4. Effects of 12-hour calf withdrawal on conception rates and calf performance of *Bos indicus* beef cattle in extensive production systems

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Summary

This study was conducted to evaluate if restricted suckling at night from 45 days post-partum increases the conception rates of *Bos indicus* beef cows in extensive production systems in sub-tropical conditions and to quantify the related effects on calf-weaning weights. Fifty-two multiparous Brahman type cows with reproductive tract scoring (RTS) ≥ 4 at 45 days post-partum were randomly assigned to two groups of 26 cows each separated into an *ad libitum* suckling group or calf non-removal group (NRG) and treatment group or calf removal group (RG). Calves in the treatment group were separated for 12 hr during the night from 45 days post-partum to the onset of the breeding season. Satisfactory classified bulls were used at the ratio of 1:20 cows for a breeding season of 90 days.

BCS and BW of cows were recorded 45 days post-partum, at the start of the breeding season, and at pregnancy diagnosis that took place 60 days after the end of the breeding season. Pregnant cows were monitored throughout the gestation period. Calves were weighed at calving and weaning. Weaning weights were corrected to 205 days. BW and BCS at the onset of the breeding season was 395.8 ± 50 kg and 2.5 ± 0.3 for the RG and 410.5 ± 40 kg and 2.6 ± 0.3 for the NRG. Calving to breeding intervals were 93 ± 17.5 days for RG and 99 ± 22.1 days for NRG, respectively. Calving to conception intervals differed significantly between the experimental groups (110.9 ± 10 days for RG and 132.8 ± 19 days for NRG) and a similar result was obtained for the commencement of the breeding season to conception intervals (17.8 ± 15 days for RG and 31.1 ± 18.9 days for NRG). Conception rates were 80% for the RG and 59% for the NRG, which correlated better with BW than BCS at the

onset of the breeding season. Weaning weights differed significantly between control and treatment groups (149.3 ± 18 kg for RG and 134.5 ± 20 kg for NRG). From 45 days post-partum to the onset of the breeding season, cows in the RG experienced a positive energy balance (3%) while those in the NRG had a negative energy balance (-0.1%). It was concluded that 12-hr calf separation at night increases the conception rates and improves the calf-weaning weights of *Bos indicus* beef cattle in extensive production systems under sub-tropical conditions.

4.1 Introduction

Twelve-hour calf separation shortens the interval to first oestrus post-partum and increases the conception rate of *Bos taurus* beef cows in intensive production systems (Stewart *et al*., 1993b; Gazal *et al.*, 1999). There is, however, no information on 12-hr calf separation in *Bos indicus* cows in extensive production systems under sub-tropical conditions as well as the influence of calf separation on the weaning weights of calves. The present study was thus conducted to determine if restricted suckling at night from 45 days post-partum increases the conception rates in *Bos indicus* beef cows in extensive production systems and to quantify the related effects on calf weaning weights.

4.2 Materials and Methods

4.2.1 Study location

The experiment was carried out at the Inácio de Sousa extensive beef cattle farm located in Manhiça district, about 100 km to the north of Maputo city, in Mozambique. The climate at this location is sub-tropical humid, with an average temperature of 28˚C and average annual rainfall of 950 mm. About 80% of the

rainfall is concentrated during the rainy season that last for six months (October to March), with 50% of the rain distributed in December and January.

4.2.2 Experimental design

Fifty-two multiparous Brahman-type cows were randomly allotted from a group of post-partum cows that had all calved during the calving season (October to December), normal parturition, irrespective of the sex of their calves. The cows were randomly assigned to two groups of 26 cows each: treatment group (RG) and control group (NRG). Reproductive tract scoring (RTS) was performed at 45 days post-partum (calculated based on the actual calving dates) via rectal palpation using a 5-point cows reproductive tract scoring method as described by Schwalback *et al*. (2000). Only cows with a RTS of 4 or above were incorporated in the experiment.

Cows were maintained in the herd under the same management as the whole farm, taken to grazing areas between 7:00 hours and 17:00 hours, without supplementary feeding and calves from the treatment group were removed at 18:00 hours after the herd returned to the coral.

Separation of calves for a period of 12 hr (12-hr night-calf-separation; 18:00 hours to 6:00 hours) began 45 days post-partum until the beginning of the breeding season and then calves were allowed to suckle *ad libitum*. Calves from the control group remained with their dams for the entire period. Breeding soundness examinations were performed using the system of Hopkins and Spitzer (1997) and only satisfactory classified bulls were used at a ratio of 1:20 cows for a breeding season of 90 days (January to March).

The post-partum interval to the start of the breeding season (CBI) and the duration of treatment were calculated. Body weight was recorded using a standard scale for cattle (Richter scale Company® - Livestock &Animal Scale, Model CS-001 Series, Cattle Scale Weigh Beams) 45 days post-partum and at the onset of the breeding season and during pregnancy diagnosis along with the BCS determinations. BCS determinations were done using a 5-point Scottish scoring method (Wiltbank, 1991). The energy balance

of the cows (weight loss or weight gain) at the onset of the breeding season was calculated and expressed as a percentage. Pregnancy diagnosis took place 60 days after the end of the breeding season.

