Pre-and Postcalving Supplementation of Multinutrient Blocks on Lactation and Reproductive Performances of Grazing Bali Cows

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(Diterima dewan redaksi 19 September 2005)

ABSTRAK

BELLI, H.L.L. 2006. Suplementasi blok multinutrien terhadap laktasi dan tampilan reproduksi dari induk sapi Bali yang digembalakan sebelum dan sesudah melahirkan. *JITV* 11(1): 6-14.

Pengaruh pemberian blok multinutrien (MNB) terhadap laktasi dan tampilan reproduksi induk sapi Bali sebelum dan sesudah melahirkan telah dievaluasi. Sebanyak 17 induk multipara dengan *body condition score* (BCS) 1-2 (skala 5), kurang lebih 90 hari sebelum taksiran partus dikelompokkan secara acak ke dalam kelompok A (n=9) yang mendapat pakan rumput alam sebagai diet dasar serta grup B (n=8) mendapat tambahan 1,25 kg MNB yang disusun dari: molasses 28%, urea 5%, bungkil kelapa 15%, tepung ikan 5%, dedak padi 25%, kapur 8,5%, garam 7,5%, grit 5%, dan ultra mineral 1%. Induk sapi ditimbang dan dinilai BCS nya setiap dua minggu, yang dimulai pada minggu ke-12 sebelum parturisi, dalam 24 jam sampai dengan 16 minggu setelah parturisi. Produksi susu diperoleh dengan menggunakan teknik timbang-menyusu-timbang yang dilakukan 4 kali yakni 2, 4, 8 dan 12 minggu setelah partus. Tingkah laku menyusui yakni frekuensi menyusui, lama menyusui dan total waktu menyusui dalam sehari diamati 6 kali selama laktasi dalam interval mingguan dimulai pada minggu pertama. Bobot lahir pedet diukur dalam waktu 24 jam sesudah kelahiran, dilanjutkan dengan interval mingguan sampai berumur 12 minggu. Involusi uterus ditentukan dengan palpasi per rektal pada hari ke-7 sesudah melahirkan. Interval waktu antara partus sampai estrus pertama dimonitor melalui pengamatan estrus dua kali sehari. Angka konsepsi pada inseminasi pertama dinilai menggunakan metode diagnosis kebuntingan pada 45-60 hari kemudian. Induk sapi yang diberi suplemen MNB memiliki bobot hidup dan BCS yang secara signifikan menghasilkan lebih banyak produksi susu dan anaknya menunjukkan tingkat pertumbuhan yang lebih tinggi dibandingkan induk yang tidak diberi suplemen MNB. Nilai rata-rata karakteristik menyusui dipengaruhi oleh suplementasi. Tingkat involusi uterus, konsepsi sampai perkawinan pertama dari dua perlakuan tersebut adalah sama, tetapi interval waktu antara partus sampai dengan timbulnya estrus pertama lebih pendek pada induk sapi yang diberi MNB.

Kata Kunci: Suplementasi, Blok Multinutrien, Induk Sapi Bali

ABSTRACT

BELLI, H.L.L. 2006. Pre-and postcalving supplementation of multinutrient blocks on lactation and reproductive performances of grazing Bali cows. *JITV* 11(1): 6-14.

The influence of multinutrient blocks during pre and postcalving on lactation and reproductive performances of Bali cows were evaluated. Seventeen multiparous pregnant cows with body condition score (BCS) 1 to 2, approximately 90 d before the expected date of calving, were divided randomly into groups A (n=9) and B (n=8), and were grazed on the native pasture as a basal diet, while those of Group B received 1.25 kg multinutrient blocks, whose constituent was as follows (%): molasses (28), urea (5), coconut cake (15), fishmeal (5), rice bran (25), lime (8.5), salt (7.5), grit (5) and ultramineral (1). Cows were weighed and assessed for BCS (on a five-point scale) every two weeks, commencing at 12 weeks prior to calving, within 24 h after calving up to 16 weeks after calving. Milk production and composition were assessed by the weigh-suckle-weigh technique at four times i.e. 2, 4, 8 and 12 weeks after calving. Suckling behaviour i.e. frequency of suckling, duration of nursing and total min nursed were observed 6 times in the course of lactation at weekly intervals commencing at 1 week after calving. Calf birth weight was measured within 24 h after calving and continued at weekly intervals until 12 weeks of age. Uterine involution was determined by rectal palpation at 7 d postcalving. The interval from calving to first estrus was monitored by estrus observation twice a day. Conception at first service was assessed by pregnancy diagnosis 45 to 60 d after insemination. Cows fed multinutrient blocks supplement had higher liveweight, BCS throughout the experiment. The cows produced significantly more milk and had higher growth rates of the calves than the unsupplemented cows. The mean values of the characteristics of suckling were influenced by supplementation. The rate of uterine involution and conception to first service were similar in the two treatment groups, but interval from calving to the exhibition of the first estrus was shorter in supplemented cows.

