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Somatic Cell Count Dairy-Cow Milk

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ABSTRACT

Results regarding somatic cell count (SCC) out of 9 539 dairy-cow milk samples collected during three years (2010-2012) are discussed. The study comprises eight provinces, manly from western and central regions in Cuba. Somatic cell count was performed with a Fossomatic ™ Minor equipment from the National Center for Animal Health, and values obtained were scored on a scale of items according to the Somatic Cell Score (SCS). Data were processed by Microsoft Excel software program from Microsoft Office Professional Plus (2010) and the statistical package STATGRAPHICS Plus 5.1. Values from SCC and SCS (985,0 ± 15,0 and 4,61 ± 0,03, respectively) evidenced the presence of mastitis in an increasing annual trend at all levels (stabled and individual dairy cows, and milk tanks). SCC and SCS significant differences between state farms (1 026,3 ± 16,1 and 4,67 ± 0,03, respectively) and private farms (539,3 ± 26,7 and 3,82 ± 0,0, respectively) were detected. Losses in milk production were estimated in 15 % based on the average value for somatic cell count.

Key Words: *bovine mastitis, somatic cell count, economic losses*

INTRODUCTION

Bovine mastitis is an inflammatory response of the mammary gland to aggression. It has a great impact on production, wellbeing and quality of the milk produced (Fernandez *et al.*, 2012).

Somatic cell count (CCS) is a routine test, most widely used as an indicator of healthy udders and quality of milk in a herd; it is also used in mastitis preventive and control programs all over the world. This indicator can be measured in the milk from stables, cows, or several farms (Coentrão *et al.*, 2008 and Philpot and Nickerson, 2000). CCS is considered the best quality indicator for milk, because it includes hygienic, compositional and technological aspects; in addition to consumer demands per healthy cow (Hamann, 2001).

The somatic cells are an indicator both of resistance and susceptibility of cows to mastitis; useful intra mammary infection (IIM) predictors, and a basic component in milk quality. In spite of it, many producers do not fully understand the implications of CCS to udder health and how increased parameters of CCS can affect production and quality of milk (Sharma *et al.*, 2011).

Cuba is lagging behind the world´s dairy technological development (Ponce, 2007). The somatic cell content as parameter of milk quality in herds is still measured through the California test (CMT). The purpose of this paper is to show CCS results in Cuban herds to corroborate associated problems and contribute with the development of our dairy production.

MATERIALS AND METODS

The results from three years (2010, 2011 and 2012) of somatic cell counts (CCS) of bovine milk with Fossomatic™ Minor equipment, at the Center for Milk and By-product Quality Control Trials (CENLAC), from CENSA, of 9 539 samples from eight western and central provinces, were analyzed. The Sample distribution per year was 2 564 (2010), 4 387 (2011) and 2 588 (2012). According to the kind of sample, only three were from milk tanker trucks; 1 483 from milk containers; 7 328 from individual cows; and 725 from stables. State owned farms provided 8 686 samples and private farms had 783 samples. The values were converted to Somatic Cell Score (SCS), according to Shook (2008).

$$SCS = \log_2(CCS / 1 \times 10^5) + 3$$

For data analysis Microsoft Excel (Microsoft Office Professional Plus 2010) and STATGRAPHICS Plus 5.1 for Windows were used, from which comparison of two or more samples (t test); sub group and one-dimensional analyses were applied.

RESULTS AND DISCUSSION

Table 1 shows the general mean for CCS and its converted value (SCS) CCS as statistical measure

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offers some limitations: it does not have normal distribution and its relation with milk production is not linear. Therefore, to permit more precise statistical analysis, CCS must be transformed into Somatic Cell Score (SCS), to produce normal distribution with variance homogeneity, standardize, and optimize data understanding and its direct relation with milk production losses due to mastitis (Barbosa *et al.*, 2007 and Mendoza-Sánchez *et al.*, 2006).

The general mean value of CCS evidences the issue of mastitis in the sampled herds and it is way above the set limits in other countries. In 2002 Brazil established a maximum CCS of 1 000.10^3 cell/ml, acceptable until 2010. In that year the minimum dropped to 750.10^3 cells/ml, in 2011 it would be 400.10^3 cells/ml. Research conducted in northeast Brazil (the region most similar to Cuba´s climate and cattle infrastructure) reported a mean of 402.10^3 cells/ml (de Lima *et al.*, 2006).

