Influence of subclinical mastitis on milk composition of crossbred Holstein x Zebu dairy cows

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Summary

Milk composition is influenced by nutritional and non-nutritional factors. Subclinical mastitis is one of the most important non-nutritional factors affecting milk composition. Noteworthy, the contents of lactose and non-fat solids (NFS) in milk from Brazilian dairy herds are usually lower than those found in the published literature, which could be related to the high prevalence of subclinical mastitis in Brazilian dairy herds. Thus, we aimed to evaluate the influence of somatic cell counts (SCC), as an indicator of subclinical mastitis, on milk composition of crossbred (Holstein-Friesian x Zebu) dairy cows in Brazil. Since there are two well-defined seasons (dry-mild; rainy-hot) in most part of the country, this source of variation was also included in our study. Data from 468,262 samples collected from bulk tank milk (BTM) of commercial dairy farms over a period of three years (2006-2008) were used in the analysis. SCC values were divided in seven classes, ranging from <50,000 to >1,600,000 cells/ml. The contents of fat, protein, lactose, total solids and SNF in milk during the dry and rainy seasons were, respectively: 3.77/3.75, 3.28/3.30, 4.42/4.42, 12.50/12.45 and 8.72/8.70. Considering 400,000 cells/ml as a threshold, the contents (%) of the same milk components were 3.72/3.80, 3.30/3.28, 4.47/4.37, 12.51/12.44 and 8.78/8.64 for SCC values below and above the threshold, respectively. Although SCC had influenced all milk components ($p<0.01$), the most pronounced changes occurred for lactose content which was decreased by 0.30 percent units at each $\log_{10}$SCC increase. This reduction was more pronounced during the rainy season when compared with the dry season (0.36 vs. 0.26 percent units, respectively). A similar inverse relationship was also observed between SCC and SNF (-0.20 percent units), with the magnitude of reduction being higher in the rainy season than in the dry season (0.26% vs. 0.16%, respectively). The season of year influenced milk fat and protein contents ($P<0.05$ and $P<0.01$, respectively). There was a significant interaction between year season and SCC for all milk components. In general, our data showed that the SCC was inversely associated with milk lactose and SNF contents in Brazilian commercial dairy farms.

Introduction

There is great interest regarding the factors affecting milk components synthesis since changes in milk composition can affect its value as a raw material for dairy industry [3]. Milk composition is influenced by several factors including nutritional ones such as feeding systems, feed constituents and dietary fat and protein, and by non-nutritional factors, such as age of the cow, stage of lactation, season of the year, and disease [5,6]. Subclinical mastitis is one of the most important non-nutritional factors affecting milk composition [2]. Some studies have shown that contents of lactose and non–fat solids (NFS) in milk from Brazilian dairy herds are usually lower, than those reported in the literature for most breeds [3,6]. On the other hand, the prevalence of subclinical mastitis in most Brazilian dairy herds is considered very high, as evidenced by analysis of SCC in milk samples obtained from both bulk tank and individual cows [6]. Based on data above-mentioned, we hypothesized that

the high SCC could be responsible for the low milk lactose and NFS contents observed in our dairy herds. The objective of this study was to evaluate the influence of somatic cell counts (as an indicator of subclinical mastitis) and season of year on milk composition of crossbred Holstein-Friesian x Zebu dairy cows in Brazil.

Material and Methods

Data from 468,262 milk samples collected from bulk tank (BTM) of commercial dairy herds from Southeast Brazil were analyzed. Milk composition and SCC were analyzed by infrared and flow citometry, respectively using the Bentley Combi 2300. All analyses were performed in the Milk Quality Laboratory, Embrapa Dairy Cattle, Juiz de Fora, Minas Gerais. The milk samples were collected throughout a period of three consecutive years (2006 to 2008). The statistical analyses were conducted initially using the Chi-square test to evaluate the association of year season and SCC categories. A general linear model (GLM) was created to evaluate the effects of both $\log_{10}$SCC and year season on milk composition. The GLM was: $Y = {}_0 + {}_1X_1 + {}_2X_2 + {}_3X_1X_2$, , where Y is the outcome variable (fat, protein, lactose, total solids or SNF) and X_1, $X_2$and X_1X_2 are the explicative variables ($\log_{10}$SCC, year-season and their interaction), respectively. A linear regression model was used to evaluate the effect of $\log_{10}$SCC on milk composition. The linear equation was: $Y = {}_0 + {}_1X_1$, where Y is the outcome variable (fat, protein, lactose, total solids or SNF) and X_1 is the explicative variable ($\log_{10}$SCC). ${}_0$ and ${}_1$are the constant and angular coefficients of the linear model, respectively. The year season was classified as dry/mild (May-October) and rainy/hot (November-April) and SCC values were divided in two categories (SCC 400,000 and SCC > 400,000 cells/ml). The statistical analysis was performed using the Statistical Package for the Social Science (SPSS, 1998).

