Body condition score to predict the postpartum fertility of crossbred beef cows

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Abstract – The relationship between changes in body condition score (BCS) during the postpartum and fertility in beef cows suckling calves under extensive conditions were investigated. Cows were subjected to four BCS evaluations over the postpartum period, starting around one month after calving. In the second evaluation cows were treated with medroxy-progesterone acetate impregnated pessaries and received an injection of estradiol benzoate. At the third evaluation, pessaries were removed and calves were separated from the cows for 96 hours, during which time estrous was observed twice a day, and animals artificially inseminated 12 hours after detection. When calves returned to their dams, bulls were introduced until a 60-day mating period was reached. The distribution of BCS differed among calving groups and evaluations. Results indicated that only cows comprising a BCS 3 (1 to 5 scale) around the first month postpartum can be used in an artificial insemination program with possibilities of becoming pregnant. There was no statistical difference between the calving groups in pregnancy rate. The evolution of the BCS of the cows during postpartum can be used to adjust the start of the breeding season to coincide with the time of the year where herd pregnancy rates will be highest.

Index terms: *Bos taurus*, artificial insemination, breeding season, pregnancy rates.

Condição corporal na predição da fertilidade pós-parto de vacas de corte cruzadas

Resumo – A relação entre as modificações no escore de condição corporal (BCS) e a fertilidade de vacas de corte durante o pós-parto foi examinada em grupos organizados em função das datas dos partos. Foram efetuadas quatro avaliações com início em torno de um mês pós-parto. Na segunda avaliação, as vacas receberam pessários impregnados com acetato de medroxi-progesterona e uma injeção de benzoato de estradiol. Na sua remoção, foi efetuada a terceira avaliação e separação dos terneiros durante quatro dias. Durante esse período foi observado cio duas vezes ao dia, sendo as inseminações realizadas 12 horas após. Depois do retorno dos terneiros às vacas, foram introduzidos touros até completar 60 dias de estação reprodutiva. As distribuições dos BCS diferiram significativamente entre grupos de parição e momentos de avaliação. Os resultados indicaram que apenas vacas com BCS 3 (escala de 1 a 5) em torno do primeiro mês pós-parto podem ser incluídas em programas de inseminação artificial com possibilidade de ficarem prenhas. Não foi observada diferença estatisticamente significativa entre grupos de parição quanto a taxa de prenhez. A evolução do BCS durante o pós-parto pode ser empregada para ajustar a estação reprodutiva à melhor época do ano, visando maiores taxas de gestação.

Termos para indexação: *Bos taurus*, inseminação artificial, estação reprodutiva, taxa de prenhez.

Introduction

One of the main goals of beef cattle production system is to optimize annual fertility rate. To achieve this, the majority of the cows suckling calves should conceive before 90 days postpartum. In most of the extensive beef cattle systems in the state of Rio Grande do Sul, Brazil, breeding occurs during the spring and summer seasons (Mies Filho, 1987; Moraes, 1994) and is dependant on climatic conditions which regulate the growth of natural pastures.

In the same region the effect of the calving month, from September to November, was studied indicating a reduction in the interval between calving to conception for those cows that calved in November, however this advantage was invalidated by a lower frequency of estrous and conception rate (Pimentel & Pimentel, 1983). Under these conditions most cows are subjected to low nutritional levels during the latter half of gestation in winter, and are suckling their calves at the time when the breeding season begins. This results in low reproductive efficiency of the herds.

Pregnancy rate for suckling cows is around 25%, and for the whole herd around 50% (Cachapuz, 1997). Artificial insemination applied in these systems is mainly used in heifers. The use of a progestagen treatment associated to a 4-day calf removal makes the use of AI easier to carry out under extensive conditions in suckling cows (Jaume & Moraes, 2001). By means of this treatment calved cows can be artificially inseminated during a 4-day period when they are separated from their calves, which facilitates heat detection, and LH release is stimulated to complete follicular maturation and ovulation (Williams & Griffith, 1995; Canto et al., 1998).

The results of two previous experiments studying ovarian activity during the early postpartum period in cows calving during spring and autumn, in Rio Grande do Sul, showed that the reestablishment of reproductive activity coincides with the recovery of body condition of cows (Moraes et al., 2002). Body condition scoring is a subjective measurement used to classify animals by the amount of muscle and fat in their bodies. The estimate of the nutritional status of cows through the use of BCS is a practice described from the beginning of the past century (Phillips, 2001). It constitutes important data for decision taking, such as when to wean calves, as well as when to supplement cows in order to reduce the postpartum anoestrus period (Short et al., 1996; Ezanno, 2005). However, in the production systems described in this work, supplementary feeding of cows is not a common practice and animals depend solely on what the natural pastures provide. There is ample information on the effects of body condition on fertility, but there is a need to improve local systems for the effective use of body condition scoring to improve reproductive rates (Scaglia, 1997; Jaume & Moraes, 2001; Sampedro et al., 2003; Bastos et al., 2004; Grecellé et al., 2006). For these reasons it is important to study the evolution of BCS during the postpartum period and its relation to fertility in order to identify when breeding period should take place.