Key Words: Supplementation, Multinutrient Block, Bali Cows

INTRODUCTION

Bali cows' performance in West Timor is very much reliant on the herbage available on native pasture. Results by JELANTIK (2001a; 2001b) indicated that grass availability and particularly quality fluctuates with season. Reasonable quality grass is only available for a short period during the early rainy season. Even in this period, due to the shooting pattern of growth (MCDOWELL, 1993) and more efficient photosynthesis as characterized by C4 type resulting from ambient temperature (WILSON, 1994), tropical forage matures quickly, it is generally much decrease in protein content. The crude protein content of some dominant grasses falls under 4% of the dry matter in a mature state (RIWU KAHO, 1993).

In a review, RANDEL (1990) concluded that inadequate precalving and (or) postcalving energy or protein supply lowers pregnancy-rates and first-service conception rates and prolongs the postpartum interval. Furthermore, the fast reduction of natural pasture and further reduction in forage production with the invasion of pasture weeds necessitates supplementation to provide better utilization of the mature tropical grasses, thus improving cows' performance.

The objective of the study was to examine the effect of supplementation by multinutrient blocks during the pre and post-calving period on body weight and condition score and their milk produced, calve performances, suckling behavior and reproductive traits.

MATERIALS AND METHODS

Seventeen multiparous pregnant Bali cows with BCS 1 to 2, approximately 90 days before the expected date of calving, were randomly allotted to one of two feeding groups. The 9 cows of Group A were grazed on native pasture, while the 8 cows of Group B grazed with the others but, in addition, received 1.25 kg of a multinutrient block which ingredients was as follows (%): molasses (28), urea (5), coconut cake (15), fishmeal (5), rice bran (25), lime (8.5), salt (7.5), grit (5) and ultramineral (1). Cows were weighed and body condition scored (BCS) on a five-point scale at two week intervals and within 24 hour after calving.

Milk production of the suckling cows was assessed by the weigh-suckle-weigh technique and milk composition was analysed for protein, fat, lactose and total solids percentage at 2, 4, 8 and 12 weeks after calving. Calves' birth weight was determined within 24 hours after calving and weight development was followed by weekly weighings. The components of suckling behavior i.e. frequency of suckling, duration of suckling, and total minutes nursed, were observed six times in the course of a lactation at weekly intervals, commencing 1 week after calving.

The interval from calving to the initiation of each cow's normal luteal phase, was monitored by assessing plasma progesterone (P4) concentrations twice weekly. A progesterone concentration of >1 ng/ml was regarded as indicative of the presence of a corpus luteum on the ovary and, thus, an indicator of cyclic ovarian activity. The end of the anestrous period was defined as the 1st day on which plasma progesterone concentrations were greater than 1 ng/ml and was followed by concentrations of >3 ng/ml. The interval from calving to the first estrus exhibited, was monitored by intensive estrus observation twice a day and by monitoring of plasma progesterone. Conception rates were assessed by pregnancy diagnosis 45 to 60 days after insemination.

Cow's live weight and BCS are statistically analyzed using multivariate analysis of variance (manova) in general linear model (GLM) procedure of SAS (1988), while reproductive parameters were calculated by Student's t-test. Differences of weight and BCS, interval from calving to normal luteal phase, and from calving to first oestrus, weight of calves at birth and at 90 days of age, milk production and the three measures of milk composition are analysed by Duncan test. The characteristics of suckling behaviour are analysed with a model that include stage of lactation; the linear regression of suckling behaviour characteristics on milk production and the interaction of the stage of lactation and milk production level.

RESULTS

Live weight and BCS

Precalving live weight and BCS changes of cows grazing on natural pasture and cows supplemented with multinutrient blocks are presented in Table 1.

Further, cows' live weight and condition scores within 24 hour and at the end of the 16 weeks' period post-calving can be seen at Table 2.