Results

The percentage of milk samples with SCC > 400,000 cells/ml was higher (P<0.001) in rainy/hot season than in the dry/mild season (49.9 vs. 46.3%, Tab. 1). The same results were observed when the analysis was conducted for each year (data not shown).The mean values (%) of fat, protein, lactose, total solids and SNF in milk in the dry and rainy seasons were, respectively: 3.77/3.75, 3.28/3.30, 4.42/4.42, 12.50/12.45 and 8.72/8.70. Considering 400,000 cells/ml as a threshold, the contents (%) of the same milk components were 3.72/3.80, 3.30/3.28, 4.47/4.37, 12.51/12.44 and 8.78/8.64 for SCC values below and above the threshold, respectively. The SCC affected (P<0.01) concentration of all milk components, whereas year season influenced (P<0.05) only milk fat and protein contents (Tab. 2).The effect of interaction of the year season and SCC was significant for all milk components (Tab.2). By using the linear regression model we found that the most pronounced changes occurred for lactose content which was decreased by 0.30 percent units at each $\log_{10}$SCC increase (Tab. 3). In addition, this reduction was more pronounced during the rainy season when compared with the dry season (0.36 vs. 0.26 percent units, respectively). A similar inverse relationship was also observed between SCC and SNF (-0.20 percent units), with the magnitude of reduction being higher in the rainy season than in the dry season (0.26% vs. 0.16%, respectively). The season of year influenced milk fat and protein contents (P<0.05 and P<0.01, respectively).

Discussion

Changes in milk composition associated with mastitis are well known, and include a decrease in constituents such as casein, lactose, fat and total solids [3]. Also, there has been shown that the relationship between the incidence of mastitis and season of the year is variable, depending on geographical and climatic conditions [7]. Our data showed an increased SCC during the rainy/hot season (corresponding to our summer) which was associated with a more pronounced reduction in milk lactose and NFS contents in this period. This negative association between milk lactose content and SCC is consistent with results obtained by others [1]. The year season influenced both milk fat and protein contents which could be explained by differences related to feeding management and diet composition. These effects should be taken into account in dairy programs where milk composition is used as a criterion for pricing.

Tab. 1: Frequency distribution of bulk tank milk (BTM) according to somatic cell counts (SCC) categories and year season. Differences between seasons were significant at P<0.001 (Chi-square test)

SCC categories (x 1,000 cells/ml)	Year Season			
	Dry/Mild		Wet/Hot	
	N	%	N	%
SCC ≤ 400	132,445	53.7	110,944	50.1
SCC > 400	114,189	46.3	110,704	49.9
Total	246,634	100.0	221,648	100.0

Tab. 2: Estimatives of year season, somatic cell counts (SCC) and interaction effects on milk composition. P – level of significance; ES - effect size estimative

Milk contents	Estatistic	Variation Source		
		Year season	SCC	Year season x SCC
Milkfat	P	0.026	<0.001	<0.001
	ESE	0.577	0.974	0.001
Protein	P	<0.001	<0.001	<0.001
	ESE	0.905	0.976	0.001
Lactose	P	0.164	<0.001	<0.001
	ESE	0.292	0.982	0.002
NSF	P	0.462	<0.001	<0.001
	ESE	0.091	0.982	0.001
Total solids	P	0.052	0.002	<0.001
	ESE	0.482	0.942	0

Conclusion

Our results showed a persistent high milk SCC throughout the year, especially during the rainy season (end of spring and summer). In addition, all milk components were affected by SCC, but the strongest effect was on the lactose and SNF contents. These data indicate a need for a comprehensive program of mastitis control that could benefit the dairy farmers, industry and consumers.

Tab. 3: Influence of somatic cell counts on milk composition (%) variation by linear regression, according to year season. C - constant of linear model; angular coefficient of linear model; Significance level of linear models (P<0,001); Significance level of angular coefficients (P<0,001)

Milk's contents	Period					
	Year		Rainy Hot		Dry Mild	
	C	β	C	β	C	β
Fat	3.41	0.13	3.39	0.14	3.43	0.13
Protein	3.25	0.02	3.29	0.01	3.23	0.03
Lactose	4.77	-0.30	4.82	-0.36	4.72	-0.26
SNF	9.14	-0.20	9.20	-0.26	9.10	-0.16
Total solids	12.56	-0.02	12.58	-0.04	12.52	-0.01

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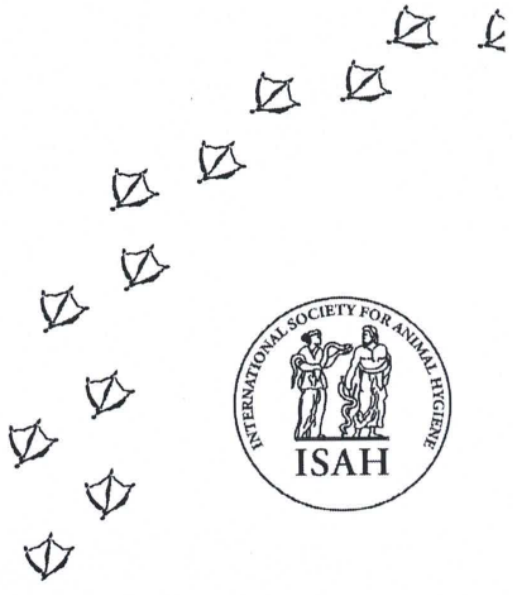

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