

Full Length Research Paper

Relationship between somatic cell counts, dairy cattle milk yield and composition in Burkina Faso

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Accepted 28 January 2008

The study was carried out on ten local dairy cows called Zebu at a research centre located in the west part of Burkina Faso. Dairy cows were supplemented 53.8 MJ metabolized energy and 735.7 g Crude Protein and were free access to natural pasture. Milk yield recording and individual milk sample collection took place within one month. Milk samples were analyzed for composition with the method of mid infrared spectroscopy and for somatic cell count with fluorescent method. The results showed that saleable milk yield varied between dairy cows and days. The lowest milk yield (1.04 ± 0.29 L/day) was associated to higher somatic cell count ($5.30 \pm 0.73 = \text{Log}_{10}$) compare to cows with the highest daily milk yield in this study (3.46 ± 0.39 litres/day and $4.73 \pm 0.45 = \text{Log}_{10}$). But, the higher fat content (5.79 ± 1.62) was found for cow with higher somatic cell count. Saleable milk yield and milk composition were strongly associated to somatic cell count but the study did not show how much milk and its components could vary with higher somatic cell count.

Key words: Local cow, milk yield, Somatic cell count, composition.

INTRODUCTION

Animal production is the second income source and exportation (19%) after cotton in Burkina Faso (Ministry of Animal Resources, 2000) and milk is the most regular diet source and income for farmers during the rainy season. According to the Ministry of Animal Resources (2004), the main species used for milk production are cattle, goats and sheep with 7,300,000 of cattle, 10,000,000 of goats and 6,700,000 of sheep. Milk production is estimated between 130 and 180 millions litres per year and 95% of milk produced is from rural area and 5% from peri-urban and urban areas. Natural pasture represents 85% of feed resource, crop residues, 11% and supplementation, 4%.

Livestock production system is characterized by nomadism, transhumance and sedentary system and zebu cow

is mostly used for milk production (Kouakou, 1999) but the dominant system are transhumance where the herd and herder move according to the season from area to area for grazing. Traditional and semi-intensive dairy farms are mainly located around the city.

A study in Ouagadougou urban area in Burkina Faso shows hygiene problems and udder health problems of dairy cow and somatic cell count (SCC) was 5, 385,000 cells/ml and 98 milk samples were positive for California Mastitis Test (Traoré et al., 2004). The presence of mastitis in such a case has effect on milk production reported by several authors (Bartlett et al., 1990; Bonfoh et al., 2004; Juozaitiene et al., 2006; Dang and Anand, 2007).

Zebu cow has very short lactation length (Jöchle, 1972) and low producer, 1 - 3 L/day (Anago-Sidibé et al., 2006). But, the exact estimation of milk yield of Zebu cow has been difficult due to the suckling of calves for milk let down (Coulibaly and Nialibouli, 1998; Yilma et al., 2006).

In such a low production case, presence of mastitis will

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Table 1. Supplementing dairy cows' diets composition. Each cow received 7 kg of dry matter (DM) per day composed by 04 kg of grass hay from the station's grasses, 1.5 kg of cottonseed cake and 0.5 kg of molasses.

	DM (kg)	ME (MJ)	CP (g)
Grass hay	04	32	240
Cottonseed cake	1.5	15.45	487.5
Molasses	0.5	6.35	8.2
Total	07	53.8	735.7

completely decrease milk yield per cow and cause hygiene problems in dairy farms. It is well documented that mastitis is the most frequent disease of dairy cows (Bartlett et al., 1990; Lescourret and Coulon, 1994; Bonfoh et al., 2004; Whist and Østerås, 2006). Furthermore, the higher somatic cell count is strongly associated to the presence of mastitis in dairy farms. In general, mastitis is caused by bacteria such as *Staphylococcus aureus*, *Streptococcus agalactiae*, environmental streptococci and coliforms. The mastitis control appears important regarding no pasteurized milk drinking in several areas (Bonfoh et al., 2003; Savadogo et al., 2004).

Very few studies have been done on SCC and milk yield in Burkina Faso and the aim of the present study was to investigate relationship between SCC, milk yield and composition of local Zebu cow and contribute to available data for future studies.

MATERIALS AND METHODS

The study was conducted on ten local dairy cows (*Bos indicus*) called Zebu at the research centre (Institute of Environment and Agricultural Research, IN E RA) located in the west part of Burkina Faso at coordinates 04°20' West and 11°06' North; Altitude: 450 m and 475 ha as area available (Abessolo, 2001). The average rainfall is 1100 mm per year and the average temperature during the hot period is 38.2°C.

