Somatic Cell Count Evaluation in Early Lactation between Primiparous and Multiparous *Bos indicus* Cows

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ABSTRACT

Using *Bos indicus* cows, a study examined the relationship between somatic cell count (SCC) and milk yield. For this study, one hundred fifty cows (Primiparous, PM, 75 and Multiparous, MP 75) in early lactation (days in milk, PM =134 ± 3; MP = 136 ± 5), milk production (9,88 kg/d, on average) of the creole breed Gyr lechers were enrolled. Before being assigned to each treatment, the SCC values were lower than 220,000 cells/mL, on average. All cows were maintained to graze daily on *Megathyrsus maximus* and supplemented with *Morus alba* ad libitum, being hand-milking at 0700 daily. Before analysis, the SCC was logarithmically transformed (log10). Then, PROC Mixed from SAS version 9.4 was used to evaluate all measurements. Regarding our results, the MP had greater milk yields than PM cows (10.83 vs. 9.18 ± 0.38 kg/d; $P = 0.003$). Similar results were observed for fat-corrected milk (8.26 vs. 6.80 ± 0.34; $P = 0.002$), although the fat values did not differ between both groups ($P = 0.86$) being lower than referential values for these breeds (2.46 ± 0.16, on average). No differences were observed in the other milk components ($P = 0.65$ to 0.85). Despite that, the somatic cell count (SCC) values showed a statistical tendency in PM than in MP (1.89 vs. 2.13 ± 0.05; $P = 0.07$). In conclusion, low-fat content was observed in both groups, possibly due to the low quality of foods used in ruminant feeding. Meanwhile, parity and advanced lactation conditioned the SCC contents. Therefore, other studies should be performed to identify more factors that could be determinants.

Keywords: Milk, Tropical livestock, Udder health

INTRODUCTION

According to Britt et al. [1], by 2067, the world's population is predicted to reach 10.4 billion, reducing the arable land available for food production. So, the sustainability of dairy farms will be vital to stopping the growing agricultural frontier. Compared to breeds from temperate regions, tropical bovine production is low regarding milk kilos, composition, or udder health. As a result, developing and tropical nations continue to face difficulties in increasing milk output[2,3]. Nevertheless, mastitis is among the costliest diseases affecting the dairy cattle industry[4]. Most of the immune cells in milk are lymphocytes, polymorphonuclear neutrophils (PMN), and macrophages, represented by the somatic cell count (SCC)[5]. This udder inflammation can be subclinical and chronic, but both forms have severe risks to obtaining milk of good hygienic quality and

farming profitability[6]. In addition, the resilience of high-yielding animals and poor efficacy of therapies and prevention (i.e., antibiotic resistance and dubious efficacy of vaccines) could be associated factors. In this sense, one of the most used indicators to assess milk quality and define milk prices is SCC[8]. According to Juárez et al.[6], the first and principal tool used by technicians and farmers to evaluate udder health in flocks is SCC, an essential tool with easy application. Although much scientific evidence has been reported from other continents[9–11] using breeds of *Bos taurus* at the Latin American level, few studies where the raising *Bos indicus* predominates have been informed. Data from MAGAP[12] have shown that in the Amazon region, cattle raising represents one of the more important activities in generating money resources for these families[2]. In fact, of 5236 agricultural productive units (UPA's) identified in Orellana province, approximately 46% are developed as small livestock farmers with low technological levels and bad management of their biotic resources[2,13–15]. Therefore, in this scenario, no studies have been conducted to explore the udder's health status and can recommend some mastitis control practices. Aimed this, this first study in Orellana province aimed to explore the udder health in early lactation in *Bos indicus* cows.

MATERIALS AND METHODS

Dairy Farms

This study collected milk samples from one livestock farm in Joya de los Sachas, Orellana, Ecuador. According to González Marcillo et al.[13], the humid tropical rainforest conditions characterize this area's climate. Its altitude is 275 m above sea level, and the average annual rainfall is 2942 mm. The average yearly temperature is 29.7 °C. One hundred fifty cows (Primiparous, PM, 75 and Multiparous, MP 75) in early lactation (days in milk, PM =134 ± 3; MP = 136 ± 5), milk production (9,88 kg/d, on average) of the creole breed Gyr lechers were enrolled. The cows were maintained to graze daily on *(Megathyrsus maximus*, CP 12%) and supplemented with white mulberry *(Morus alba)* ad libitum, being all cows every day hand-milked at 0700. Before being assigned to each treatment, the SCC values were lower than 220,000 cells/mL, on average.