Figure 1 shows the live weight changes in the pre- and post-calving periods of those two groups either grazing on natural pasture or supplemented with multinutrient blocks. The difference between those groups appeared at 8 weeks before calving ($P<0.05$), and continuously up to 16 weeks post-calving.

Figure 2 shows the condition score of Bali cows solely grazing on nature pasture and those supplemented with multinutrient blocks pre and post-calving period. The signifiant difference of BCS between two groups occurred at 6 weeks before calving ($P<0.01$) until the end of the study.

Table 1. Effect of pre-calving supplementation of multinutrient blocks on live weight and BCS of Bali cows before calving

Item	Supplemented		Non-supplemented		Total	
	Mean	SEM	Mean	SEM	Mean	SEM
Initial live weight gain (kg)	220.1	1.5	206.7	1.4	213.4	2.2
Final live weight (kg)	252.0	1.5	215.7	1.4	233.8	3.6
Live weight change (kg)	31.9[b]	0.9	9.0	1.2	20.5	2.8
Initial BCS	1.9	0.3	1.8	0.3	1.8	0.2
Final BCS	3.5[b]	0.3	2.7	0.3	3.1	0.5
BCS change	1.6[a]	0.2	0.9	0.0	1.3	0.5

a: Different from the non-supplemented group (P<0.05, Duncan-test)
b: Different from the non-supplemented group (P<0.01, Duncan-test)

Table 2. Effect of pre- and post-calving supplementation with multinutrient blocks on live weight (LW, kg) and BCS of suckling Bali cows grazing on natural pasture

Item	Supplemented		Non-supplemented		Total	
	Mean	SEM	Mean	SEM	Mean	SEM
LW within 24 hour after calving	230.7[b]	1.5	196.6	1.4	213.7	3.5
LW at 16 week after calving	260.9[b]	1.6	212.7	1.3	236.8	4.1
LW change	30.1[b]	1.1	16.1	0.8	23.1	2.2
Daily gain (g/d)	269.0[b]	3.2	143.9	2.4	210	6.9
BCS after calving (1-5)	3.1[b]	0.3	2.2	0.2	2.7	0.6
BCS at 16 week after calving	4.2[b]	0.2	3.1	0.2	3.7	0.6
BCS change	1.4[a]	0.3	0.9	0.0	1.2	0.4

a: Different from the non-supplemented group (P<0.05, Duncan-test)
b: Different from the non-supplemented group (P<0.01, Duncan-test)

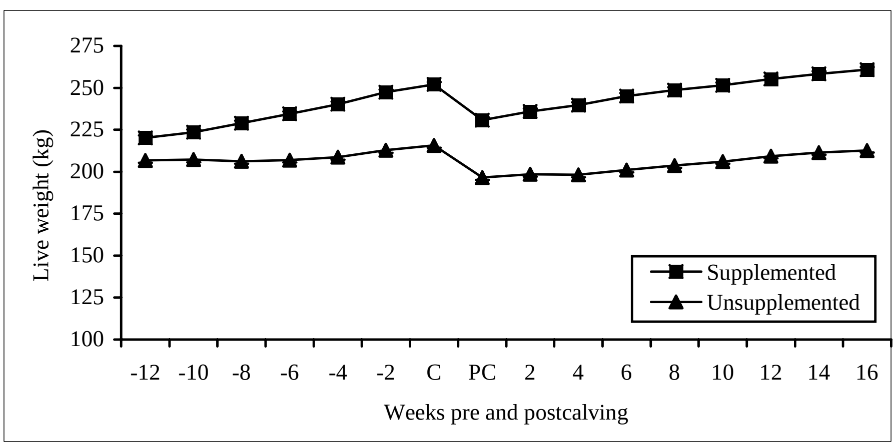

Figure 1. Pre and post-calving live weight of Bali cows grazing on natural pasture either supplemented by multinutrient blocks or not (C = before calving, PC = within 24 hour after calving)

Cows receiving multinutrient block supplement produced more milk (2.3 *vs* 1.5 kg/day, P<0.01) compared with cows in the non-supplemented group (Figure 3). There was an effect of week on lactation (P<0.01) for milk yield, while the interaction of week and treatment was not significant. Milk yield peaked in the fourth weeks of lactation and declined thereafter at a rate of approximately 0.1 kg/week for the supplemented group and 0.06 kg/week for the non-supplemented group.

