



Research Article

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Milk Quality Assessment by Means of Somatic Cells Identified in the PMC Test and Porta SCC



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Abstract

The cells of the body (somatic) that are found in milk are called milk cells. Somatic cells are made up of leukocytes and epithelial cells. Leukocytes are introduced into the milk in response to inflammation that may appear due to illness or injury and epithelial cells detach from the lining of the udder tissue. The content of somatic cells in milk allows us to know key data on the function and health status of the lactating mammary gland and due to its close relationship with the composition of milk, they are a very important criterion of its quality. Of all the milk cells in an infected room, approximately 99% will be leukocytes, while the rest will be secretory cells that originate from the tissues of the mammary gland. The somatic cell count of milk is commonly expressed as the total somatic cells per milliliter of milk. Environmental bacteria are present in the cow's environment, in its skin, manger, puddles of water, etc. and penetrate the udder when certain conditions exist. Once the bacteria attack the cells inside the mammary gland, the body's immune response is to send white blood cells to neutralize the invading bacteria. These white blood cells are, which constitutes somatic cell counts (SCC). A high CCS in the milk of individual cows or in the cooling tank means that the bacteria have invaded the cow's gland.

The objective of the present work was to determine if the methods by the California test (CMT) and an electronic device (PORTA SCC) measure somatic cell concentrations equivalent to each other, in milk samples. A total of 50 milk samples were taken in duplicate from the lactating females of the milk cattle production module, in the "El Salado" zootechnical post, the Faculty of Veterinary Medicine and Zootechnics -Benemérita Universidad Autónoma de Puebla in Puebla's State, México directly from the milking animals and also from the cooling tank. The concentration of somatic cells was quantified using the methods CMT and PORTA SCC. When comparing the results obtained by the CCS, which is the method referred to by the Official Mexican Standard (NMX-F-700-COFOCALEC-2004) as a calibration method for the electronic methods, the results showed a high positive correlation between the two methods and they showed no statistically significant differences between the two measurement groups.

Keywords: Somatic cells; Milk quality; Subclinical mastitis

Introduction

Talking about milk quality means, for the consumer, products of good quality and with good presentation and for the farmer greater production by having his healthy herd and therefore, higher income from selling milk. In the commercialization of this product, the awards for milk quality are based primarily on the percentages of fat, cryoscopy, protein and specifically for having low levels of somatic cells [1]. Somatic cells are the body's own white cells that serve as a defense to the cow's mammary gland against pathogenic organisms. The importance of the somatic cell count in milk is that we can know if the milk we get from the mammary gland is of good quality, likewise, we will know the health status of it by obtaining a high number of somatic cells. Somatic cell count (SCC) is the number of cells per milliliter of milk, a useful indicator for the concentration of leukocytes in milk. The SCC is used as an indicator of the health of the mammary gland [2]. The determination of the somatic cell content of milk, tank, cow or udder quarters is the most important diagnostic aid to judge the health status of a herd's udder.

The quality of the milk is corroborated with the results of the somatic cells [3-5]. The Federal Health Law, in its article 240, establishes that milk for human consumption is defined as the natural secretion of the mammary gland of healthy and well-fed cows and when it comes from another animal species will be designated with the name this. The product obtained five days after delivery and fifteen days before it is excluded. Tables 1 & 2 show the chemical composition of fresh cow's milk, which corresponds to the maximum and minimum ranges of their nutritional characteristics and some differences between races. For the sale of raw milk or anger for human consumption, article 246 states that, it must be sold within a period of no more than three hours after milking, which will be verified by not coagulating the milk with the alcohol test at 68 % and in no case will it be sold packaged. Milk quality involves three aspects: Quantity, its components and contaminating factors (bacteriological contamination, somatic cell count and presence of residues).

Mastitis is an inflammation of the mammary gland commonly caused by microorganisms causing this disorder and rarely by physical or chemical trauma, it is characterized by pathological changes in the breast tissue; increase in the number of somatic cells, physical, chemical and microbiological changes of milk. It is known that in dairy cattle, clinical and subclinical mastitis affects the composition and properties of the manufacture of dairy products. Thus, bacterial infections are by far the most common cause of mastitis in dairy cattle and much is known about the effect of these intramammary bacterial infections on the composition of milk [6,7]. Subclinical type mastitis is particularly one of the most persistent and widely considered disease conditions worldwide for the control of hygiene and quality of cow's milk, since it influences the total milk production and modifies the composition and its technological utility [8].

