REVISTA COLETA
Científica
Year 1, Vol. I, n.1, Jan. - Jul ., 20 17
(CC BY 4.0) | ISSN 2763-6496
DOI: 10.5281/zenodo.4737079
ARK: https://n2t.net/ark:/24285/RCC.v1i1.30

Importance of diagnosing subclinical mastitis and its economic impacts on dairy farms – literature review

Importance of subclinical mastitis diagnosis and its economic impacts on milk properties - literature review

Received: 11/21/2016 | Accepted: 06/15/2017 | Published: 06/20/2017

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Abstract

Worldwide, mastitis is the disease that exerts the greatest importance on the quality of milk, as it causes a decrease in production, loss of milk quality and the function of the glandular parenchyma. The subclinical form determines the greatest economic losses due to the high prevalence (44.9% to 97%) and reduction in milk production between 25.4 and 43%, being 15 to 40 times more frequent than the clinical form, most One of the estimates indicates that, on average, one quarter affected results in a 30% reduction in her productivity, and an affected cow loses 15% of her production in lactation. Losses can be expressed by the decrease in production, in the alteration of components that interfere in the manufacturing process of dairy by-products, rates of culling and replacement of animals, and treatments of affected cows. Subclinical

mastitis does not show visible changes in the mammary gland or milk, but the composition of this product undergoes considerable changes in its elements, such as an increase or decrease in chlorine ions (Cl), sodium (Na). The main diagnostic methods for subclinical mastitis are: the California Mastitis Test (CMT) and the Somatic Cell Count (SCC) of individual mammary quarters , methods that allow the producer to make decisions, such as establishing a milking line or measuring prophylactic measures to prevent spread through the herd.

Keywords: Diagnosis. Subclinical mastitis. Impacts economical

Abstract

Worldwide, mastitis is the disease that exerts the greatest importance on milk quality, as it causes decreased production, loss of milk quality and glandular parenchyma function. The subclinical form determines the greatest economic losses due to the high prevalence (44.9% to 97%) and reduction of milk production between 25.4 and 43%, being 15 to 40 times more frequent than the clinical form, the majority of the estimates indicates that , on average, an affected quarter results in a 30% reduction in its productivity, and an affected cow loses 15% of its production during lactation. The losses can be expressed by the decrease in production, in the alteration of the components that interfere in the process of manufacturing of dairy by-products, animal disposal and replacement rates, and treatments of affected cows. Subclinical mastitis has no visible changes in the mammary gland or milk, but the composition of this product undergoes considerable changes in its elements, such as an increase or decrease in chlorine (Cl), sodium (Na) ions. The main methods of diagnosis of subclinical mastitis are: the California Mastitis Test (CMT) and the Somatic Cell Count (CCS) of the individual mammary quarters, methods that allow the producer to make decisions, such as establishing a milking line or prophylactic measures that prevent the spread by the herd.

Keywords: *Diagnosis. Subclinical mastitis. economic impacts*

1. Introduction

Milk and its derivatives are playing an increasingly important role in supplying food and generating jobs and income for the Brazilian population. It is a complex, nutritious and stable mixture of fat, proteins and other solid elements, which are suspended in water and constitute the compositional parameter that defines the quality of milk. In this context, bovine mastitis stands out, which is the most prevalent disease in dairy herds, capable of compromising milk quality, impacting public health and causing serious economic damage .

Mastitis is the name for the inflammatory process in the mammary gland (Costa, 1998), which occurs when an infectious, chemical, mechanical or thermal agent attacks the mammary gland, producing an inflammatory reaction and damage to the glandular epithelium, characterizing mastitis.

Bovine mastitis has been identified as the main disease that affects dairy herds in the world, causing serious economic losses to both the milk producer and the dairy industry. Studies confirm its economic importance and the relevance of the economic impact of the presence of the disease in herds, the main losses associated with the presence of mastitis in herds are the reduction in milk production, milk disposal, cost of treating clinical cases, increased cost of labor, decrease in the selling price of milk and disposal of animals. The loss with the reduction in milk

production has been identified as the one with the greatest economic impact, however, the perception of this loss is the most difficult for the milk producer to see . For Dias (2007), the control of mastitis in dairy herds is an important step towards the development of good quality products and the reduction of risks to the population (St -Pierre, 2003).

In view of the importance of subclinical mastitis for dairy cattle, the objective of this work is to point out the impacts of this disease on milk production and the health of lactating bovine females, in addition to demonstrating the relevance of the diagnosis of subclinical mastitis, its implications for productivity and animal health. herd and point out the economic losses due to the disposal of milk and eventually animals.