In the United States, the legal limit for grade A milk is 750.10^3 cells/ml, high if compared to limits set by other countries in Europe, in Australia and New Zealand (400.10^3 cells/ml). In Canada, the limit is 500.10^3 cells/ml (Sharma *et al.*, 2011).

In Argentina, the inclusion of CCS in milk payment systems was a turning point to improve sanitary quality of milk. Maintaining CCS as an element for payments will be the necessary incentive to deepen and sustain the existing control measures (Calvinho and Tirante, 2005).

When calculating losses from the national milk production in 2012 (604.3.10^6 l, O.N.E., 2013), the mean values, accounted for 15 % of milk not produced (Costello, 2004). To have an idea of what this 15 % represents, if the mean CCS were 400.10^3 cells/ml, the total volume of milk would be 682.5.10^6 l. These are not only inferences, with a mean CCS that does not cover the whole country, but useful to prove the serious problem of bovine mastitis observed in the sampled herds, only in terms of unproduced milk. The cost of mastitis treatment is direct (veterinarian expenses, extra working requirements, rejected milk and decrease in milk production and quality); as well as indirect (increased risk of subsequent disorders, reduced fertility, increased risks of sacrifice and, occasionally, infertility), according to Nielsen (2009).

A rise in CCS and SCS is observed, with significant differences in every year, with regards to the previous one; excluding CCS in 2010 and 2011. If the analysis of the general mean indicates that there is a problem, seeing how it aggravates will reveal the urgent need to start preventing and controlling actions against mastitis in Cuban herds.

Table 2 shows the mean CCS and SCS according to the sample type and property. With only the mean CCS value as reference from containers, the unproduced milk would be 13 % (Costello, 2004). The CCs value from the container has great importance, as it is easier and more reliable to diagnose and monitor the health state of the mammary gland on a farm (Mangandi, 2008). For all the samples (stable, individual, container), CCS is over 600 000 cells/ml, even when the values only represent one reference, as they are not from the same herd. However, the interpretation depends on the sample type. When the samples come from cows (compound samples), it is important to consider the milk dilution effect in negative bacteriological stables over increased CCS (Dohoo and Meek, 1982). The SCS analyses more clearly evidence how they decrease as the sample is reduced, from container to stable.

The mean stable values indicate the presence of a health problem in the udder, considering that recent research in Cuba reported mean CCS of 167 000 cell/ml for stables free of intra mammary infection (IIM) (Ruiz *et al.*, 2012). Internationally, values of 68 000 cells/ml have been reported (Djabri *et al.*, 2002). The recommended threshold to distinguish healthy stables from unhealthy ones is 100 000-200 000 cells/ml (Hamann, 2005; Hillerton, 2005 and Schukken, 2003).

In Cuba, there is only one device to make somatic cell counts, in CENLAC, which is used for research. Somatic cell count as milk quality indicator is only controlled by CMT; whereas for some time now, industrialized countries have programs for routine control of CCS in stables, cows and containers (Dohoo and Meek, 1982). Apart from generating uncertainties in producers due to high subjectivity, CMT is unable to show problems clearly, because it is impossible to rely on data at the national level, like the country and regional CCS. One CCS advantage is that data availability, even in countries like Belgium have no national programs to register other variables, but the CCS data are kept as part the national milk records (Detilleux *et al.*, 1997).

The significant difference between state and private production is interesting, which could be associated to the milking procedures. In Cuba mechanical milking has poorer indicators of bovine mastitis than in the manual (Ruiz, 2012). A faulty milking device (pulse generators and tubes, out of range vacuum pumps, porous milk tubes and tea cups) may act as vectors for pathogens, produce nipple damage and cause impact pulses that increase colonization in the nipple canal (Edmondson, 2001).

Table 3 shows CCS rank distribution from container milk samples; less than 27 % of the samples have lower or equal values to 200 000 cells/ml, a cut off value for good udder health in the herd (Philpot and Nickerson, 2000). Even if the threshold is broadened to 400 000 cells/ml, only 40 % of herds will have lower values. More than 30 % of the herds have CCS 1 000 000 cells/ml and more than 15 % (values higher than 1 600 000 cells/ml), which produce 2/3 parts of what would be produced in container CCS equal to or lower than 200 000 cells/ml, according to Costello (2004).