Total solid and fat percentage in milk was affected (P<0.01) by multinutrient block supplementation, whereas the percentage of protein and lactose was not affected by multinutrient block.

Calf performance

Calf birth weight and postnatal development are presented in Figure 4.

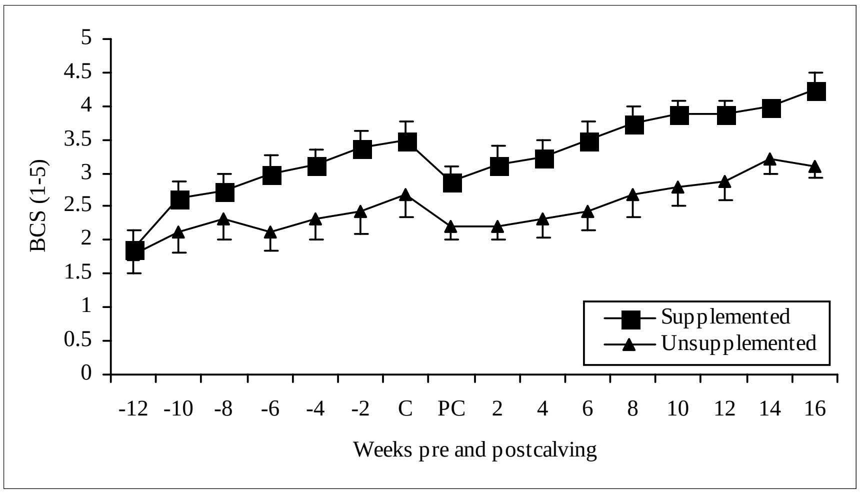

Figure 2. Pre and post-calving BCS of Bali cows grazing on natural pasture either supplemented by multinutrient blocks or not (C = before calving, PC = within 24 hour after calving)

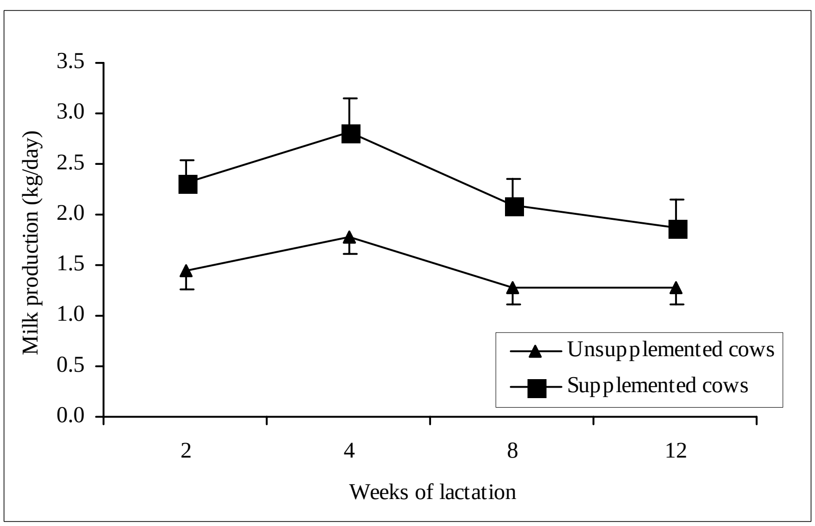

Figure 3. Effect of multinutrient blocks supplementation on milk yield of Bali cows grazing on natural pasture

A dietary supplement of multinutrient block during the 12 weeks of the pre-calving period in Bali cows grazing on natural pasture did not affect birth weight of the calves (14.1 *vs* 12.8 kg). There was a significant increase in the subsequent growth rate of the calves compared with the non-supplemented cows (311 *vs* 259 g/day, P<0.05). Calves from the supplemented group were heavier at 12 weeks (40.3 *vs* 34.7 kg, P<0.05) and had a higher weight change (26.1 *vs* 21.8 kg, P<0.05) than calves from non-supplemented cows (Figure 4). Calf weight at 9 weeks (when calves were almost entirely dependent on milk for nutrient intake) was different between the two groups (35.5 *vs* 31.5 kg; P<0.05).

Suckling behavior

The mean values for the characteristics of nursing during 6 successive weeks were affected by supplementation are presented in Table 3. Except for the total number of minutes nursed during weeks 2 and 3, averaged over all cows and treatments, frequency of nursing, duration of each nursing bout and total minutes nursed did not change as lactation progressed.

