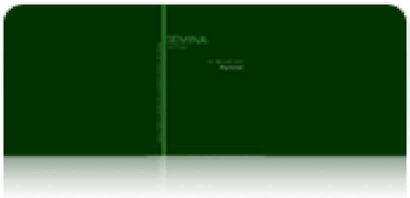

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Quality indicators of tank milk in different production systems of tropical regions

Indicadores de qualidade do leite de tanque em diferentes sistemas de produção na região tropical

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Abstract

Research was conducted in eight commercial herds located in the state of Rio Grande do Norte, Brazil. Properties were classified according to the production system, the seasons were divided into four and the genetic groups into six. Milk samples from morning milking were collected monthly, directly from a cooling tank. Protein, fat, lactose, total solids, casein, urea nitrogen concentrations/levels, somatic cell count (SCC) and total bacterial count (TBC) were determined. For milk composition, the detected results were satisfactory and met the requirements of Normative Ruling 62, but the averages for SCC and TBC were above the recommended limit. All variables, with the exception of casein from total protein were influenced ($P < 0.05$) by the production system used in the production unit. A lower fat content was recorded in 2010 compared to 2011. For the seasons, all the constituents of milk had lower values in drier season (seasons 3 and 4), with the exception of casein; SCC and TBC had higher values in periods 1 and 2, which are considered rainy periods. There was variation in the chemical composition of milk according to the genotypes. Milk chemical composition met the legal and market requirements, with a positive emphasis on specialized production systems. The variations over the year and according to the genetic group of the herd are also significant and should be taken into account in the search for improvements. As for the hygiene and health aspects of milk, the results portray the need for a greater focus by the entities involved in the sector, as well as the producers, on the viability of an adequacy program and monitoring of management practices related to this criterion.
Key words: Dairy cattle. Milk composition. Somatic cell count. Mastitis. Hygienic milking.

Resumo

A pesquisa foi conduzida em oito rebanhos comerciais situados no estado do Rio Grande do Norte, Brasil. As propriedades foram classificadas quanto ao sistema de produção, as estações do ano foram divididas em quatro e os grupamentos genéticos em seis. Foram coletadas, mensalmente, diretamente

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do tanque de resfriamento, amostras de leite na ordenha da manhã. Foram determinados os teores de proteína, gordura, lactose, sólidos totais, caseína, as concentrações de nitrogênio ureico, a contagem de células somáticas (CCS) e a contagem bacteriana total (CBT). Para a composição do leite, os resultados detectados foram satisfatórios e atenderam às exigências previstas na Instrução Normativa 62, mas as médias obtidas para CCS e CBT estão acima do limite recomendado. Todas as variáveis analisadas, com exceção da caseína da proteína total, foram influenciadas ($P<0,05$) pelo sistema de produção utilizado na unidade produtiva. Verificou- se menor teor de gordura em 2010, quando comparado a 2011. Para as estações do ano, com exceção da caseína, todos os constituintes do leite apresentaram menores valores na época mais seca (estações 3 e 4), já a CCS e CBT apresentaram maiores valores nas épocas 1 e 2, que são considerados períodos de chuva. Verificou-se variação na composição química do leite de acordo com os genótipos estudados. A composição química do leite atende às exigências legais e de mercado, com destaque positivo para os sistemas de produção especializados. As variações ao longo do ano e de acordo com o grupo genético do rebanho são também significantes, devendo ser levadas em consideração na busca por melhorias. Quanto ao aspecto higiênico-sanitário do leite, os resultados retratam a necessidade de um enfoque maior das entidades envolvidas no setor, bem como dos produtores, na viabilização de um programa de adequação e acompanhamento das práticas de manejo relacionados a este critério.

Palavras-chave: Bovinocultura de leite. Composição do leite. Contagem de células somáticas. Mastite. Ordenha higiênica.

Introduction

The demand for quality that characterizes the modern consumer market has motivated the dairy industry to implement payment programs that consider the quality of milk (MARTINS et al., 2008). Therefore, some indicators are used to mark the price to be paid for the milk, among those which stand out being somatic cell count (SCC), total bacterial count (TBC) (TAKAHASHI et al., 2012) and the percentages of protein and fat (ROMA JÚNIOR et al., 2009).