Pregnant cows were monitored to the end of the gestation period, and calving dates were recorded. Calving intervals (CI) were calculated and then used to calculate the calving to conception intervals (CCI) and breeding to conception intervals (BCI), as follows:

CCI = CI – 280 days

BCI = CCI – CBI

280 days is the mode gestation length for Brahman type cows used in the present study (Escrivão, 1998).

The weights of the calves were recorded at calving, within 48 hr of parturition and at weaning.

As calving dates differed marginally, but all calves were weaned on the same day, a correction factor was included to correct for these differences in weaning weights. Weaning weight was corrected to 205 days using the following formula:

$$C_{ww} = B_w + [(W_w – B_w) / W_a)* 205)]$$

Where:

C_{ww} – Corrected weaning weight

B_w – Birth weight

W_w – Weaning weight

W_a – Weaning age

4.2.3 Statistical analysis

Data was analysed using the analysis of variance (ANOVA) procedure in SPSS version 14.0 for Windows, by including the treatment group as fixed factor in the model and the variables BW, BCS, energy balance, pregnancy status, post-partum interval to breeding, birth weights, corrected weaning weight and the corresponding interactions. Pearson product moment correlation coefficients were calculated between variables as well as the significance levels. Differences between factors were assessed at a significance level of $p<0.05$ (95% accuracy). All results were expressed as least square means (LSmeans) ± standard deviation (SD) and multiple comparisons of means were done by means of the Bonferroni method in order to correct for unbalanced data, where the number of observations differed. Pregnancy status of treated and control cows was compared by Chi-square analyse (SPSS, 2005).

4.3 Results

Cows incorporated in the present study showed at 45 days post-partum the following reproductive tract characteristics: vulva and vagina were normal with moist pink mucosa, intra-pelvic location of the cervix, involuted uterus and approximately symmetric and thin wall without content, good tone and active ovaries with either follicle or corpus luteum.

Body weight and BCS of cows in the experimental groups were typical for Brahman-type cows in an extensive production system in Mozambique (Schwalback *et al*., 1997), taking into consideration the physiological status of the cows and season of the year.

From calving to breeding, the available forage increased in both quantity and quality as a result of the seasonal variation on forage production associated with the sub-tropical climate. Nevertheless cows in the control group experienced a negative energy balance, though the BCS were similar (Table 4.1).

Under the true extensive production conditions with minimal management on which the experiment took place the BW, BCS and energy balance of cows at the start of the breeding season and, birth weights of calves, corrected weaning weights, calving to breeding interval, breeding to conception interval and conception rates are summarised in Table 4.1, while correlations between variables are presented in Table 4.2.

Table 4.1 Effects of calf removal on live weight, BCS, energy balance, weaning weights of the calves and re-conceptions characteristics of *Bos indicus* beef cows in extensive productions systems (LS means ± SD)

	Group	
Trait	RG	NRG
Live weight at calving (kg)	384 ± 43	410.9 ± 32
Live weight (kg)*	395.8 ± 50	410.5 ± 40
Body condition score*	2.5 ± 0.3	2.6 ± 0.3
Energy balance (kg)*	11.8 ± 10[a] (3%)	–0.4 ± 12[b] (-0.1%)
Birth weigth (kg)	28.3 ± 0.9	28.5 ± 0.9
Corrected weaning weight (kg)	149.3 ± 18[a]	134.5 ± 20[b]
Calving to breeding interval (days)	93 ± 18	99 ± 22
Calving to conception interval (days)	111 ± 10[a]	133 ± 19[b]
Breeding to conception interval (days)	18 ± 15[a]	31 ± 17.3[b]
Conception rate (%)	80	59

* At the start of the breeding season

[a,b] Means with different superscripts in the same row differ significantly ($p < 0.05$)

Table 4.2 Pearson product moment correlations coefficients between BW, BCS and conceptions and re-conceptions data of *Bos indicus* beef cows under extensive conditions

Control Variables			*C_{ww}*	*CBI*	*BwOBS*	*BCSOBS*	*BWMBS*	*BCSMBS*	*BWPD*	*BCSPD*	*PD*
Group	C_{ww}	Correlation	1.000								
		Significance (2-tailed)	.								
		Df	0								
	CBI	Correlation	-.212	1.000							
		Significance (2-tailed)	.158	.							
		Df	44	0							
	BwOBS	Correlation	.046	-.062	1.000						
		Significance (2-tailed)	.761	.683	.						
		Df	44	44	0						
	BCSOBS	Correlation	.160	-.003	.254	1.000					
		Significance (2-tailed)	.289	.986	.088	.					
		Df	44	44	44	0					
	BWMBS	Correlation	.038	-.060	.957	.250	1.000				
		Significance (2-tailed)	.802	.693	.000	.093	.				
		Df	44	44	44	44	0				
	BCSMBS	Correlation	.074	-.173	.008	.477	.109	1.000			
		Significance (2-tailed)	.626	.251	.955	.001	.471	.			
		Df	44	44	44	44	44	0			
	BWPD	Correlation	.087	.012	.759	.292	.793	.166	1.000		
		Significance (2-tailed)	.567	.936	.000	.049	.000	.271	.		
		Df	44	44	44	44	44	44	0		

