EFFECT OF POST-PARTUM BODY CONDITION SCORE ON MILK YIELD AND COMPOSITION OF FRIESIAN X BUNAJI DAIRY COWS

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ABSTRACT

The study determines the effect of dam body condition on milk yield and milk composition of dairy cows. The milk production records of 60 Friesian x Bunaji dairy cows were used for the study. The body condition score (BCS) was recorded on scale 1 to 5 with an increment of 0.25 points. The mean initial milk yield (IMY), daily milk yield (DMY) and total milk yield (TMY) was 6.54, 6.51 and 1872kg, respectively, while the mean peak yield (PY), peak day (PD), peak week (PWK) and lactation length (LL) were 10.61kg, 26.94 days, 4.33 weeks and 283.87 days, respectively. The mean fat, protein and lactose content of the milk was 4.22, 4.15 and 4.00 %, respectively, while the mean fat, protein and lactose yield was 0.269, 0.272 and 0.261 kg/day. The ratios of the milk composition were FPR (1.02), FLR (1.03) and PLR (104). There was relatively high variability in the population of the experimental animals with regard to their milk yield characteristics (CV = 15.38 – 67.13%) compared to the milk composition variables (CV = 4.36 – 26.09%). The effect of dam body condition score was significant (p<0.05) on all the milk yield characteristics except IMY, PY and ADY. Dams with moderate BCS of between 2.5 to 3.5 during the lactation period takes longer days to peak yield (PD = 27.41 ± 3.27 days) and peak week (PWK = 4.43 ± 0.49 weeks) with longer lactation length (LL = 301 ± 31.17 days) and consequently higher TMY (1995.25 kg/lactation). However, those with higher BCS (>3.5) had higher IY (7.00 ± 1.86 kg) and shorter days to peak yield (PD = 20.50 ± 13.12 days), PWK (3.0 ± 1.95 weeks) and shorter LL (275.33 ± 25.44 days), which invariably resulted in relatively lower TMY (1819.83 ± 335.80 kg/lactation). The dam BCS had significant effect (p<0.05) on the percentage milk fat (MFC), milk lactose (MLC), fat protein ratio (FPR) and fat lactose ratio (FLR). Dams with higher (>3.5) BCS had higher MFC, MLC, FPR and FLR. It is obvious that BCS is an important factor that reflects the metabolic stability of dairy cows.

Keywords: Post-partum, Body condition score, Milk yield, Milk composition, Friesian X Bunaji dairy cows

INTRODUCTION

The milk production of cows correlates with their body condition and body condition scoring is a widely recommended method of evaluating the nutritional management of dairy cows. When the milk production peaks and the energy requirements exceed its intake, the cows go into negative energy balance (NEB) when they mobilize their lipid reserves, getting thinner, and lose their body condition score (BCS) (Aeberhard *et al.,* 2001; Coffey *et al*., 2002). Not all the cows reduce their BCS equally. The high genetic merit dairy cattle have a higher predisposition for mobilization of body fat reserves to cover milk production demands (Veerkamp, 1998). This was demonstrated in cows selected for higher milk yield (Berry *et al.,* 2003). These cows had lower BCS during lactation and their BCS changes after calving were higher than in cows with lower genetic merit (Buckley *et al.,* 2000a). Thus, mobilization of body fat reserves and milk production are closely related (Pryce *et al.,* 2001). These findings were confirmed by a study conducted by Gallo *et al*. (1996), who observed a higher and more prolonged BCS loss in cows with higher milk yield. Therefore, BCS and milk yield are in a negative correlation (Veerkamp and Brotherstone, 1997), and high-yielding dairy cows generally have a lower BCS (Pryce *et al.,* 2001 Kadarmideen, 2004).

A decrease in BCS post-partum depends not only on the milk yield level but also on the BCS level at calving. Cows probably have a physiological target level for body reserves in early lactation. Therefore, Garnsworthy (2007) presumed that cows fatter at calving would tend to lose more body fat than thinner cows. A positive and significant relationship between milk production and calving BCS has been reported in New Zealand dairy cows (Roche *et al.,* 2006). Later research by same author (Roche *et al.,* 2007) suggested that this association between calving BCS and milk production is nonlinear. In the same vein, Yang (2009) confirmed that BCS at calving is also nonlinearly related to milk production, and that obese cow with high BCS at calving produce less milk just like thin cows. Also, Yang (2009) observed that milk yield increased rapidly during early lactation, and was associated with a decrease in BCS. The greater the BCS loss of the cow during early lactation, the higher the milk production (Waltner *et al.,* 1993; Veerkamp *et al.,* 1994; Pryce *et al.,* 2001; Dechow *et al.,* 2002; Yang 2009). Most of these findings were conducted on the high yielding dairy breed and little is known about the effect of body condition score on milk yield and composition of the low-to-moderate yielding dairy cows of the topics. The objective of this study therefore was to determine the effect of body condition score on milk yield and milk composition of Friesian x Bunaji cows.