The large territory and the different socio-economic, cultural and climatic conditions of soil in Brazil induce a diversity of production systems for dairy production. Still, the fact that dairy cattle is present in over 80% of Brazilian municipalities (OLIVEIRA et al., 2007) restates the dispersion of this activity across very heterogeneous agricultural establishments (MAIA et al., 2013), thereby justifying the studies focused on this theme.

According to Andrade et al. (2014), the diet fed to the animals and climatic factors have an influence on the desirable pattern of milk constituents. However, it is speculated that the dynamic character inherent in the production environment can also have a direct influence on the composition and quality of milk produced, as well as time of year, environmental variation, lactation stage, produced volume of milk and storage characteristics (TAKAHASHI et al., 2012). Thus, the objective was to evaluate the chemical composition and sanitary quality of milk produced in different production systems, years, seasons and genotypes.

Material and Methods

Study site and herds

The study was conducted during the period January 2010 to March 2012 in eight commercial herds located in the Agreste region of Rio Grande do Norte state, Brazil. The region is characterized by a tropical rainy Aw climate with dry and rainy seasons in the Köppen-Geiger climatic classification. Rains occur between the months of February and July, with an average rainfall of 855 mm per year. The average temperature is 25.3°C and average relative humidity of 79%.

The properties were classified according to the production system, being specialized or semi-specialized, considering the following criteria:

- Farms specialized in milk production: those presenting cultivated pasture with management and pasture fertilization, division by grouping according to milk production, mechanized milking system, canalized or semi-canalized – with pre- and post-dipping practice – cleaning equipment and tanks with sanitizers, milk preservation in tank cooler in bulk, mastitis control practices, treatment of dry cows, treatment in cases of clinical mastitis;

- The properties that did not present this set of management practices were classified as semi-specialized.

The seasons of the year were divided into four: (1) - January to March; (2) - April to June; (3) - July to September; (4) - October to December.

Genotypes were divided into groups, classified as follows: (1) – 7/8 Holstein and Holstein (pure); (2) – Jersey (pure); (3) – 31/32 Holstein; (4) – Brown Swiss and 31/32 Holstein; (5) – ¾Girolando and 31/32 Holstein; (6) – ¾Girolando.

Table 1 describes the properties in respect of production systems and genetic groups.

Table 1. Characterization of properties.

Property	Production System	Genetic group
1	Semi-specialized	Girolando ¾
2	Specialized	Holstein 31/32
3	Specialized	Jersey (pure)
4	Semi-specialized	80% Girolando ¾ and 20% Holstein 31/32
5	Specialized	80% Holstein 7/8 and 20% Holstein (pure)
6	Semi-specialized	Girolando ¾
7	Semi-specialized	70 %Brown Swiss and 30% Holstein 31/32
8	Specialized	Girolando ¾

Collection of milk samples and laboratory analysis

Milk samples from the morning milking were collected monthly, directly from cooling tank. The samples were placed in plastic bottles of 40 mL, homogenized and properly identified with the property number. Samples were kept at a temperature between 2 and 6°C and sent to a Brazilian Milk Quality Network laboratory at the "Luiz de Queiroz" College of Agriculture (ESALQ/USP) for analysis of milk composition. The samples sent for SCC and TBC evaluation were stored in vials containing Bronopol® (2-bromo-2-nitro-1,3-propanediol) and Azidiol® preservatives, respectively.

Samples were submitted to analysis by infrared absorption (Bentley 2000®; Bentley Instruments Inc., Chasca MN, EUA) to determine protein, fat, lactose, total solids and casein levels. Milk urea nitrogen concentrations (MUN) were determined by the enzymatic spectrophotometric method (ChemSpeck 150®; Bentley Instruments Inc., Chasca MN, EUA). Somatic cell count was determined using electronic counting by Fourier transform infrared spectroscopy (FTIR), with MILKO SCAN FT+ equipment (FOSS®, Denmark). Total bacterial count (TBC) was analyzed by flow cytometry using Bactocount® equipment (Bentley Instruments Inc., Chasca MN, EUA).

Data analysis

Discrepant information due to sampling and/ or analytical error was deleted from the database. Initially there were 782 observations and after a final edition, we obtained 693 observations of fat, protein, lactose, total solids, non-fat dry extract and somatic cell count (SCC); 288 of casein and 582 of total bacterial count (TBC).