Table 1: Physical-chemical Composition of Cow's Milk (g /100ml) [29].

| Components | Min | Max |
|------------|------|------|
| Water | 84 | 89 |
| Solids | 10.6 | 17.9 |
| Lipids | 2.6 | 8.4 |
| Proteins | 2.4 | 6.5 |
| Lactose | 2.4 | 6.1 |
| Ashes | 0.6 | 0.9 |

Table 2: Composition of Milk (%) of Different Breeds of Dairy Cattle [29].

| Breed | Fats | Protein | Lactose | Ashes |
|-------------|------|---------|---------|-------|
| Holstein | 3.4 | 3.32 | 4.87 | 0.68 |
| Jersey | 5.37 | 3.92 | 4.93 | 0.71 |
| Swiss Brown | 4.01 | 3.61 | 5.04 | 0.73 |

In the cow the somatic cell count (SCC) is used as a good predictor of subclinical mastitis, since this variable is an important component in terms of quality, hygiene and control of mastitis, a high raw milk count is always associated with Alterations in protein quality, changes in the composition of fatty acids, lactose, ion and mineral concentrations, increase in enzymatic activity and elevation of pH [9]. There are several methods of analysis of the milk focused on determining its quality, among these we have the count of leukocytes and epithelial cells (somatic cells). The number and class of somatic cells present in milk vary in response to environmental, physiological and pathological normal conditions there is a reduced number of leukocytes in the mammary gland and milk; But when glandular tissue is injured they can appear in high amounts. NMX-F-708-COFOCALEC-2004 Milk Product System - Food - Dairy - Determination of fat, protein, lactose, non-fat solids and total solids, in raw milk, by infrared spectroscopy - Test method, declaration of validity published in the Official Gazette of the Federation on March 1, 2005.

The economic losses that are generated as a result of bovine mastitis, considered as the disease that causes the most economic losses to dairy farmers, since their presence in the stables is reflected in excessive expenses on medicines for the producer and a decrease in income from decrease in production, which

should generally be perceived within the farm [10]. Cow mastitis, together with fertility disorders, is the most important cause of the lack of profitability of a farm. Extensive studies, conducted in milk-producing countries such as: Israel, France, United States of America, among others, have shown that 50% of all cows suffer from mastitis, which, mainly, are subclinical. Losses caused by this disease can be grouped as follows: Decreased production, milk disposal, cost of medications, veterinary fees, extra work, and loss of genetic potential [11,12].

Mastitis continues to be the most prevalent and expensive disease of dairy cattle in most parts of the world. Dairy cows share their environment with microorganisms and it is inevitable that some of them enter the mammary gland and cause mastitis [12]. However, Romero [13] mentions that the costs of mastitis in the United States are around 107 to 180 dollars per cow and in total the annual losses of mastitis have been estimated between 1.5 to 2 billion US dollars [14,15], or 11% of total American milk production. Many of the costs are attributed to reduced milk production, discarded milk, cow / year replacements, obvious costs for veterinary medical treatments [14,15].

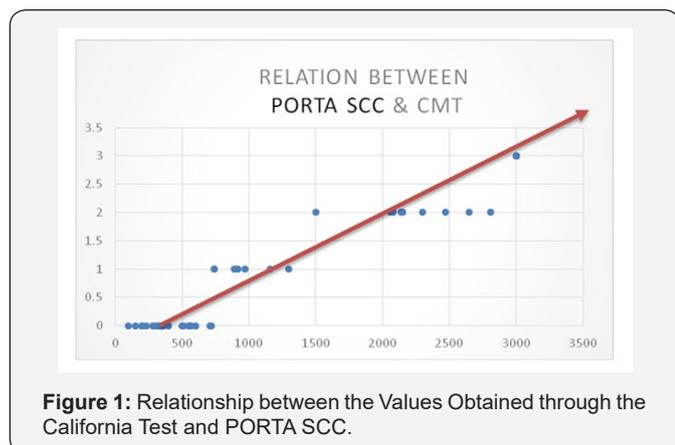
Material and methods

Table 3: Interpretation of CMT grades.

| CMT Grade | Range of Somatic Cells | Interpretation |
|---|------------------------|---------------------|
| N (Negative) | 200,000 - 500,000 | Healthy Room |
| T (Traces) this reaction or more indicates the presence of subclinical mastitis | 500,000 - 800,000 | Subclínica Mastitis |
| 1 | 800,000 - 1,500,000 | Subclínica Mastitis |
| 2 | 1,500,000 - 5,000,000 | Serious infection |
| 3 | Más de 5,000,000 | Serious infection |