This is a bibliographic review of updated scientific articles published in journals of great relevance in the field of veterinary knowledge.

2. Bibliographic review

2.1 Bovine mastitis and its economic impacts

Mastitis is characterized by a process of inflammation of the mammary gland promoted by different factors, the main ones being caused by bacteria, about 90% of cases. It represents one of the main obstacles for dairy cattle, due to the severe economic losses it entails. According to Tozzetti (2008). It can be divided into two clinical forms, which are common findings of pain, redness and heat, and subclinical ones, which are also common and can be detected through simple milk tests.

The disease has been identified as the main disease that affects dairy herds worldwide, causing serious economic losses to both the milk producer and the dairy industry (National mastitis Council , 1987). The disease causes high losses and also the disposal of milk and, expenses with medicines, functional loss of glands and even death of the animal. (EMBRAPA 2012). This disease causes changes in the mammary glandular tissue and a decrease in milk secretion, or its total loss (Langoni , 2000).

The subclinical form determines the greatest economic losses due to the high prevalence (44.9% to 97%) and reduction in milk production between 25.4 and 43% (Brant & Figueiredo, 1994), being 15 to 40 times more frequent than the clinical form (Brito; Brito 1998, Fonseca, Santos, 2001, 2002 & Ribeiro et al., 2003).

Cases of subclinical mastitis result in large losses in productivity, most estimates indicate that, on average, an affected quarter results in a 30% reduction in her productivity, and an affected cow loses 15% of her lactation production. The losses can be expressed by the decrease in production, in the alteration of components that interfere in the manufacturing process of dairy by-products, rates of culling and replacement of animals and treatments of affected cows (Radostistis , et al., 2002).

In addition to the economic losses resulting from mastitis in lactating cows, its effect is noted, mainly, by the reduction in production and changes in milk composition. At the same time, it represents a potential risk to public health, due to the elimination of pathogens that cause zoonoses and toxins produced by microorganisms in milk. For the producer, the losses are of great magnitude. They are reflections of greater disposal of animals, spending on medicines, reduction in production and disposal of milk. (Embrapa 2012).

Several microorganisms are associated with the development of mastitis. Bacteria are the main microorganisms that cause mastitis, but other microorganisms

such as fungi, yeasts, algae and mycoplasmas may be involved. (SILVA 2006). Although more than 137 species and serotypes of microorganisms have been isolated from bovine mammary gland infections, most infections are caused by bacteria (Watts, 1988).

Epidemiologically , bovine mastitis is divided into contagious and environmental mastitis. Contagious mastitis is defined by the form of transmission from animal to animal, has the animal itself as a reservoir and its location is intramammary , while environmental mastitis is characterized by the fact that the pathogen reservoir is located in the very environment of dairy cows (Pedrini , 2003).

2.2 Classification of Mastitis

According to the clinical manifestation of the disease, mastitis is divided into two groups, clinical mastitis and subclinical mastitis. However, there is the appearance of pus, lumps and other changes in the physical characteristics of the milk. The condition may present other significant changes such as fever, drop in milk production and decrease in food consumption (Embrapa, 2012).

Clinical mastitis can be classified as superacute , acute, chronic subacute and gangrenous (Fonseca, 2007). Superacute cases are usually associated with infestation by environmental agents of the coliform group, characterized by very intense inflammation, with the presence of systemic signs, such as fever, dyspnea, prostration and anorexia, among others. In the acute form these signs are present, but the evolution is slower and the systemic signs are more discreet (BURVENIC et al. 2003).

The subacute form is characterized by the presence of lumps in the mug test, with more discreet inflammatory signs. The chronic form is characterized by persistent infection of the udder, which can last for days, months or years, and fibrosis may occur in the affected quarters, in some cases accompanied by atrophy of the udder and the presence of a fistula (HILLERTON, 1996). The gangrenous form of mastitis is characterized by the presentation of the mammary quarter, with an altered color, ranging from dark to bluish-purple and without sensitivity. The affected room may be humid with constant dripping of blood serum (Embrapa, 2012).

Subclinical mastitis does not show visible changes in the mammary gland and milk, but the composition of this product undergoes considerable changes in its elements, such as an increase in chlorine ions (CL) sodium (NA) and a decrease in the concentration of casein, fat, solids total and milk lactose (Brito et al., 2007).

For Andrade (2001) the subclinical picture that is more incident in dairy herds, macroscopic changes in the milk and signs of inflammation in the udder are not observed, it is difficult to detect, long lasting and about 40% of the cases evolve to the clinical form.