MATERIALS AND METHODS

The study was conducted on the dairy herd of the National Animal Production Research Institute (NAPRI) Shika, Nigeria, located between latitude 11^0 and 12^0N at an altitude of 640m above sea level, and lies within the Northern Guinea Savannah Zone (Oni *et al.,* 2001). Sixty Friesian x Bunaji cows comprised of 13 primiparous and 47 multiparous cows were used for this study. The cows were raised during the rainy season on both natural and paddock–sown pasture, while hay and /or silage supplemented with concentrate of undelinted cotton seed cake, were offered during the dry season. They had access to water and salt lick *ad-libitum*. Unrestricted grazing was allowed under the supervision of herdsmen for 7 – 9 hours per day.

Body Condition Score and Milk Production Characteristics

Body condition score (BCS) of the dams were determine on monthly basis by two evaluators using a scale of 1 to 5 on increments of 0.25 with 1(very thin) and 5 (very fat) representing the biological extremes.

Cows were milked twice daily (morning and evening) and milk yield was recorded on daily basis. The time of milking was between 0630 and 0830 and between 1630 and 1830. The milk yield record was used to calculate the milk production characteristics as follows:

Total milk yield (TMY): this is also known as total lactation yield, it is the total milk yield per cow per lactation.

Initial milk yield (IMY): the first day yield of individual cows after the colostrum period, it include both the morning and evening milk yield of the first day in lactation.

Peak yield (PY): Peak milk yield is the highest recorded test day milk production within a lactation

Peak day (PD): The day corresponding to the highest yield (peak yield) within the lactation period or the optimum day-in-milk when peak milk occurs.

Peak week (PWK): The week corresponds to the highest yield within the lactation period.

Lactation length (LL): number of day from the beginning of lactation to the drying period.

RESULTS AND DISCUSSION

Means of Milk Yield and Composition Characteristics

The mean peak day (PD), peak yield (PY), total lactation yield (TLY) and lactation length (LL) obtained in this study were 26.94 ± 3.01 days, 10.6 ± 0.41kg, 1872 ± 93.95 kg and 283.87 ± 7.08 days, respectively (Table 1). These values were similar to one earlier reported by Akpa *et al*. (2006) in the same Friesian-Bunaji crossbred cows; 26.1 ± 0.4 days for day at PY, 7.4 ± 0.3kg for PY, 1456 ± 30 kg for TLY and 218 ± 7.0 days for LL. Also, the average TLY and LL in this study is comparable to the 1988 kg and 250 days reported by Malau-Aduli *et al*. (1996) and the 2420 ± 93.0 kg and 250 ± 5.8 days reported by Aduli *et al*. (1992) in Friesian-Bunaji crosses, and the 310 days of lactation reported by Kahi *et al*. (2000) in Brown Swiss-Sahiwal crossbred cows. However, the TLY in this study was higher than the 1538 kg reported by Das and Sadana (1999) in Friesian-Mpwapwa cross bred cows. Similarly, the peak yield average of 10.61 kg in this study (Table 1) was higher than the 7.4 kg reported by Akpa *et al*. (2006) in Friesian x Bunaji cows. The peak week of 4.33 in this study was within the range of 3 – 8 weeks reported by Grossman *et al*. (2003) in Holstein Friesian cows. However, the mean TLY in this study was higher than 1709.49 ± 892.09 kg and 1662.57 ± 108.96 kg reported by Badri *et al*. (2011) and Musa *et al*. (2005), respectively in Butana dairy cows. The descripancy may be due to the number of years covered, volume of data used for the estimation of the yield characteristics, management and the breed studied.

Comparatively, the TLY for the Friesian-Bunaji crosssbred cows in this study (1872 kg) was higher than 1082 kg reported by Mondal *et al*. (2005) in pure Bunaji. The higher TLY of the Friesian-Bunaji cross bred cows than the pure Bunaji cows agreed with the principle of heterosis in animal breeding, where by offsprings of crosses are expected to perform above the average of the two parents (Legate and Warwick 1990; Bryant *et al.,* 2005). Therefore, the basic strategy for improving the performance of the local genotype in the tropics is by crossbreeding with the high producing temperate breeds. This would increase milk yield as well as blending the adaptability of the indegenous breed with the temperate breeds (Roche *et al.,* 2006).