For statistical analysis, independent experimental variables were defined as: the production system (specialized and semi-specialized), the genotype, year, time of year, and properties. For effect of the year were considered only 2010 and 2011. Data were tabulated and subsequently subjected to analysis of variance and the Fischer F-test. A mean comparison test was considered for the following criteria: the Tukey test was applied for up to 30% coefficient of variation and number of treatments ≤ 4; the t-test was used for coefficients of variation greater than 30% and number of treatments > 4. Both tests considered a level of 5% probability for type I error. Statistical procedures were done through the Statistical Analysis System - SAS (1998) program.

The mathematical model used was:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where Y_{ij} = observed value of the dependent variable; μ = overall average; t_i = effect of the *i*-th treatment; e_{ij} = experimental error. The treatment effects were: Production System (specialized or semi-specialized), i = 1 and 2; Genetic grouping, i = 1 to 6; Year, i = 1 and 2; Season of the year, i = 1 to 4; Farms, i = 1 to 8.

Results and Discussion

The results obtained for the variables of the eight herds are described in Table 2. For milk composition, the results detected were satisfactory and met the requirements of Normative Ruling 62 (BRASIL, 2011). This regulation seeks to standardize acceptable levels for hygienic composition and quality of milk in Brazil and is being gradually implemented throughout all regions of the country, according to their peculiarities. Other studies developed such as Sgarbieri (2005), Oliveira et al. (2011), and Ribeiro Neto et al. (2012) have shown that compliance with the requirement levels for milk composition is achievable, despite variations in the analyzed production systems.

Table 2. Chemical composition and sanitary conditions of the milk tank on the farms.

Composition	N	Average		SD	CV %
		Milk composition			
Fat (%)	693	3.54	±	0.46	12.99
Protein (%)	693	3.30	±	0.18	5.95
Lactose (%)	693	4.40	±	0.13	2.95
Total solids (%)	693	12.20	±	0.56	4.59
DDE (%)	693	8.66	±	0.18	2.07
MUN (mg/dL)	693	13.21	±	3.74	28.31
Casein (%)	288	2.60	±	0.64	24.61
PCAS (% Prot)	288	76.68	±	5.95	7.80
		Sanitary conditions			
SCC (mil/mL)	693	589.90	±	367.50	62.30
TBC (CFU/mL)	582	437.71	±	1048.96	239.64

N = number of observations; SD = standard deviation; CV = coefficient of variation; DDE = defatted dry extract; MUN = milk urea nitrogen; PCAS = casein from total protein; SCC = Somatic cell count; TBC = total bacterial count.

Somatic cell count (SCC) is a parameter which is usually used as a subclinical mastitis indicator (BERGLUND et al., 2007), and the average found in this study was higher than the limit recommended by the NR 62/2011 (BRASIL, 2011), equivalent to 500x thousand cells/mL for the region and study period.

High SCC values are associated with changes in milk composition, including milk changes in proteins and lipids, as well as its metabolites (SUNDEKILDE et al., 2013), leading to lower industrial efficiency of milk and a decrease in the life of the processed product (RUEGG, 2011). Also, due to the formation of scar tissue in the alveolar region replacing the secretory tissue, high SCC is also associated with production losses (BARBANO et al., 2006).

Cinar et al. (2015) concluded that high SCC negatively affects not only the yield, but also the composition and quality of milk, and suggests that monthly monitoring is the most effective method to monitor and evaluate changes in the production and quality of milk caused by the presence of mastitis in the herd.

In addition, for Holmberg et al. (2012) mastitis represents the biggest health problem in dairy cattle and there are several reasons to reduce the frequency of the disease. For dairy farmers, economic losses due to mastitis are associated with a reduction in milk production, milk disposal, conception rate and veterinary treatment costs.

Total bacterial count (TBC) in milk also showed a high average in relation to that regulated by NR 62/2011 (BRASIL, 2011), however, it is below the value referenced by Ribeiro Neto et al. (2012) for milk in the Northeast Region. Considering that the bacterial contamination of milk varies with the health of the mammary gland (ZADOKS et al., 2004), cleaning of the udder, teats, utensils, equipment surfaces and also with the storage conditions, this reiterates the importance of cleaning and sanitizing of all the parts that make up production logistics to improve the quality of raw milk (RANGEL et al., 2014). It is also worth mentioning that the microbiological quality of milk has a direct influence on the quality of the final product (QUEIROGA et al., 2007).

Brazilian dairy farming is characterized by marked heterogeneity in production systems, covering large, medium and small producers with different forms of organization. There are highly technical systems in milk production, which contrast rudimentary systems in the same geographical arrangement.