The unproduced milk values are calculated for 100 l containers; 1 483 containers would represent 148 300 l. According to CCS values 18 773 l more could have been produced.

Table 4 shows the mean CCS and SCS per province. In terms of CCS, the situation is worse in the western provinces; however, the SCS values in Villa Clara are the highest. In general, Camagüey is the only province with acceptable values for the two indicators. The difference concerning the number of samples suggests using these values only as a primary reference for CCS per provinces. More data are necessary to achieve a more accurate approximation of mastitis in Cuba.

CONCLUSIONS

The CCS and SCS values evidence a serious bovine mastitis in the sampled herds, which has been increasing in recent years, and it is observed at all levels (stable, individual and container). A significant difference is also observed in CCS and SCS between state and private farms, concerning the milking type. The values achieved are estimated to account for 15 % of unproduced milk.

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Table 1. General and annual means of CCS and SCS

Category	#	CCS (10^3 cells/ml)	SCS
General	9 469	985.0 ± 15.0	4.61 ± 0.03
2010	2 564	882.6 ^{a} ± 27.9	4.34 ^{a} ± 0.05
2011	4 387	965.7 ^{a} ± 21.8	4.54 ^{b} ± 0.04
2012	2 588	1 119.2 ^{b} ± 29.9	4.99 ^{c} ± 0.05

Values with different superindexes in the same column differ significantly for P < 0.01

Table 2. CCS and SCS means according to sample type and ownership

Category	#	CCS (10^3 cells/ml)	SCS
Container	1 483	878.5 ^{a} ± 27.1	4.93 ^{a} ± 0.06
Individual	7 328	1 040.4 ^{b} ± 18.1	4.68 ^{b} ± 0.03
Stable	725	644.1 ^{c} ± 45.1	3.21 ^{c} ± 0.11
State-owned	8 686	1 026.3 ^{a} ± 16.1	4.67 ^{a} ± 0.03
Private	783	539.3 ^{b} ± 26.7	3.82 ^{b} ± 0.09

Values with different superindexes in the same column and section differ significantly for P < 0.01

Table 3. Container milk distribution concerning CCS rank

Limit		#	%	# Collected	% Collected	Unproduced milk 1 day (100 l/container)		
Inferior	Superior					%	1 tanque	Total
-	≤ 200	395	26.64	395	26.64	0	0.0 l	0.0 l
> 200	≤ 300	103	6.95	498	33.58	0	0.0 l	0.0 l
> 300	≤ 400	117	7.89	615	41.47	2	2.0 l	238.8 l
> 400	≤ 500	108	7.28	723	48.75	4	4.2 l	450.0 l
> 500	≤ 600	64	4.32	787	53.07	6	6.4 l	408.5 l
> 600	≤ 700	73	4.92	860	57.99	8	8.7 l	634.8 l
> 700	≤ 800	58	3.91	918	61.90	10	11.1 l	644.4 l
> 800	≤ 900	63	4.25	981	66.15	13	14.9 l	941.4 l
> 900	≤ 1 000	45	3.03	1 026	69.18	15	17.6 l	794.1 l
> 1 000	≤ 1 600	212	14.30	1 238	83.48	18	22.0 l	4 653.7 l
> 1 600	≤ 4 000	211	14.22	1 449	97.71	29	40.8 l	8 618.3 l
> 4 000		34	2.29	1 483	100.0	29	40.8 l	1 388.7 l

Table 4. CCS and SCS provincial means

Category	#	CCS (10^3 cells/ml)	SCS
Pinar del Río	394	859.2 ± 76.1	3.46 ± 0.15
Artemisa	111	888.3 ± 103.5	4.78 ± 0.22
La Habana	82	952.7 ± 135.9	4.89 ± 0.26
Mayabeque	7 892	1 035.7 ± 16.8	4.80 ± 0.03
Matanzas	505	905.1 ± 63.8	4.30 ± 0.11
Villa Clara	29	448.8 ± 27.7	5.10 ± 0.09
Sancti Spiritus	161	778.3 ± 105.5	3.48 ± 0.23
Camagüey	365	306.3 ± 29.8	2.43 ± 0.14