In contrast to the temperate breeds, the mean TLY of 1872 kg in this study was far lower than the 6198 kg and 6440 kg reported by Mantyssari *et al*. (2002) for pure Friesian and Ayrshire breed, respectively and 6679 kg reported by Kadarmideen (2004) in Swiss-Holstein cows. The Friesian, Ayrshire and Swiss-Holstein are pure breed developed over the years as dairy breed and therefore are bound to be superior in milk production than the local breed and their crosses. Syrstad (1991) reported that cattle in the tropics have on average, lower milk yield and shorter lactation length than the cattle in the temperate countries. The differences is coused by both genetic and non genetic factors (Akpa *et al.,* 2006; Alphonsus *et al.,* 2012; Alphonsus *et al.*, 2013).

Table 1: Descriptive statistics of milk yield and milk composition variables and their ratios

Characteristics	N	Mean	CV	Min	Max
Milk Yield Characteristics					
Initial milk yield (kg)	60	6.54 ± 0.51	47.58	2.0	13.00
Peak day	60	26.94 ± 3.01	67.13	5.0	83.00
Peak week	60	4.33 ± 0.45	62.17	2.0	12.00
Peak yield	60	10.61 ± 0.41	23.03	7.0	16.00
Average daily yield (kg)	60	6.51 ± 0.28	26.81	4.04	12.00
Total milk yield (kg)	60	1872 ± 93.95	31.35	926.50	3427.00
Lactation length	60	283.87 ± 7.08	15.38	126.00	305.00
Milk Composition Variables					
Milk fat content (%)	60	4.22 ± 0.04	6.42	3.29	4.39
Milk protein content (%)	60	4.15 ± 0.03	4.36	3.66	4.35
Milk lactose content (%)	60	4.00 ± 0.06	8.37	3.33	4.34
Milk fat yield (kg/day)	60	0.269 ± 0.01	25.96	0.169	0.497
Milk protein yield (kg/day)	60	0.272 ± 0.01	25.75	0.167	0.490
Milk lactose yield (kg/day)	60	0.261 ± 0.01	26.09	0.164	0.489
Fat-protein-ratio	60	1.02 ± 0.01	3.38	0.90	1.15
Fat-lactose-ratio	60	1.06 ± 0.01	5.15	0.94	1.18
Protein-lactose-ratio	60	1.04 ± 0.01	5.52	0.96	1.17

N=number of animals used, Abrev=abbreviations, SE=standard error, CV= coefficient of variation, Min=minimum, Max= Maximum

The results of this study revealed that the studied milk yield characteristics had high coefficient of variation, indicating high level of descrepancies amongst individual cows. This corroborate the findings of Badri *et al*. (2011) and Pollott (2004) that milk yield characteristics are traits with adequate genetic variation to allowed for selection responses. Also, El-Khidir (2009) noted that, for animal production studies, presence of high level of descrepancy of traits amongst individuals of the population indicates the good chance of improving these traits by selection.

Effect of Postpartum Body Condition Score (BCS) on Milk Yield and Milk Composition

The mean postpartum BCS in this study was 3.04 ± 0.06 with the coefficient of variation (CV) of 11.32% , this was higher than the mean BCS of 2.74 and CV of 13% reported by Kadarmideen and Wegmann (2003).

The relatively higher mean BCS in this study than that of the Kadarmideen and Wegmann (2003) is probably due to the relatively lower milk production of the Friesian x Bunaji cows than the Holstein-Friesian used by Kadarmideen and Wegmann(2003). The Holstein-Friesian cows are genetically superior in milk production than the indegenous cows and their crosses (Alphonsus *et al.,* 2012), and several studies have shown that genetically superior milk producing cows tend to have genetically lower BCS throughout lactation (Veerkamp and Brotherstone, 1997; Buckley *et al.,* 2000b). Similarly, cows with high genetic merit for milk production generally have greater BCS loss in early lactation than those with low genetic merit for milk yield (Veerkamp *et al.,* 1994; Buckley *et al.,* 2000a). The mean variance observed for the BCS was similar to those reported for most of the other countries where BCS was measured on a scale 1 to 5 (Pryce *et al*., 2001; Berry *et al*., 2002).