A comparative analysis for milk composition and the hygienic-sanitary aspects of specialized and semi-specialized systems defining the study methodology are presented in Table 3. All analyzed variables except for casein from total protein were influenced ($P < 0.05$) by the production system used in the production unit. The literature reports that environmental factors such as the age at calving, calving month, lactation stage and the nutritional level of the animals all have an influence on milk composition (RESTLE et al., 2003; NORO et al., 2006). Therefore, knowing that these factors undergo great variation within each production unit, it is possible to understand the variation in milk composition shown in Table 3.

Simioni et al. (2013) studied the characterization of herds in the West of Santa Catarina (a state in the south of Brazil), and reported a trend of reduction in the levels of protein and fat as the level of productive specialization increased, with no clear trend in the other variables except for TBC, which showed significant reduction at the specialized level of production.

SCC and TBC values behaved similarly in both systems, with higher values on farms which had developed dairy farming with semi-specialized production systems ($p<0.05$). Cavalcanti et al. (2010) stated that the use of appropriate hygiene techniques in milking is a strategy for improving the bacteriological quality of milk. The use of alkaline and acid cleaners in addition to sanitizers is associated with bacterial count below 100 thousand CFU/ml, while the use of only one or no product is associated with higher counts than 500 thousand CFU/mL (ARCURI et al., 2006). These authors concluded that adopting proper cleaning procedures of milking and milk storage equipment helps to reduce the bacterial count. This fact corroborates what was found in this study; it is possible to infer that the specialized milk production farms adopted more efficient cleaning procedures for milking and the instruments involved in the production and storage processes.

Table 3. Chemical composition (in %) and sanitary quality of milk according to the production system adopted on the farm.

Composition	Farms		CV %
	Specialized	Semi-specialized	
Milk composition			
Fat (%)	3.65[a]	3.43[b]	12.77
Protein (%)	3.38[a]	3.22[b]	5.05
Lactose (%)	4.36[b]	4.43[a]	2.93
Total solids (%)	12.32[a]	12.07[b]	4.46
DDE (%)	8.68[a]	8.64[b]	2.10
MUN (mg/dL)	14.04[a]	12.36[b]	27.61
Casein (%)	2.70[a]	2.49[b]	24.33
PCAS (% Prot)	76.30[a]	77.10[a]	7.76
Sanitary conditions			
SCC (mil CS/mL)	561.73[b]	618.63[a]	62.16
TBC (mil CFU/mL)	182.27[b]	703.91[a]	232.31

[a,b] Different letters in the same line indicate that there is a statistical difference by Tukey test at a significance level of 5%; CV = coefficient of variation; DDE = defatted dry extract; MUN = milk urea nitrogen; PCAS = casein from total protein; SCC = Somatic cell count; TBC = total bacterial count.

The results of the chemical composition and sanitary quality of milk in accordance with the year are described in Table 4. As described by Ribas et al. (2015), the effect of the year on the quality characteristics reflects a complex of influences to which animals are subjected during the year, such as differences in climate, management, health and nutrition.

Lower fat levels were verified in 2010. It is known that fat content is strongly influenced by genotype and by environmental factors, and is the most variable component of dairy species and breeds. Usually, normal fat content has been linked to good rumen conditions, promoted by ingesting levels of good quality fiber in the diet, which provides increased acetate production (VAN SOEST, 1994). However, in addition to these factors, it is noted that the amount of milk produced also has a direct influence on this parameter, so that the fat percentage is inversely proportional to the amount of milk produced (ARAÚJO et al., 2012). Therefore, it is possible that this would explain the observed difference for milk fat content, since rainfall shortages in 2011 caused severe quantitative and qualitative reduction in food resources, culminating in a reduction in milk production.

Table 4. Chemical composition (in %), sanitary and hygienic quality of milk according to the year.

Composition	Year		CV (%)
	2010	2011	
	Milk composition		
Fat (%)	3.44[b]	3.63[a]	12.79
Protein (%)	3.30[a]	3.29[a]	5.56
Lactose (%)	4.43[a]	4.37[b]	3.00
Total solids (%)	12.13[a]	12.25[a]	4.54
DDE (%)	8.70[a]	8.61[b]	2.06
MUN (mg/dL)	13.14[a]	13.43[a]	28.26
Casein (%)	2.73[a]	2.54[b]	6.26
PCAS (%Prot)	70.00[b]	77.36[a]	1.42
	Sanitary conditions		
SCC (mil/mL)	509.75[b]	649.07[a]	60.58
TBC (CFU/mL)	478.90[a]	436.90[a]	239.62

[a,b] Different letters in the same line indicate that there is a statistical difference by Tukey test at a significance level of 5%; CV = coefficient of variation; DDE = defatted dry extract; MUN = milk urea nitrogen; PCAS = casein from total protein; SCC = Somatic cell count; TBC = total bacterial count.