The study was carried out during the months of September 2018 to January 2019, in the "El Salado" zootechnical post, belonging to the Faculty of Veterinary Medicine and Zootechnics of the Benemérita Universidad Autónoma de Puebla, in the module of bovine specialized in milk production. Milk samples were used from 50 cows of the Holstein-Friesian and Jersey breed, taken before mechanical milking, which is performed daily every 12 hours. The Mastitis California test was conducted on all cows in the milking line. The cows that presented some degree of subclinical mastitis, were subsequently subjected to the Porta SCC test, to know the number of somatic cells that occur in each of the rooms of the mammary gland affected by subclinical type mastitis, this result It was compared with that obtained from the California mastitis test, to verify if there was similarity in the results obtained. To verify the relationship of the results by both methods, a Pearson correlation analysis was carried out to show the behavior and dispersion of the data obtained. The degree of CMT is directly related to the content of somatic cells in milk. Table 3 shows the interpretation for the test.

Results



Of the total cows sampled (50), 197 productive rooms and 3 unproductive rooms were presented. Regarding the types of mastitis, 6 cases of clinical mastitis were found, where the affected room (s) showed signs of the inflammatory process such as heat, blush, pain, tumor and functional loss when observing the presence of blood-contaminated milk, scabs, chunks, etc. The number of rooms affected by subclinical mastitis was 50, of which 22 had the degree of traces and up to 730,000 somatic cells and leukocytes per mm of milk, 8 rooms with grade 1 and up to 1,400,000 somatic cells and leukocytes per mm of milk, 11 rooms with grade 2 and up to 2,900,000 somatic cells and leukocytes per mm of milk, 9 rooms with grade 3 and up to 3,000,000 somatic cells and leukocytes per mm of milk. Once the values for each test were obtained, the correlation was performed, where a high correlation was found between the results obtained by both methods $r^2 = 0.95$ (Figure 1).

Discussion and Conclusions

A high percentage of cows suffer from the problem of mastitis and especially of subclinical mastitis that does not present the inflammatory process, but which does reflect losses in milk production. The economic losses caused by bovine mastitis to the world dairy industry are considerable as reported by the different authors [16-19]. Economically it is of vital importance for México that farmers prevent, manage and control bovine mastitis due to the negative effects that milk production has; situation that is directly related to the fact that in 2001 México ranked 13th worldwide as a producer of fluid milk with 9,500.7 million liters, while Puebla produced 380 million liters of milk in the same year, placing it in the 10th place nationwide. Currently, it can be seen that there is an increase in the demand for milk and domestic production is still insufficient to cover the total demand for milk, so imports have been used to complement the national supply [20-24]. The above can be aggravated if the Government of México and the State of Puebla continue without establishing an effective program for the prevention, management and control of bovine mastitis in dairy cattle.

In addition, this situation is even more complicated because the restrictions for the entry of agricultural products to our

country have been reduced and there will no longer be any type of safeguards for this kind of products. Hence the importance that bovine mastitis should be considered as a priority problem. Finally, one should not lose sight of the care and preservation of Public Health when consuming milk and its derivatives; which must be guaranteed that they are of good quality, not contaminated and that they come from cattle herds free of bovine mastitis or other infectious diseases, whose pathogens can affect the human [25-28]. When the quality of the milk is controlled, especially avoiding its alteration, adulteration and contamination, this product can be used without any inconvenience for the production of lacticiniums offering innocuous products of superior quality, products that are in great demand in the nutritional part and of consumption. Some works describe the quality of milk, through the monitoring and control of the somatic cells and leukocytes present in it, which, as mentioned, has an impact on the final production and avoids losses due to the presence of mastitis [29,30].

At a practical or field level, somatic cell determinations in milk through the analysis of the California Mastitis Test, provides high safety in the presence of mastitis, especially subclinical type, however, it is not very accurate in the amount of somatic cells and leukocytes present in milk as indicated by the standard NMX-F-700-COFOCALEC-2004, therefore it is highly reliable to use the SCC portal to specify the actual number of somatic cells and leukocytes in each case of mastitis of subclinical type, as well as determining the amount of somatic cells and leukocytes in the cooling tank to determine the degree of quality of the milk obtained and, where appropriate, seek a better price for the sale of the product in the local market, guaranteeing a product free of contaminants and pathogens or harmless. The results obtained show a high incidence of cases of subclinical mastitis, which has a direct impact on the quality of the milk produced in the bovine module specialized in milk production of the "El Salado" zootechnical post of the faculty of MVZ- BUAP, in Tecamachalco, Puebla.

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