Milk samples

A complete design block with a randomized PM and MP was used to disperse the cows. The investigation lasted for 21 days. As a result, 50 mL samples of milk were aseptically collected, conserved with antimicrobial tablets (Bronopol, Broad Spectrum Micro-tabs II, D&F Control Systems Inc., San Ramon, CA), and maintained at 4°C until processing for milk composition and SCC analyses. Then, in the Uyunbicho at the Central University of Ecuador, milk composition was examined using infrared absorption, and SCC was calculated using an automatic somatic cell counter that had previously been calibrated for cow milk (Fossomatic 500, Foss-Electric, Hillerd, Denmark).

Statistic evaluation

PROC Mixed from SAS 9.4 (SAS Institute Inc., Cary, NC, USA) was used to analyze the data. The SCC was logarithmically converted ($\log_{10}$) prior to analysis. While residual error and cows were regarded as random variables, our fixed effects (PM and MP) were included in the model. With SAS's PDIFF option, differences between least squares means were calculated, and the Tukey test was used to compare them. Additionally, the PRO CORR of SAS was associated with the milk composition and SCC. Statistical differences and trends were announced at $P \leq 0.05$ and $P \leq 0.10$, respectively.

RESULTS

Table 1 shows the milk composition and SCC compared to primiparous (PM) and multiparous (MP). Days in milk were estimated to be 134 and 136 days for primiparous and multiparous does, respectively, at the start of the trial ($P > 0.05$). Comparing primiparous and multiparous women's milk yields revealed differences ($P = 0.003$); the MP showed a 15% higher milk yield than those in PM (10.83 vs. 9.18 ± 0.38 kg/d; Table 1). As for FCM values, although the fat contents did not change between treatments (2.46 ± 0.16%, on average; $P = 0.68$), the corrected milk by fat was greater in MP than those obtained for PM (8.26 vs. 6.80 ± 0.34%; Table 1)

Item	Treatments		SEM	P = value
	Primiparous	Multiparous		Treatment
Milk yield, kg/d	9.18	10.83	0.38	0.003
FCM, L/d[1]	6.80	8.26	0.34	0.002
Milk composition, %				
Total solids	11.10	11,17	0.17	0.76
Solids no fat	8.68	8.66	0.66	0.79
Fat	2.41	2.51	0.16	0.68
Protein	3.24	3.23	0.50	0.85
Lactose	4.71	4.69	0.02	0.60
Fat yield, g/d	208b	261a	16	0.02
Protein yield, g/d	299a	253b	14	0.01
Somatic cell count, log	1.89	2.13	0.05	0.07

[1]Fat corrected milk at 4%; FCM = kg of milk yield × [0.4+ 0.15 × (fat %)].

Table 1. Comparisons between the somatic cell counts (SCC) and milk yield features of 120 primiparous and multiparous *Bos indicus* cows.