High SCC levels lead to several changes in milk composition, not only affecting its quality, but also its composition (CINAR et al., 2015). This is because they alter the permeability of blood vessel glands and decrease the secretion of milk components synthesized in the mammary gland (protein, fat and lactose) by the direct action of pathogens or enzymes on the secreted components inside the gland (MACHADO et al., 2000). An interesting aspect is that the lactose metabolization by mesophilic bacteria which colonize the milk in the cooling tank results in the formation of organic acids which makes the milk less stable to heat processing. High SCC can also negatively interfere with the synthesis of casein due to the destruction of secretory parenchyma and less casein secretion by mammary gland cells (LITWIŃCZUK et al., 2011).

The high values of SCC and TBC observed could be related to most - if not exclusively to - directing financial resources to purchase food during the dry season that characterized the year of 2011. The rainfall shortage severely suppressed forage resources on farms, as well as causing an increase in raw material prices used in animal feed, which may have triggered lower product purchasing power used in the hygiene of milking and instruments.

Lopes et al. (2011) claim that the cost acquiring pre- and post-dipping solutions, acids and alkaline detergents, paper towels, disinfectants and other products used for milking hygiene consists of a representative percentage within the effective operating expenses. Also, Cicconi-Hogan et al. (2013) stressed the importance of using solutions and detergents in the prevention and control of mastitis in stating that organic farms are reluctant to make use of certain industrial products for milking hygiene, and therefore contamination by *Staphilococcus aureus* is elevated.

The analysis results of the seasonal effect in relation to the physico-chemical composition and quality of milk are described in Table 5. With the exception of casein, all the constituents of milk had lower values in the dry season (seasons 3 and 4). Gonzalez et al. (2004), Simioni et al. (2014) and Vargas et al. (2015) also found variation in bovine milk composition according to the months of the year, and pointed out low quantitative and qualitative supply of forage as the probable cause that occurs at some periods of the year. The reduction in levels of fat, protein and total solids, which are substantially influenced by nutritional management (ROSA et al., 2012), reaffirm this effect.

Table 5. Chemical composition (in %) and sanitary quality of milk according to season of the year.

Composition %	Seasons				CV %
	1	2	3	4	
		Chemical composition			
Fat (%)	3.51[b]	3.65[a]	3.55[ab]	3.42[b]	13.02
Protein (%)	3.35[a]	3.30[b]	3.29[b]	3.26[b]	5.53
Lactose (%)	4.39[b]	4.38[b]	4.43[a]	4.38[b]	3.04
Total solids (%)	12.22[ab]	12.28[a]	12.22[ab]	12.08[b]	4.55
DDE (%)	8.71[a]	8.63[bc]	8.67[ab]	8.60[c]	2.05
MUN (mg/dL)	13.15[a]	13.83[a]	14.04[a]	11.75[b]	27.63
Casein (%)	2.76[a]	2.56[a]	2.50[a]	2.54[a]	24.45
PCAS (% Prot)	74.66[b]	78.16[a]	76.70[ab]	77.02[ab]	7.60
		Sanitary conditions			
SCC (mil/mL)	603.70[a]	640.13[a]	554.51[a]	564.89[a]	62.19
TBC (CFU/mL)	581.70[a]	586.80[a]	167.40[b]	418.1[ab]	236.88

[a,b] Different letters in the same line indicate that there is statistical difference by Tukey test at a significance level of 5%; CV = coefficient of variation; DDE = defatted dry extract; MUN = urea nitrogen; PCAS = casein from total protein; SCC = Somatic cell count; TBC = total bacterial count; Season 1 = January to March; Season 2 = April to June; Season 3 = July to September; Season 4 = October to December.

SCC and TBC showed higher values in seasons 1 and 2, which are considered rainy periods. It is recurrent in the literature that increases in levels of SCC and TBC transpire in the rainy season, mainly due to increase in soil attached to the animal that hinders the sterilization of the udder and can colonize both the organ as well as the milk itself, compromising quality (RHODA; PANTOJA, 2012).