The trial was carried out during the dry season from February to April 2007. Lactating cows with body weight varying between 228 and 296 kg were included in the study at day 30 of lactation. All cows were allowed to natural pasture. Supplementation with hay, molasses and cottonseed cake was done in order to meet their requirements both for maintenance and production. The limited number of dairy cows in the current study can be explained by the low rate of artificial insemination to be successful, long pregnancy period, calving at the same time and calf mortality at calving and during the study. Only dairy cows calved during the interval time of the experiment was included. Also, cows which lost their calves during the experimental time were discarded. In such a case ten cows were successful for the study.

The formulation of the diet was based on table values: (per kg of DM), 60 g CP and 8 MJ (ME) for grass hay; 325 g CP and 10.3 MJ (ME) for cottonseed cake; 16.4 g CP and 12.7 MJ (ME) for sugar-cane molasses (NRC, 1978).

The requirement diet of dairy cow (body weight 250 kg) producing 7 kg milk/day is 875 g CP and 69.1 MJ ME/day (Chamberlain, 1989). Each cow received 7 kg of dry matter (DM) per day composed by 4 kg of grass hay from the station's grasses, 1.5 kg of cottonseed cake and 0.5 kg of molasses (Table 1). One kg of cotton

seed cake was given to cow during morning milking and 2 kg of grass hay were mixed with 0.5 kg of molasses and given after morning milking. The rest of cottonseed cake (0.5 kg) was given during evening milking and the rest of grass hay (2 kg) was given after evening milking. The grass hay was made from the research centre pasture which is dominated by *Andropogon gayanus*, *Andropogon spp*; *Pennisetum pedicelatum*; *Eragrostis tremula*.

Composition of the supplementary materials (Sidibé-Anago et al., 2006): Grass: 955 ± 06 g/kg of Dry Matter (DM); 31 ± 0.2 g/kg DM of Crude protein (CP), 844 ± 11.3 g/kg DM of Neutral Detergent Fiber (NDF); 711 ± 15.4 g/kg DM of Acid Detergent Fiber (ADF); Cottonseed cake: 947 ± 0.8 g/kg of DM; 437 ± 26.8 g/kg DM of CP; 357 ± 44.7 g/kg DM of NDF; 129 ± 1.8 g/kg DM of ADF; Molasses: 811 ± 4.1 g/kg DM.

Cows were milked twice a day at 07:30 AM and 5:00 PM. The milking was performed by two people during all experiment. The milking technique was hand milking. The teats were cleaned with simple water before calf was allowed to stimulate milk let-down.

Also, calf was allowed to suckle at the end of milking. Each cow had an individual milking bucket with cow identification number. The men had milking clothes and towel for teat cleaning. The cows' teats were cleaned with simple water and drying with towel. Before milking took place each day both in the morning and evening, the barn was cleaned. Furthermore, the barn was routine cleaned each two days. The sampling took place only in the morning for milk composition and SCC but the measurement of milk volume took place both in the morning and evening. The volume was measured with the test tube (2,000 ml). The samples collection took place one month for each dairy cow. Plastic flasks (100 ml) were used for milk sample both for milk composition and SCC. Before taking sample, the milk was measured and mixed twice. Milk was analyzed for fat, protein, lactose, dry matter (DM) and solid non fat (SNF).

The analysis was performed with the method of mid infrared spectroscopy (FMA 2001, Miris AB, and Uppsala, Sweden). Analyse of SCC was performed with fluorescent method (DeLaval Cell Counter, Tumba, Sweden). Milk yield was measured directly after milking. Milk samples for milk composition and somatic cells count (SCC) were analyzed the same day or stored at + 4°C in freezer and been analyzed within two days. The analysis was performed using analyse of variance (ANOVA) of Minitab Pro-gramme Version 14 (Minitab, 2002). The difference was considered to be significant between cows at $P < 0.05$. The dairy cows were compared for yield, SCC and composition of milk at the probability level of $P < 0.05$ using Tukey's pairwise comparison procedure. The different values of variables are expressed in mean ± standard deviation (sd).

RESULTS

Milk yield per day and SCC

The current study showed that milk production of local

Table 2. Daily milk yield and SCC (N = 26).

Cow identity	Daily milk yield (litre)	Coefficient of Variation (%)	SCC (Log ₁₀)
C00121	2.27 ± 0.33 ^a	14.34	5.15 ± 0.36 ^a
C0024	2.14 ± 0.35 ^a	16.31	5.07 ± 0.62 ^a
C0062	2.25 ± 0.48 ^a	21.70	5.03 ± 0.19 ^a
C0071	2.89 ± 0.48 ^a	16.72	5.07 ± 0.27 ^a
C95012	1.76 ± 0.45 ^b	25.58	4.88 ± 0.43 ^b
C96011	1.04 ± 0.29 ^d	28.20	5.30 ± 0.73 ^a
C96017	1.12 ± 0.13 ^d	11.77	5.11 ± 0.32 ^a
C96018	3.46 ± 0.39 ^c	11.54	4.73 ± 0.45 ^b
CI001	2.23 ± 0.36 ^a	16.46	6.19 ± 0.40 ^c
CL002	1.72 ± 0.45 ^b	26.59	4.84 ± 0.46 ^b

Mean values with different superscript ^{a,b,c,d} in the same column are significantly different ($p < 0.05$). Means values in each column with the same superscript ^a or ^b or ^c or ^d are not different ($p > 0.05$).