In contrast, the other milk components did not differ between treatments ($P = 0.60$ to 0.85%; Table 1). Overall, the mean values were for total solids (11.14 ± 0.17%), solids non-fat (8.67 ± 0.66%), protein (3.24 ± 0.50%) and lactose (4.7 ± 0.02%). Nevertheless, when comparing the fat and protein contents expressed as g/d, the MP had greater fat contents than PM cows (261 vs. 208 ± 16; P 0.02) but with lower protein contents (253 vs. 299 ± 14; P 0.01; Table 1). On the other hand, statistical tendencies were observed for SCC ($P = 0.07$). In the current study, the overall averages of SCC were 153.703 × 103 mL-1 (log SCC 1.89) and 394.560 × 103 mL-1 (log SCC 2.13) for primiparous and multiparous cows, respectively. As shown in Figure 1, the regression analysis showed strong significant associations between total solids and fat ($P < 0.001$) and solids non-fat and CP ($P < 0.001$), as well as for SCC and lactose contents ($P < 0.001$).
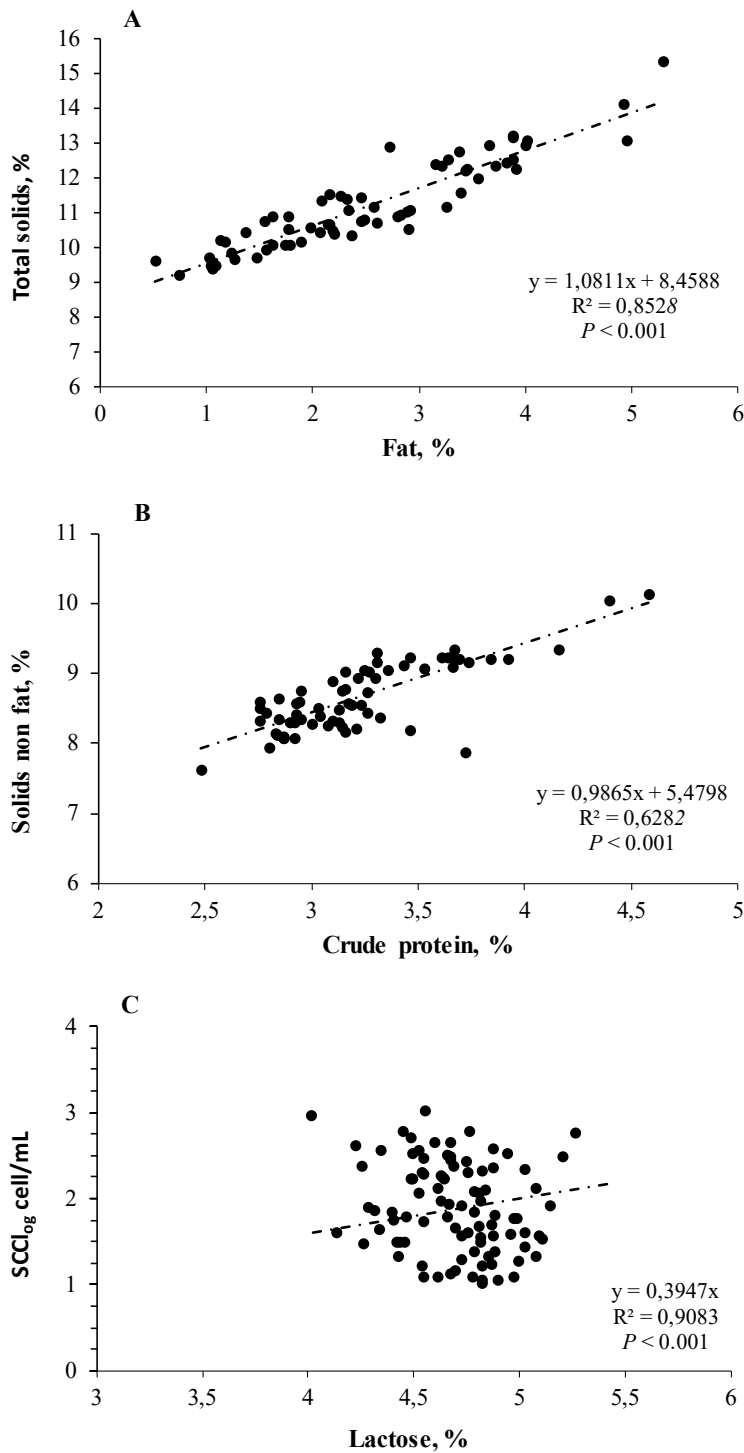
Figure 1. Regression analysis is linear for total solids and fat (A), solids non-fat and CP (B) and SCC and lactose (C).

Table 2 displays the simple correlation coefficients for milk yields, composition, and SCC. This study did not link Milk yield and SCC (-0.04 to 0.67; P = 0.50 to 0.64). Nevertheless, there were significant correlation coefficients for PM and MP between total solids and fat (r = 0.92 to 0.94; *P* < 0.001) and solids non-fat and CP (r = 0.79 to 0.90; *P* < 0.001: Table 2).

Variable	Milk, kg/d	Fat	CP	TS[1]	SNF[2]

	Milk		Fat		CP		TS		SNF	
	PM	MP	PM	MP	PM	MP	PM	MP	PM	MP
Milk, kg/d			− 0.25	− 0.22	0.14	0.22	− 0.15	− 0.08	0.25	0.28
			0.013	0.069	0.16	0.06	0.14	0.52	0.013	0.01
Fat	− 0.25	− 0.22							0.035	0.17
	0.013	0.069							0.73	0.16
CP	0.14	0.22	0.000	0.27	0.000		0.30	0.54	0.90	0.79
	0.16	0.06	0.99	0.02	0.99		0.003	0.001	0.001	0.001
TS	− 0.15	− 0.08	0.94	0.92	0.30	0.54			0.36	0.54
	0.14	0.52	0.001	0.001	0.003	0.001			0.001	0.001
SNF	0.25	0.28	0.035	0.17	0.90	0.79	0.36	0.54		
	0.013	0.01	0.73	0.16	0.001	0.001	0.001	0.001		

[1] TS, total solids; [2]SNF, Solids non-fat; PM, primiparous cows and MP, multiparous cows.

Table 2. Somatic cell counts of primiparous (PM) and multiparous (MP) Bos indicus cows were correlated simply with milk yield attributes (n = 120).