The findings of this study corroborate the ones obtained by Magalhães et al. (2006), which found lower values for SCC in spring when rainfall is generally lower, which according to our study corresponds to seasons 3 and 4, covering the months from July to December. In monthly monitoring conducted by the USDA (2015) of US cooling tanks, it was found that the peak SCC values occurred in summer (June to September), when there are high temperatures, increased humidity and stress on cows, providing more favorable conditions for bacterial growth.

The analysis results of the effect of genotype with respect to physico-chemical composition and milk quality are described in Table 6.

The chemical composition of milk varied with genotypes, corroborating Giovannini et al. (2014), who associated the production of fat to animal genetics. Higher fat and protein content were observed for milk produced by the compound group of Jersey cows, reaffirming the ability of animals of this breed to produce milk with higher levels of fat and protein.

Other changes in milk composition may be explained by the diluting effect of the milk components in the produced milk volume, in fact, high levels of production lead to lower fat and protein content in milk (GALVÃO JÚNIOR et al., 2010). In evaluating crossbred dairy cows, Martins et al. (2012) reported the influence of genetic composition and production level on milk composition, particularly on the levels of fat, protein and total solids.

Table 6. Effect of genotype on the chemical composition (in %) and sanitary quality of milk.

Composition	Genotype						CV%
	1	2	3	4	5	6	
Milk composition							
Fat (%)	3.10[d]	4.39[a]	3.17[d]	3.52[bc]	3.61[b]	3.44[c]	7.85
Protein (%)	3.20[d]	3.64[a]	3.13[e]	3.34[b]	3.26[c]	3.26[c]	3.55
Lactose (%)	4.43[bc]	4.24[e]	4.48[ab]	3.36[d]	4.40[c]	4.49[a]	2.59
Total solids (%)	11.67[c]	13.24[a]	11.77[c]	12.16[b]	12.25[b]	12.18[b]	2.55
DDE (%)	8.57[d]	8.85[a]	8.60[cd]	8.64[c]	8.63[cd]	8.74[b]	1.89
MUN (mg/dL)	16.33[a]	10.98[c]	14.30[b]	13.43[b]	11.57[c]	13.80[b]	25.40
Casein (%)	2.84[a]	2.84[a]	2.38[b]	2.57[ab]	2.50[ab]	2.55[ab]	24.06
PCAS (% Prot)	73.45[b]	77.73[a]	76.95[ab]	77.12[ab]	77.20[a]	77.23[a]	7.63
Sanitary conditions							
SCC(mil/mL)	705.75[b]	543.24[cd]	176.7[e]	828.84[a]	609.74[bc]	427.6[d]	51.70
TBC(CFU/mL)	174.9[bcd]	142.9[cd]	578.2[abc]	618[ab]	643.9[a]	37.4[d]	234.2

[a,b,c,d] Different letters in the same line indicate that there is a statistical difference by Tukey test at a significance level of 5%; CV = coefficient of variation; DDE = dry extract defatted; MUN = milk urea nitrogen; PCAS = casein from total protein; SCC = Somatic cell count; TBC = total bacterial count; Group 1= 7/8 Holstein and Holstein (pure) ; Group 2 = Jersey (pure); Group 3 = 31/32 Holstein; Group 4 = Brown Swiss and 31/32 Holstein; Group 5 = ¾ Girolando and 31/32 Holstein; Group 6 = ¾ Girolando.

The analysis of physical and chemical composition of genotype 5 milk (Girolando ¾ and Holstein - pure) was, in a way, compromised by the fact that milk coming from two genetic groups that produce milk with different compositions had been mixed in the same tank. Animals with higher percentage of zebu blood tend to produce more concentrated milk, while animals with the highest percentage of Holstein blood produce milk with lower levels of fat, protein and total solids due to its higher production.

Conclusion

The chemical composition of milk has met the legal and market requirements, demonstrating significant positive results towards specialized production systems which can be converted into economic advantage due to better production yield and/or surplus. However, it also showed significant variations throughout the year and according to the genetic group of the herd; aspects that deserve to be considered in seeking production activity improvements and specialization.

Regarding the aspect of hygiene and sanitation, it is worrisome that neither specialized nor semi-specialized systems met the current legal requirements. These results portray the need for a greater focus on the entities involved in the sector, as well as on producers to achieve an adequate program of monitoring management practices related to this criterion.

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