Table 3. Relationship between SCC and Milk yield. ANOVA Table.

Source	Degree of Freedom	Sum of Square	Mean Square	F-test	p-Value
Daily yield (litres)	129	53.535	0.415	1.49	0.012
Error	130	36.200	0.278		
Total	259	89.735			

S = 0.5277 R-Sq = 59.66% R-Sq (adjust) = 19.63% $p < 0.05$.

Zebu cow varies between cows as well as between days. The lowest average yield per day was 1.04 L while the highest average was 3.46 L per day for saleable milk. The study also showed that higher SCC (Log₁₀ = 5.30 ± 0.73) was got with lower milk yield (Table 2). Further, the variation in milk yield for cow C96011 (28%) was also important compare to 11.54 % obtained with 96018 with higher milk yield in the study.

There was no difference in production and SCC for cows C00121; C0024; C0062 and C0071. The variation was 14 and 20% in yield between days. Milk yield per cow per day was related to SCC per day in this study ($p < 0.05$).

Milk composition and SCC

Fat, protein and DM content were also different (Table 4) for the lowest yielder (C96011) and the best yielder cows (C96018) in the current study. But, lactose content was not different (Table 4) for both two cows. Fat, protein, DM and SNF were observed to vary between dairy cows and different (Table 4). In contrast, lactose content was not different ($P > 0.05$) for nine dairy cows. But, the higher lactose content was got with dairy cow number C00121. Furthermore, F-test for ANOVA was significant between

SCC and dry matter content (Table 5). Dairy cow with higher SCC (Log₁₀ = 6.19 ± 0.40) had less DM (13.41 ± 1.66%) compare to dairy cow number C96018 (14.85 ± 1.03 % of DM) with (Log₁₀ = 4.73 ± 0.45). The average for all cows was 4.85 ± 0.81 % of fat, 3.36 ± 0.15 % of protein, 14.43 ± 0.63 % for DM and SCC (Log₁₀) was 5.13 ± 0.40.

DISCUSSION

In general, studies on SCC or controlling mastitis are usually done on the large size of dairy herd and take several seasons or years (Omoro et al., 1999). The current study focused on ten dairy cows in a short period but gave useful information on local Zebu cows and for future studies and controlling mastitis programmes in Burkina Faso. Zebu dairy milk yield was variable between cows (Table 2) in this study but in agreement with other previous studies on Zebu cow (Bonfoh et al., 2003; Bonfoh et al., 2004; Sidibé-Anago et al., 2006). Zebu cow milk was estimated to 1 to 2 L per day and with individual variation. The recent study took place at mid lactation of zebu dairy cow between day 30 and day 60 of lactation. Five of ten dairy cows included in this study yield as an average 2 L/day (Table 2).

Table 4. Milk composition (N = 26).

Dairy Cows	Fat (%)	Protein (%)	Lactose (%)	DM (%)	SNF (%)
C00121	4.56 ± 0.86 ^a	3.36 ± 0.39 ^a	5.06 ± 0.18 ^a	13.94 ± 0.84 ^a	9.23 ± 0.46 ^a
C0024	4.03 ± 1.19 ^b	3.11 ± 0.40 ^b	4.72 ± 0.53 ^b	12.77 ± 1.37 ^b	8.64 ± 0.35 ^b
C0062	5.33 ± 0.70 ^a	3.56 ± 0.49 ^a	4.93 ± 0.11 ^b	14.71 ± 1.11 ^c	9.37 ± 0.62 ^a
C0071	4.16 ± 1.55 ^b	3.28 ± 0.42 ^b	4.88 ± 0.20 ^b	13.13 ± 1.48 ^a	8.92 ± 0.54 ^b
C95012	6.48 ± 1.13 ^c	3.70 ± 0.19 ^c	4.63 ± 0.13 ^b	15.95 ± 1.05 ^d	9.29 ± 0.25 ^a
C96011	5.79 ± 1.62 ^c	3.33 ± 0.72 ^a	4.84 ± 0.60 ^b	14.83 ± 1.77 ^c	8.91 ± 0.40 ^b
C96017	4.33 ± 0.77 ^b	3.34 ± 0.89 ^a	4.78 ± 0.40 ^b	13.52 ± 1.31 ^a	8.98 ± 1.04 ^b
C96018	5.20 ± 1.03 ^a	3.74 ± 0.30 ^c	4.93 ± 0.11 ^b	14.85 ± 1.03 ^c	9.52 ± 0.35 ^a
CI001	4.42 ± 1.49 ^b	3.37 ± 0.58 ^a	4.80 ± 0.16 ^b	13.41 ± 1.66 ^a	8.92 ± 0.73 ^b
CL002	4.20 ± 1.19 ^b	3.70 ± 0.38 ^c	4.85 ± 0.29 ^b	13.76 ± 1.21 ^a	9.52 ± 0.47 ^a

