentages after the implementation of the measures described. Consequently, the milk quality improved, as described by Silva and Antunes (2018), and resulted in decreases in SCC and TBC. Before the implementation of the measures, the SCC exceeded the values described in the Normative Instruction no. 76 (IN76) of the Brazilian Ministry of Agriculture, Livestock, and Supply, which is 500,000 cells mL<sup>-1</sup> (BRASIL, 2018); but after only 90 days of changes in the milking managing, it decreased 37.5% and fit into the limits of this legislation. Similar results were reported by Vallin et al. (2009) in the South region of Brazil; they found 51.86% decrease in SCC after implementation of changes in milking management, which were similar to those described in the present work, thus confirming the efficiency of the methodology.

The sanitary conditions established also ensured a better microbiological quality of milk, with decreases in TBC and a higher food safety (MESQUITA et al., 2018). From the public health point of view, milk with high TBC represents risks for consumers due to a potential of transmission of microorganisms and toxins resistant to the pasteurization process (VARGAS et al., 2013). The loss of nutritional and microbiological quality of milk associated to high SCC and TBC makes it improper for consumption and processing and reduces the yield and shelf life of dairy products (COSTA et al., 2019). Therefore, limit values for these parameters in milk were established in Brazil (BRASIL, 2018), which are used by industries and cooperatives to attribute bonuses and penalties to the value of raw milk according to its quality (DEMEU et al., 2016).

The daily costs related to mastitis in the herd decreased R\$ (BRL) 18.53 after the implementation of the new measures, representing an economy of R\$ (BRL) 6,763.45 a year. Lopes et al. (2012) found that annual expenses with treatments of

**Table 1.** Results of the implementation of the recommended measures for an adequate milking management.

Variable	Adoption of measures		Decrease / Increase (%)
	Before	After 90 days	
Mean milking time (min) <sup>1</sup>	105 a	105 a	0.0
Mean milk production (day L <sup>-1</sup> ) <sup>1</sup>	727 a	850 b	170
Clinical mastitis index (%) <sup>2</sup>	1.54 a	0.55 b	64.0
Subclinical mastitis index (%) <sup>2</sup>	30 a	18 a	40.0
Somatic cell counting (cells mL <sup>-1</sup> ) <sup>1</sup>	800,000 a	500,000 a	370
Total bacteria counting (UFC mL <sup>-1</sup> ) <sup>1</sup>	1,000,000 a	300,000 b	70.0
Total profit of the production (R\$ (BRL)) <sup>1</sup>	42,093.3 a	46,4709 b	104

<sup>1</sup>T test for paired samples; <sup>2</sup>Chi-square test with Fisher's adjustment; Means followed by different letters in the rows are significantly different at  $p < 0.05$ .

a cow with mastitis vary from R\$ (BRL) 48.34 to R\$ (BRL) 725.13, and expenses with preventive treatment reach, at most, 19.7% of the economic impact of the disease. Other studies also estimated costs for implementation of preventive actions and showed that it is more economically advantageous to invest in hygiene measures, which results in indirect profit in the production (LOPES et al., 2016; SILVA et al., 2019).

It makes the activity viable, with higher financial returns, which enables the farmer to invest in the property and implementation of bonus systems to employees. Hygiene measures result in better conditions for the animals, focused on their

well-being (OIE, 2019); lower disease indexes generated by mastitis, such as metritis (DALANEZI et al., 2020), pneumonia (FUENZALIDA; RUEGG, 2020), and metabolic diseases (DUTRA et al., 2017); and decreases in death, discarding, and replacing of animals (MASSOTE et al., 2019).

## CONCLUSION

The adoption of measures focused on an adequate milking management affects positively sanitary, production, and economic indexes connected to damages caused by mastitis, resulting in increases in milk quality and profitability of the production.

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