The disease determines changes in the concentration of the main components of milk, such as: protein, fat, lactose, minerals and enzymes. The main factors related to the alteration of milk components are damage to milk-producing cells, which can result in changes in the concentration of lactose, protein and fat, and increased vascular permeability, which determines the increased passage of substances from the blood. for milk, such as sodium, chlorine, immunoglobulins and other serum proteins (Steffert , 1993)

2.3 Diagnosis

The clinical form of mastitis presents obvious signs such as: edema, increase in temperature, edema, hardening, pain in the mammary gland, lumps, pus or any

characteristic alteration of milk (RIBEIRO, 2003). The diagnosis of clinical mastitis is possible by evaluating the appearance of the milk, regarding the peculiar characteristics of this product, the existence of lumps and changes in the glandular parenchyma, such as increased temperature, local redness and hardened consistency of the gland (Fonseca & Santos, 2001).

According to Peres (2011) the diagnosis of clinical mastitis is easily performed by examining the gland, visualizing the characteristics of the inflammatory process - the increase in volume, wounds, nodules, redness and others and by palpation of the udder, in order to check the texture, the presence of areas of hardening (fibrosis), heat, pain, edema, nodules, abscesses and changes in the milk. Visualization of the mammary gland must be performed before and after milking and palpation immediately after milking, with an empty udder.

The presence of small lumps of clots, blood, pus and or watery milk reveals the presence of acute mastitis in its initial phase. Normal milk strains completely, with no formation of lumps. It is important to make comparisons of samples from all four quarters. This test is mainly important in the rapid identification of mastitis without, however, identifying the etiological agent (Feitosa, 2004).

For Dias (2007), because subclinical mastitis does not show visible signs and goes unnoticed by owners and employees, clinical mastitis can spread in the herd, infecting other cows. In addition, destruction of the functional capacity of the mammary gland may occur, causing a decrease in milk production and damage to the health of the animal.

The California Mastitis Test (CMT) is used worldwide for diagnosing subclinical mastitis, with the advantage of being a quick, easy-to-perform, low-cost test that can be used at the time of milking (RADOSTITS; BLOOD; GAY, 2002). It is an indirect method of counting somatic cells in milk, based on a chemical reaction between a milk sample and the reagent (3% sodium lauryl sulfate and purple Bromocresol), in an appropriate tray. The reagent breaks the membrane of the cells that release the nucleic material (DNA), resulting in degrees of coloration and viscosity, caused by the agglutination of the proteins (Madalena, Matos & Holanda, 2001).

The CMT is performed with the aid of a specific reagent and a racket containing four compartments where approximately 2 ml of milk is collected directly from each teat. The same amount of reagent is then added, mixing it with the milk using gentle circular movements (Embrapa, 2012). According to Veiga (2009) the CMT reagent is prepared by mixing 300 ml of anionic detergent with 600 ml of distilled water. The pH is adjusted to 8 and 15 ml cresol bromine purple and 5 ml cresol bromine green (both 0.5% solutions) are added. The final pH should be 7.5. The reagent in contact with deoxyribonucleic acid from somatic cells present in milk, in abnormal amounts, causes precipitation and gel formation. The indicators show changes in the pH of the milk . The result is given in five scores ranging from negative (-), suspect (dashes), weakly positive (+), positive (++) and strongly positive (+++). (Poll , 2012).

Another efficient technique in the diagnosis of subclinical mastitis is the electronic somatic cell count in milk, which is a modern form of mastitis diagnosis that is internationally accepted as a criterion for evaluating the health of the cow's mammary gland and, consequently, the quality of the milk, individually produced or by the herd, by examining the expansion tank (Costa, 2010). The CCS can be determined using the electronic counter of somatic cells in which the milk samples have the nuclei of the cells stained and exposed to a laser beam, reflecting red light

(fluorescence) and the signals are transformed into electrical impulses detected by a photomultiplier and transformed into number of cells/ mL (Brasil, 2003).

In addition to the aforementioned methods, Costa (2010) recommend using microbiological methods to identify the etiological agents involved, for the implementation of therapeutic procedures and adequate control and prophylaxis strategies. Microbiological examination of aseptically collected milk samples is considered the standard method for determining udder health and for definitively diagnosing bovine mastitis so that control measures can be implemented more efficiently.