BCSPD	Correlation	-.035	.064	.153	.399	.244	.585	.484	1.000	
	Significance (2-tailed)	.817	.671	.311	.006	.102	.000	.001	.	
	Df	44	44	44	44	44	44	44	0	
PD	Correlation	-.086	.313	.356	.348	-.007	.241	.008	.419	1.000
	Significance (2-tailed)	.570	.034	.015	.018	.964	.107	.960	.004	.
	Df	44	44	44	44	44	44	44	44	0

Cww – Corrected weaning weight; CBI – calving to breeding interval; BWOBS – Body weight at the onset of breeding season; BCSOBS – Body condition score at the onset of the breeding season; BWMBS – Body weight at the mid of breeding season: BCSMBS – Body conditions score mid breeding season; BWPD – Body weight at pregnancy diagnosis; BCSPD – Body condition score at pregnancy diagnosis; PD – Pregnancy data. **In Bold - ($p<0.05$)**

4.4 Discussion

The present study was conducted on *Bos indicus* beef cattle with the 12 hr night-calf removal for 48 ± 18 days prior to the breeding season in extensive production system in sub-tropical region. Previous studies have been performed on *Bos taurus* beef cattle within weeks prior to the onset of the breeding season (Stewart *et al*., 1993b) and in crossbreed *Bos taurus x Bos indicus* beef cattle from 9 to 12 days post-partum to first luteal phase or 100 days post-partum in intensive production systems (Gazal *et al*., 1999).

The conception rates were 80% for the RG and 59% for the NRG. Although the conception rates did not differ ($p>0.05$) between groups, the numerical difference of almost 20% was considerable (Table 1). The observed numerical increase in conception rates for cows in the RG agrees with the results of Stewart *et al*. (1993b) but contrast with those from Gazal *et al*. (1999) who reported that 12-hr (night or day) calf separation did not affect the duration of post-partum anestrus. The agreement with Stewart's results is probable due to the fact that both experiments were performed in sub-tropical conditions and prior to breeding season, although the breed type differed significantly. In addition, results of the present study indicated that by performing a 12-hr calf withdrawal at night there is an increase on BW of cows with consequent positive energy balance (3%), which, if combined with the reduced teat stimulation frequency, triggered the hypothamuls-ovarian function (BCI of 18 ± 15 days). The *ad libitum* suckling group had a conception rate of about 59%, which concurs with the previous results of Escrivão (2005) (unpublished report) for extensive beef cattle in the south of Mozambique.

Like BW and BCS at the onset of the breeding season, CBI is an important predictor of pregnancy rate. In the present study, conception rates were affected ($p <0.05$) by CBI, which concurs with the findings in literature (Requist *et al.*, 2006), but the treatment effects were stronger because the conception rates were higher for cows in the RG and they had a shorter CBI. The BCI of cows in the RG was only 18 ± 15 days, which

represents a meaningful improvement in reproductive efficiency of extensive beef cattle, where the norm is in the order of 31 ± 17 days (NRG). This improvement is probably due to the fact that cows in the RG calved earlier in the calving season, weaned a heavier calf, and had enough time to recover for the following breeding season. These results agree with those of Stewart *et al*. (1993b) where 56.8% of the day-suckled cows showed estrus activity during the first 30 days of the breeding season, compared to 22% of the night-suckled cows.

In the current study, weaning weights increased ($p < 0.05$) with 12-hr calf removal at night contrary to the common belief. A number of reports in the literature suggest that temporarily calf removal does not affect the weaning weights of calves (Odde *et al*., 1986; Bell *et al*., 1998). The finding in the present study that 12-hr calf withdrawal has a positive effect on weaning weights of calves is probably because of the period of calf removal coinciding with the availability of good green pastures and calves making better use of it and compensatory growth seems to play a role.

The correlations observed between BCS, BW, energy balance at the start of the breeding season and conceptions rates demonstrated the importance of these variables in terms of reproduction. Results of the present study agree with those of other studies (Osoro and Wright, 1992; DeRouen *et al.,* 1994; Morrison *et al.,* 1999). Although animal scientists and veterinarians use BCS more often than BW in their routine work, this study indicated that BW when assessed in a consecutive manner is the most appropriate indicator of body energy reserves and re-breeding performance of *Bos indicus* beef cows in extensive production systems under sub-tropical conditions.

4.5 Conclusions

Twelve-hour calf removal at night for about 48 days prior to the breeding season increases the percentage of cows that exhibit estrus within the first 21 days of the breeding season, enhance conception rates and has a beneficial effect on calf weaning weights of *Bos indicus* beef cattle in extensive production systems.