Table 2: The effect of dam BCS on the milk yield characteristics

BCS	N	IMY (kg)	PD (days)	PWK (wks)	PY(kg)	ADY (kg)	LL (days)	TMY (kg)
<2.5	3	5.00 ± 2.28	26.00 ± 13.12[a]	4.00 ± 1.95[a]	10.44±1.73	6.57±0.31	285.47±7.79[ab]	1869.34±102.82[ab]
2.5- 3. 5	46	6.58 ± 0.58	27.41± 3.27[a]	4.43 ± 0.49[a]	11.25±0.43	6.63±0.31	301.00±31.17[a]	1995.25±411.27[a]
>3.5	11	7.00 ± 1.86	20.50 ± 13.12[b]	3.00 ± 1.95[b]	12.75±1.73	6.47±1.02	275.33±25.44[ab]	1819.83±335.80[b]

IMY = initial milk yield, PD = peak day, PWK = peak week, PY = peak yield, TMY= total milk yield, ADY = average daily yield, different letter superscript on the same column = significantly different means, similar letter superscript on the same column = not significantly different means.

Table 3: The effect of dam BCS on the milk composition characteristics

BCS	N	MFC	MPC	MLC	FPR	FLR	PLR
<2.5	3	3.94± 0.19[c]	4.02±0.15	3.71±0.21	1.01±0.03[b]	1.07±0.04[b]	1.09±0.04
2.5-3.5	46	4.04±0.06 [b]	4.09±0.05	3.89±0.07	0.99±0.01[b]	1.04±0.01[b]	1.05±0.01
>3.5	11	4.67± 0.29 [a]	4.17±0.22	4.17±0.31	1.05±0.04[a]	1.13±0.06[a]	1.01±0.05

MFC= milk fat content, MPC= milk protein content, MLC= milk lactose content, MFY= milk fat yield, MPY= milk protein yield, MLY = milk lactose yield, FPR = fat-protein ratio, FLR= fat –lactose ratio, PLR = protein lactose ratio, different letter superscript on the same column = significantly different means, similar letter superscript on the same column = not significantly different means.

The distribution of BCS showed that the mean BCS of between 2.5 and 3.5 was more frequent, while scores less than 2.5 or greater than 3.5 were rare. In the same vein, cows with the moderate BCS of between 2.5 and 3.5 had higher milk yield and better milk composition than those of lower or higher BCS. This suggested that majority of the experimental cows were in good BCS required for dairy cows during lactation and the moderate BCS supported higher milk yield than the lower or higher BCS. In their study, Paputugan and Makarechian (2000) reported that BCS of 2.5 and 3.0 (on a scale of 1 to 5) presents normal and desireble BCS for high birthweight and milk yield, also Kadarmideen reported an average BCS of 2.74 for dairy cows. The relatively low milk yield of dams with higher BCS of > 3.5 may be attributed to the high fat reserve compared to those with moderate BCS. This confirmed the earlier findings of Paputugan and Makerechian (2000) that higher BCS is associated with lower milk production. Also Gearhart *et al.* (1990) reported that overconditioned cows at calving may be at risk for lesser milk yield and increase reproductive and health problems. Results from Waltner *et al.* (1993) suggested that postpartum BCS and a change in BCS during lactation was related to total lactation yield. In contrast, Pedron *et al*. (1993) indicated that BCS at calving was not essential for total milk yield, while change in BCS influenced peak yield.

In this study, BCS had significant influence on both the quantity and quality of the milk produce by individual cows, this confirms the findings of Qureshi *et al*. (2007) in which they reported significant effect of BCS on the milk yield and composition of buffaloes milk.

Good BCS is essential for dairy cows, so that high producing cows can draw on the body stores of nutrients to support milk production and it components. In the present study BCS had significant effect on milk fat and lactose content and their ratios. The milk fat and lactose content increased with increase in BCS of the dam, with the BCS of > 3.5 having the highest milk fat and lactose content, while those with lower BCS of < 2.5 had the lowest milk fat and lactose content. The ratios (FPR, FLR, PLR) also followed the same trend with the milk fat and lactose content. It was reported that if body stores of nutrients are minimal, yield of milk and milk components will suffer, on the other hand, excessive BCS increases risk of metabolic problem (Hinrichs *et al.,* 2006). Also, it was reported that both thin and fat cows tend to have low milk fat in later lactation and that protein can be depressed at calving if animals are overly obese or underweight (Hinrichs *et al.,* 2006). Base on the foregoing, it could be concluded that BCS is an important management tool for monitoring the metabolic status of dairy cows during lactation.

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