DISCUSSION

Coulibaly and Nialibouly[16] observed that the evaluation of milk yield of lactating cows in tropical conditions is confounded by the fact that the calf must initiate milk letdown. Martínez-Velázquez et al.[17], using creole, Gujarat have reported at 210 DIM a higher milk yield (22 ± 1.7 kg/d) and fat (2.81 ± 0.1%) than those obtained in our study. Millogo et al.[3] in zebu dairy cattle at 41 ± 6 DIM observed lower milk yields than this study (1.3 vs. 10 kg/d, on average) but with more excellent fat contents (4.88 vs. 2.46 %). We hypothesized that our lower fat contents observer in this study could be related to poor forage quality for bad grazing management practices, as evidenced by Guaman-Rivera et al.[2,18] in Orellana province. According to Bonfoh et al.[19] and Farahani, Amanlou, and Kazemi-Bonchenari [20], the fat content in milk reflects supplementary feeding for the entire dry period, which in our conditions was not done.

However, it's crucial to remember that the variation in the amount of milk the calf suckled greatly impacted the daily variance in saleable milk yield. Additionally, since milk fat content rises during udder emptying, variation in the degree of udder evacuation and calf suckling may impact the fat content[3]. Another critical point to consider in this study is that the fat contents did not vary between PM and MP, but Bonfoh et al.[20] reported a higher fat content of Malian Zebu milk when the milk yield decreased. Based on the abovementioned evidence, estimating milk production in lactating zebu cows has always been difficult since using their calves to stimulate milk letdowns16 is necessary. Our research team decided to do this work at 134 DIM, avoiding the suckled effect.

As expected, the lactose contents did not differ between PM vs. MP (4.70 ± 0.02% on average), being their values like those reported by Millogo et al.[19] (4.84%), Martínez-Velázquez et al.[17] (4.71%), Sidibe-Anago, Ouedraogo, and Ledin[21] (4.6%). Despite weak correlations in PM and MP cows between SCC and lactose contents (r = 0.22 to 0.25), it was significant (P = 0.03 to 0.04).

According to Portnoy and Barbano[22], lactose is the main carbohydrate in milk at a concentration of around 4.6% on an anhydrous basis. Consequently, it is a key component in milk synthesis and secretion, regulating the osmotic equilibrium in the mammary cell. Decreased milk yield and compositional changes in milk, particularly concerning lactose concentration, have been reported in infected mammary glands in cows[23–25]. High-quality milk production is a primary factor for the safety and quality of dairy products[26]. Mastitis is a significant problem in dairy farming globally[5], occasioning also considerable economic losses. Besides this, Kirkeby et al.[5] stated that mastitis is a predominant reason for antibiotic use in dairy products and can impair animal welfare. The SCC in milk indicates the inflammatory response in the mammary gland[27]. In cattle breeds of origin *Bos taurus*, ample scientific evidence stated that the optimal cut-off points to distinguish between infected and uninfected quarters should have less than 200,000 cells/mL[28,29]. However, in *Bos indicus* cattle breeds, information is scarce and confused on referential SCC values to consider as uninfected. At the level

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of Ecuador, legal normative declared by INEN[30] is regarded as an uninfected quarter when the SCC values are less than 500,00 cells/mL. Bonfoh et al.[19] reported that 9% of cows had a mean value of SCC greater than 654,000 cells/mL. Similar results have been observed by Juozaitiene, Juozaitis, and Micikeviciene[31] (SCC, 800,000 cells/mL). In this first study, in PM cows ($n = 75$), 57 and 43% had lower SCC values than 39,000 and 180,000 cells/mL, respectively.

Meanwhile, for MP cows ($n = 75$), the SCC values were 65% (> 81,000 cells/mL) and 35% (>979,000 cells/mL). Based on these findings, the MP cows showed to have more risk of obtaining subclinical mastitis, according to Juozaitiene et al.[31]. In SCC values of dairy ewes, Orman et al.[31] reported a negative correlation between milk yield and parity. This supported our results, in which the PM cows showed lower SCC values when compared to those of MP cows. In these tropical conditions, due to high ambient temperatures with high relative humidity. The cattle could face heat stress through physical, biochemical, and biological changes resulting in decreased production performance and poorer immunity (i.e., a high SCC), such as observed [32]. Although most milk parameters show substantial mastitis-related changes, no correlations were found between SCC and all milk components in this study. Nevertheless, we did not discard possible seasonal effects, stage of lactation, genetics (breed), productive systems and udder and teat morphology-like associated factors in *Bos indicus* cows[33].

CONCLUSIONS

Based on these findings, the lower fat contents observed in PM and MP cows could be related to forages of poor nutritional quality. In addition, the present investigation evidenced a progressive increase in SCC with parity and advanced lactation. So, this first study performed in Orellana Province might be a point to start formulating feeding strategies for achieving greater and lower milk composition and SCC, respectively.

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