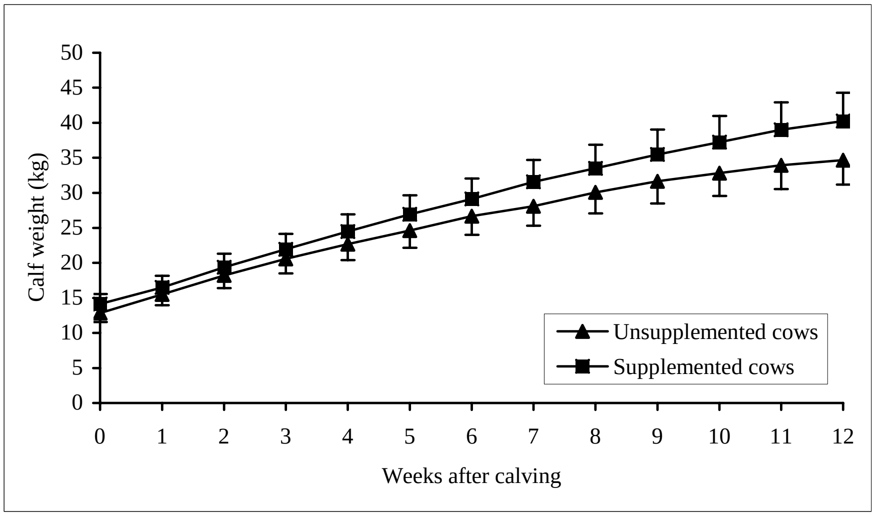

Figure 4. Calf weights (Means ± SEM) during the first 12 weeks of age from the dams grazing on natural pasture and additional multinutrient blocks

Table 3. Effect of multinutrient blocks supplement on suckling behavior of calves to Bali cows grazing on natural pasture throughout 6 weeks of lactation

Weeks of lactation	Nursings/day				Duration of nursing (minute)				Total min nursing/day			
	S		NS		S		NS		S		NS	
	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
1	6.6^b	0.6	9.6	0.6	11.3^b	0.5	5.9	0.4	67.0^b	1.8	2.2	
2	6.1^b	0.3	8.6	0.4	11.4^b	0.7	6.7	0.2	62.1	3.5	2.9	
3	5.9^b	0.2	8.2	0.5	11.4^b	0.6	6.4	0.2	59.3	2.0	2.8	
4	6.3^b	0.3	7.8	0.2	11.0^b	0.5	6.4	0.3	62.3^b	1.7	1.3	
5	6.6^b	0.3	8.7	0.3	10.7^b	0.8	6.1	0.2	66.2^b	2.4	56.5	1.6
6	5.9^b	0.2	0.3		11.0^b	0.6	0.4		62.6^b	2.9	1.8	
Average	6.2^b	0.3	8.6	0.4	11.1^b	0.6	6.4	0.3	63.2^b	2.3	56.4	2.1

b: Different from the non-supplemented group (P<0.01, t-test)

Reproductive performance

Reproductive parameters are presented in Table 4. The rate of uterine involution was not affected by treatment. Both cervical and uterine diameters had returned to normal by 4.4 weeks postpartum in supplemented and unsupplemented cows, respectively. The interval from calving to the first luteal phase was shorter in supplemented than non-supplemented cows (101.9 *vs* 112.8 days; P<0.05); in the supplemented group the average interval from parturition to the first estrus was 102.5 days and was significantly shorter (P<0.05) than in the non-supplemented group (112.2 days). The conception rate of cows in the supplemented group was 50.0% (4 of 8 cows) and 44.4% (4 of 9 cows) in non-supplemented cows and this was not affected by multinutrient block supplementation.

DISCUSSION

Pre-and post-partum live weight and BCS

This study was aimed at improving live weight and body condition of cows in late pregnancy towards the lactation period by feeding multinutrient block supplements to be used in cows grazing on natural pasture. Both increase in live weight and BCS from the initial condition 12 weeks before calving (Table 1 and Figure 1) were influenced by multinutrient block supplementation. Cows receiving additional multinutrient blocks gained 31.9 kg in live weight in late pregnancy while non-supplemented cows only gained 9.0 kg.