Mean values with different superscript ^{a,b,c,d} in the same column are significantly different ($p < 0.05$). Mean values in each column with the same superscript ^a or ^b or ^c or ^d are not different ($p > 0.05$).

In the current trial, SCC was correlated to daily yield per cow (Table 2 and 3) and showed that, the low milk yield was associated to higher SCC compare to cow which had higher milk yield. However, SCC is not different ($P > 0.05$) between dairy cows producing 2 L per day and those yielded 1 litre per day. The average of SCC (Table 2) showed clearly that, SCC was variable between days and dairy cows but did not show any difference between the levels of production. The recent finding is in agreement with other studies which reported that fifty percent of the mastitis cases with higher SCC occurring after lactation peak are not accompanied by marked modifications of the lactation curves (Lescourret and Coulon, 1994). But, Windig et al. (2005) reported that higher milk yield is correlated with SCC-peak which contradicts the present finding where dairy cow with higher milk yield had not the higher SCC (Table 2).

The results of the current study are in line with Juozaitiene et al. (2006), who reported that, cow in higher class for SCC showed lower milk production. Other study reported that 2-fold increase in SCC above 50,000 cells/ml resulted in a loss of 0.4 and 0.6 kg of milk per day in primiparous and multiparous cows respectively (Allison, 1985). In low yielding cow case like Zebu cow 0.6 kg is an important losing per day regarding milk yield per cow (Table 2). Moreover, milk yield estimation is one problem in Burkina Faso and to know how much milk could be lost by dairy farms in case of mastitis is another. The future investigations should focus on how much milk could be lost by local dairy cattle like Zebu cow when affecting by mastitis. Bonfoh et al. (2004) report from Mali with similar climate and similar production system like Burkina Faso one-third of lactating cows are positive for mastitis and SCC are above 350 000 cells/ml. We could conclude that (Table 3) SCC is correlated to milk yield per cow ($P < 0.05$) but no conclusion could be drawn if the lower milk yield from some dairy cows is affected by the higher or

lower SCC.

In general when milk yield varies its components also varies (Yilma et al., 2006). The strong correlation between milk composition and SCC (Table 5) explain that the higher SCC in milk could influence milk components. The higher fat content (Table 4) was found to be linked to the breed similar to report from Mali by Bonfoh et al. (2004). The higher fat content (5.79 ± 1.62) (Table 4) was found for cow with higher SCC. In contrast, Juozaitiene et al. (2006) report that the higher SCC is associated to mastitis and find to decrease milk yield, fat and protein content. Dry matter was correlated to SCC and could be affected in mastitis case when fat and protein are affected. However, lactose and solid non fat did not show a large difference between dairy cows in this study. In comparison to lactose content (Table 4), Dang and Anand (2007) report lower lactose content (4.10%) in SCC higher case. It could be established that the higher SCC may announce mastitis which could affect milk composition and especially fat and protein content more than the other components. But it was difficult to assess how much variation could be in milk composition in case of higher or lower SCC.

Conclusions

The study has shown that there is significant correlation between milk production and SCC. The higher SCC got in some individual cow milk could tell the risk of mastitis which may drastically affect milk yield and milk composition. But, the current study did not show how much milk could be lost in higher SCC case and how much this could decrease or increase milk components. Therefore, we strongly suggest that future studies could focus on SCC, mastitis test and establish how much milk could be lost by local Zebu dairy cow in general known low producer.

Table 5. Relationship between SCC and dry matter (DM). ANOVA Table.

Source	Degree of freedom	Sum of square	Mean square	F-test	P-value
Log10 (SSC)	3	37.52	12.51	5.16	0.002
Error	256	619.95	2.42		
Total	259	657.47			

S = 1.556 R-Sq = 5.71 % R-Sq (adjust) = 4.60 % p < 0.05.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the Swedish International Development Authority (SIDA), Department for Research Cooperation (SAREC), for financial support for this research.

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