3. Final considerations

Subclinical mastitis is a silent and costly disease in the national dairy herd, which does not present inflammatory symptoms in the mammary gland nor macroscopic changes in the raw material , however the economic losses due to the disease are due to the decrease in productivity in the alteration of the chemical composition of milk and in cases of evolution from the subclinical to the clinical form. In addition to changes in milk, another worrying factor is due to the culling of cows when the disease becomes chronic and does not respond to the treatment carried out during the drying period.

According to Cunha (2008), multiparous cows suffer greater losses, as a result of permanent damage to the mammary gland by previous infections, in addition to having more prolonged infections, which result in greater damage to the mammary tissue. Thus, the occurrence of mastitis can result in production losses not only in the current lactation, but also in the following lactation, compromising the total production of the animal.

Control of bovine mastitis includes teat disinfection before and after milking, dry cow therapy, proper functioning of milking equipment, treatment of all clinical cases, culling/segregation of chronically infected cows, and providing an environment clean, dry and comfortable for the animals (Santos & Fonseca, 2007).

The identification of positive animals makes it possible to establish an order in the milking line so that positive cows are milked last and also makes it possible to increase hygienic-sanitary care that prevents the spread of pathogens and contamination of healthy cows. The diagnosis also allows the effective treatment of subclinical mastitis in cows with the disease to be carried out during drying.

Subclinical mastitis presents itself to dairy herds as a worrying disease because it is highly contagious and presents significant damage to dairy activity, the diagnosis allows the producer to know the sick animals and becomes a key tool in decision- making in relation to sick animals such as discarding the milk of positive cows, or subjecting the animals to drying in order to carry out an effective treatment of the disease.

References

Burvenich , C., Van Merris , V., Mehrzad , J., Diez- Fraile , A., & Duchateau , L. (2003). Severity of *E. coli* mastitis is mainly determined by cow factors. *veterinarian Research* , *34* (5), 521–564. https://doi.org/10.1051/vetres:2003023

Bueno, VFF, Nicolau, ES, Mesquita, AJ de, Ribeiro, AR, Silva, JAB, Costa, EO da, Coelho, KO, & Couto, DV (2003). Etiology and antimicrobial susceptibility of bovine

mastitis agents isolated in the region of Pirassununga-SP-Brazil. *Rev. pathol. trop* , 33–43. https://pesquisa.bvsalud.org/portal/resource/pt/lil-387492

Costa HN, Molina LR, Lage CFA, Malacco , VMR, Facury Filho EJ, & Carvalho A.U. (2017). Estimation of milk production losses in crossbred Holstein x Zebu cows with subclinical mastitis based on two analysis methodologies. *Brazilian Archive of Veterinary Medicine and Animal Science* , *69* (3), 579–586. https://doi.org/10.1590/1678-4162-9019

Brazil. Ministry of Agriculture and Supply. (2003). *Normative Instruction n.9 of June 27, 2003* . Provides for the prohibition of manufacture, handling, fractionation, commercialization, import and use of the active ingredients chloramphenicol and nitrofurans and products containing these active ingredients, for veterinary use and likely to be used in the diet of all animals and insects. Official Union Gazette, Brasília, DF, 30 June. 03. Section 1, p.1-2.

Brito, J.R & Brito, MAVP (1998). *Control programs for mastitis caused by contagious and environmental microorganisms* . n.71. Juiz de Fora: Embrapa Gado de Leite, 1998. 25p. Available at: < http://www.infoteca.cnptia.embrapa.br/bitstream/doc/593442/1/Programasdecontroledasmastites.pdf>. Accessed on: 09/04/2017.

Brito, LG, Salman, AK D., Gonçales , MA R & Figueiró, MR (2007). *Booklet for milk producers in Rondônia* . Porto Velho: Embrapa Rondônia, 2007.40 p. (Embrapa Rondônia. Documents, 116)

Costa, EO da. (1998). Importance of mastitis in dairy production in the country. *CRMV-SP Journal of Continuing Education in Veterinary Medicine and Animal Science* , *1* (1), 3–9. https://doi.org/10.36440/recmvz.v1i1.3381

Costa, AC (2010). *Subclinical mastitis: isolated pathogens and their antimicrobial sensitivity, somatic cell count variation and risk factors* . 102 f. Dissertation (Master in Animal Science). Goias Federal University. Goiania.

Dias, RV da C. (2007). Main methods of control and diagnosis of bovine mastitis. *Veterinary Minutes Brasilica* , *1* (1), 23–27. https://doi.org/10.21708/avb.2007.1.1.255

Santos, M. V & Fonseca, LFL (2007). *Strategies for controlling mastitis and improving milk quality* . Barueri. Manole.