Weight changes during late pregnancy are distributed between dam and calf. It is suggested that the effect of supplementation on weight change of the dam was probably diminished by the partitioning of nutrients into fetal growth and an induction of the mammary gland for milk production. The difference in calving weight between cows fed additional multinutrient block and cows only grazing on natural pasture was probably the result of increased adipose tissue deposition in cows fed multinutrient block supplement, as indicated by the higher BCS. It was suggested that supplementation of late pregnant Bali cows with multinutrient block will improve live weight and body condition at calving, and performance of their calves by improving milk production. Both groups of cow lost 0.6 and 0.4 of BCS after calving attributable to subjective judgement. These lost of BCS immediately after calving might be in connection with relaxation of muscles and tendous associated with parturition.

In the post-calving period, good quality native grasses were available due to the beginning of rainy season. This situation was, therefore, conducive to good nutrition for both groups of cows. However, two cows of the non-supplemented group showed live weight loss during the first 2 to 4 weeks after calving. Since the remainder of the non-supplemented group did not lose weight, it is concluded that, on the average, the live weight of the cows within this group was not reduced. Moreover, the difference in live weight and BCS between the two groups during 16 weeks after calving (Table 2 and Figure 2) reflect the difference level of energy intake. These findings are in agreement to McSweeney *et al.* (1993), who supplemented *Bos indicus* heifers with cracked maize (1 kg) plus formaldehyde-treated sunflower seed meal (0.5 kg) pre and post-calving.

Changes in body weight not only include synthesis of body reserves but may also represent fluctuations in feed and water consumption, whereas BCS reflects the body tissue status, especially adipose tissue, and does not represent changes in the content of the alimentary tract (Moallem *et al.*, 2000). Moreover, West *et al.* (1990) reported significant changes in BCS but not in body weight in cows treated with increasing doses of bST and suggested that visual evaluation such as BCS may be a better indicator of nutritional status than body weight changes. This implies that BCS is a better indicator of energy balance status than body weight changes. However, BCS is not sensitive enough to evaluate the precise point of the beginning of tissue synthesis, and increases in BCS were measurable only some 30 days after the beginning of the period of positive energy balance. It is plausible that, later in lactation, when food and water intake and body water content are relatively stable, body weight changes represent changes in body tissues more accurately than in early lactation.

Table 4. Effect of multinutrient block supplementation on reproductive characteristics post-calving

Item	S		NS		Total	
	Mean	SEM	Mean	SEM	Mean	SEM
Uterine involution (week)	4.4	0.3	4.4	0.3	4.4	0.3
Interval from calving to luteal phase (day)	101.9a	1.0	112.8	1.0	107.3	1.0
Interval from calving to first estrus (day)	102.5a	1.1	112.2	1.0	107.3	1.0
Conception to first service (%)	50.0		44.4		47.2	

S = supplemented; NS = non-supplemented

a: Different from the non-supplemented group (P<0.05, t-test)

Milk production and composition

Milk production measured in control cows was well in agreement with other previous results of JELANTIK (2001) for the same breed. Supplemented cows were better able to express their potential for milk production, whereas for cows on low level energy intake, the availability of precursors for milk synthesis becomes limited (SINCLAIR *et al.*, 1994).

Milk production of cows in the experiment increased in the course of 4 weeks, then declined gradually up to 12 weeks. These findings suggest that milk yield in Bali cattle was high in the first 1 month of lactation and then declined (Figure 3). This was in agreement with observation of HUNTER and MAGNER (1988) in *Bos indicus* x *Bos taurus* heifers that milk yield was highest just after parturition and then declines.

The fat percentage of milk in the present study was higher in the supplemented cows. KNOWLTON *et al*. (1996) had observed similar result when diet with larger amounts of ruminally available carbohydrate were fed. The effect of dietary carbohydrate sources, and subsequently the VFA profile in the rumen on milk composition, supported the findings of LEES *et al.* (1990) that high fibre concentrates tended to be associated with higher milk fat concentrations and high starch concentrates with higher milk protein concentrations. In the present study, crude fibre intake was higher in cows receiving multinutrient block supplement.

The percentage of milk protein concentration was not affected by multinutrient block supplementation. It seemed that multinutrient block supplement containing 5% fish meal have higher proportion of lysine and methionine in its undegraded amino acids (O'MARA *et al.*, 1997). These two amino acids have often been cited RULQUIN *et al.* (1993) as the two amino acids first limiting milk protein synthesis in dairy cows. Moreover, WU *et al.* (1994) demonstrated that increased propionate availability for gluconeogenesis and a possible sparing of essential amino acids did not result in increased milk protein content.

Calf performance

In the present study, calf birth weight was not influenced by pre-calving multinutrient blocks supplementation (Figure 4). It indicates that the supplementary feeding was not enough to affect the foetal growth significantly. This result was in agreement with PAAT and WINUGROHO (1990), who supplemented 1 to 2 kg of rice brand to Bali cows under village conditions and found that calf birth weight was unaffected by the supplementation.

The average daily gains for calves at 12 weeks of age were affected by supplementation of the dam, were similar to other finding from studies of PANE (1990). The greater daily gain in the calves from the supplementation treatment in the present study suggests that the increased nutrient availability to the cow resulted in an increase in milk production. Calf growth rate was increased by supplementation of the dam, indicating a likely increase in availability of milk to the calf, since the dam's milk is the major source of nutrients for calf growth up to 180 days (RUTLEDGE *et al.*, 1971) under grazing conditions.

Suckling behavior

In the present study, the mean nursing frequency at different age of calves differed significantly for supplemented and non-supplemented cows. The nursing frequency of calves suckled by non-supplemented dams was close to those reported from WILLIAMS *et al.* (1984): calves suckle, on average, about eight times (8 to 10 min, per episode) during a 24 hour period if managed under confinement conditions. However, suckling frequency and duration recorded in this study were lower than those reported at comparable stages of lactation by other (JOLLY *et al.*, 1996). High milk production and high calf weight resulted in a decrease in suckling frequency. It appeared that high milk production increased the interval to the next nursing, provided the calf had the capacity to drink the quantity of milk available. As the weight of the calf increased, the capacity of the calf to drink milk increased, therefore, the number of suckling events decreased. In addition, as the weight of the calf increased, forage intake should have increased (PEISCHEL, 1980), and this may have also contributed to the decline in suckling incidence.

In general, the duration of each nursing bout did not change, but the total minutes nursed and (or) frequency of nursing declined as lactation progressed in the supplemented cows. Calves with lower milking dams suckled for fewer total minutes daily at a given stage of lactation whereas calves with higher milking dams did not. Level of estimated milk production by the dam and weight of calf were both significantly affected by the suckling behaviour of the calves. Calves suckling dams with lower levels of milk production suckled more frequently but for a shorter length of time at each nursing bout (Table 3).

In the present study, age of the calf (i.e. stage of lactation) was unrelated to suckling frequency, at least until 6 weeks of age. This was consistent with reports from earlier study (ODDE *et al.*, 1985). The delayed resumption of estrus activity of non-supplemented cows (102.1 *vs* 112.2 days; Table 4) may have been due to an increase in the suckling-induced inhibition of the pituitary ovarian axis in these animals (WILLIAMS, 1990). This may have arisen as a consequence of these animals' calves increasing their suckling frequency in other to compensate for the small volume of milk consumed per bout.

Reproductive performance

The rate of uterine involution was not affected by treatment which was in agreement with the findings of PERRY *et al.* (1991). Both cervical and uterine diameters had returned to normal by 4.4 ± 0.3 weeks postpartum in supplemented and non-supplemented cows respectively. The earliest possible time for uterine involution was about 3 weeks, but often the involution is not completed until 4-5 weeks postpartum KINDAHL *et al*., 1999).

The mean interval from calving to first estrus was shorter in the supplemented than in the non-supplemented group (102.5 vs 112.2 days), which agrees with the classic research of WILTBANK *et al.* (1962). Similar observation was reported by ECHTERNKAMP *et al*. (1982). Intervals to first estrus in the present study were longer than those described for suckled beef cows (WATTEMANN, 1980). Multinutrient block supplementation, by improving body condition, should reduce the length of lactational anestrus (LAMOND, 1969), which limits the reproductive capacity of beef cows grazing unimproved pasture in the tropics. The mean interval from calving to first luteal phase was also shorter in the supplemented than the non-supplemented group (101.9 vs 112.8 days). These findings were close to those stated by DUNN and KALTENBACH (1980) that postpartum intervals to estrus in beef cattle range from 15 to 100 days. The conception rate to first service did not differ for supplemented and non-supplemented cows (50.0 vs 44.4%). This might be an effect of the limited number of cows per group.

It was concluded that pre and postcalving supplementation with multinutrient blocks increased live weight, BCS, milk production of the cows and their calve performance, influenced suckling behavior of the calves and tended to reduce interval from calving to first estrus.

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