Fonseca, LFL & Santos, MV (2001). *Milk quality and mastitis control* . São Paulo: Lemos.

Feitosa, FLF (2004). *Veterinary Semiology the Art of Diagnosis.* Sao Paulo: Rca .

Hillerton , JE (1996). *Control of bovine mastitis. In:* workshop on integrated bovine mastitis control program, 1996, Juiz de Fora. Annals. Juiz de Fora: Embrapa, 1996. CD-ROM

Langoni , H. (2000). Modernization trends in the dairy sector: Monitoring milk quality by somatic cell count. *CRMV-SP Journal of Continuing Education in Veterinary Medicine and Animal Science* , *3* (3), 57–64. https://doi.org/10.36440/recmvz.v3i3.3332

Madalena, FE, Matos L. L & Holanda, JREV (2001). *Milk Production and Society* : A Critical Analysis of the Milk Chain in Brazil , Belo Horizonte: FEPMVZ, p.61-74, 2001

Moura, E. de O., Rangel, AH do N., Melo, MCN de, Borba, LHF, Júnior, DM de L., Novaes, LP, Urbano, SA, & Neto, JC de A. (2017). Evaluation of microbiological, cellular and risk factors associated with subclinical mastitis in female buffaloes. *Asian-Australasian Journal of Animal Sciences* , *30* (9), 1340–1349. https://doi.org/10.5713/ajas.16.0744

Pedrini , SC B & Margatho , LFF (2003). Sensitivity of pathogenic microorganisms isolated from cases of clinical mastitis in cattle against different types of disinfectants. *Instituto Biológico Archive* , *70* (4), 391–395.

Perez Neto. F & Zappa, V. (2013). Mastitis in dairy cows – Literature Review, *Rev. Scientific _ Veterinary Med Electronics* , *16.*

Poll , PSEM (2012). *Milk Quality, Mastitis, and Antimicrobial Sensitivity in a Milk Production Facility with High Somatic Cell Counts* . Dissertation (Veterinary Medicine) Federal Rural University of Rio de Janeiro UFRRJ.

Radostits , OM et al. (2002). Mastitis. In: *Veterinary clinic:* a treatise on diseases of cattle, sheep, goats and horses. Rio de Janeiro, RJ: Guanabara Koogan.

Rezende E, Junior JMS, Isola AM, Campos EV, Amendola CP, & Almeida SL (2008). Epidemiology of severe sepsis in the emergency department and difficulties in the initial assistance. *Clinics* , *63* (4), 457–464. https://doi.org/10.1590/S1807-59322008000400008

Ribeiro, M., Petrini , L., Aita, M., Balbinotti , M., Junior, WS, Gomes, J., Schramm, R., Martins, P., & Barbosa, R. (2003). Relationship between clinical mastitis, subclinical indecency and non-infectious mastitis in dairy production units in the southern region of Rio Grande do Sul. *Current Agricultural Science and Technology* , *9* (3). https://periodicos.ufpel.edu.br/ojs2/index.php/CAST/article/view/606

Gulmez Saglam , A., Sahin , M., Celik , E., Celebi , O., Akca , D., & Otlu , S. (2017). The role of staphylococci in subclinical mastitis of cows and lytic phage isolation against Staphylococcus aureus. *Veterinary World* , *10* (12), 1481–1485. https://doi.org/10.14202/vetworld.2017.1481-1485

Seegers , H., Fourichon , C., & Beaudeau , F. (2003). Production effects related to mastitis and mastitis economics in dairy cattle herds. *veterinarian Research* , *34* (5), 475–491. https://doi.org/10.1051/vetres:2003027

Santos, MV & Fonseca, LFL (2007). *Strategies for controlling mastitis and improving milk quality* . Barueri: Manole.

Silva, MV M & Nogueira, JL (2010). Mastitis: control and prophylaxis in cattle. *Electronic Scientific Journal of Veterinary Medicine* , *8* (15).

St-Pierre, NR, Cobanov , B., & Schnitkey , G. (2003). Economic losses from heat stress by us livestock industries. *Journal of Dairy Science* , *86* , E52–E77. https://doi.org/10.3168/jds.S0022-0302(03)74040-5

Tozzetti , D.S, Bataier Neto, M & Almeida, L. (2009). Prevention, control and treatment of bovine mastitis: literature review. *Electronic Scientific Journal of Veterinary Medicine* , *6* (10).

Watts, JL (1988). Etiological agents of bovine mastitis. *Veterinary Microbiology* , *16* (1), 41–66. https://doi.org/10.1016/0378-1135(88)90126-5