The objective of the present work was to assess how the BCS of beef cows varies during the postpartum period, its utility as an indicator of the time when breeding should begin, and as a predictor of postpartum cow fertility in extensive production systems in the South of Brazil.

Material and Methods

The BCS change during postpartum period was evaluated in 314 crossbred beef cows suckling calves under extensive conditions in Rio Grande do Sul. The breed of the herd were mainly composed by purebred Hereford, and crossbred cows (Hereford x Braford, Hereford x Brangus, Normand x Braford, Braford and Brangus) in different proportions mated with Braford bulls.

The age of the cows varies from three to eight years, and most of them are adult animals (75%). Animals were kept at a stocking rate of 0.5–0.7 animal units per ha on native pastures mainly composed of *Paspalum* sp. and *Axonopus* sp. on a private farm in the county of Bagé. The cows were distributed into three groups, according to calving dates. Group 1 included cows calving during the first three weeks of the calving season; group 2 included cows calving during weeks 4 to 6; and group 3 those calving during the final three weeks of the calving season. Animals were subjected to four body condition score evaluations, which were carried out on the dates presented in Table 1. For the sake of simplicity, the mean number of days postpartum was used to identify different body condition score evaluation stages, because within each calving group there is a variation of 21 days between the first and the last animal to calve in that group. Body condition score used was that of five classes (1, lean to 5, fat), used by the Rio Grande do Sul extension service (Cachapuz, 1997), carried out by visual assessment by the same technician.

The first BCS evaluation was carried out approximately one month after calving, when the cows should be close to their peak milk production, and their lowest in body condition score. At the second body condition score evaluation, cows were treated with a pessary impregnated with 250 mg of medroxy-

Table 1. Dates when the calving groups were formed and when body condition scores were taken on crossbred cows suckling calves in a private farm in South Brazil.

Calving group	Closing dates of the calving groups	First evaluation (33 days)[(1)]	Second evaluation (68 days)[(1)]	Third evaluation (75 days)[(1)]	Fourth evaluation (131 days)[(1)]	N. of cows
1	28/August	18/September	25/October	1/November	27/December	43
2	18/September	11/October	13/November	20/November	15/January	151
3	9/October	1/November	4/December	11/December	5/February	120

[(1)]Mean postpartum data in each calving group.

progesterone acetate, for seven days, and an i.m. injection of 5 mg estradiol benzoate at pessary insertion. By the time of the third evaluation, pessaries were removed and calves were separated from the cows for 96 hours. During this period, cows were observed for estrous behavior twice a day early in the morning (7:00–9:00) and late in the afternoon (17:00–19:00), and those detected in estrus were artificially inseminated 12 hours later. After the four-day period in which the cows were artificially inseminated, calves returned to their mothers and 3% of bulls that had been examined and diagnosed as reproductively sound were introduced with the cows to complete a 60-day breeding season with natural mating.

Considering the different dates between the calving groups, cows were subjected to pregnancy diagnosis by rectal examination between 119 and 142 days postpartum, when the last BCS was registered. The variables estrous behavior (yes or no) and pregnancy (yes or no) were quantified as percentages, considering parturition dates (calving groups) comprising the classes and dates of body condition scoring, and compared using chi-square analysis, and subjected to logistic regression analysis at each evaluation to identify the best predictors for estrous behavior and pregnancy rates (NCSS, 1995).

Results and Discussion

The importance of calving dates on the modification of the cow's BCS during the postpartum period can be observed in Figure 1, in which the distribution of BCS for each calving group is presented. The cows that calved in group 1 (up to the end of August) represent 14% of the population. Their pattern of BCS recovery was directly associated with the postpartum period. At 33 days postpartum, the majority of cows (>70%) presented a BCS of 2, whilst the rest were evenly distributed between BCS 1 and 3. By 68 days postpartum, no cows presented BCS 1, and the frequency of cows presenting BCS 3 had increased by 23%, to reach by day 75 postpartum a distribution of 60:40% of cows in BCS 2 and 3, respectively. In calving group 2, cows presenting BCS 1 could still be observed by day 75 postpartum, whilst most of the cows presented BCS 2 (75%), possibly due to the seasonal variation in pasture quality and quantity (Salomoni et al., 1988). By day 131, most cows were evenly distributed between BCS 2 and 3, and very few animals presented BCS 1 or 4. In calving group 3, the majority of cows were almost evenly distributed between BCS 2 and 3 at 33 days postpartum. The same pattern was observed by day 68 and 75 postpartum. By day 131, more than 60% of cows presented BCS 3 and some 30% of cows BCS 4. These data are in agreement with the decision of the local farmers to concentrate artificial insemination in the region from November to January, trying to adapt the calving period with the season of greater pasture availability (Moraes, 1994).

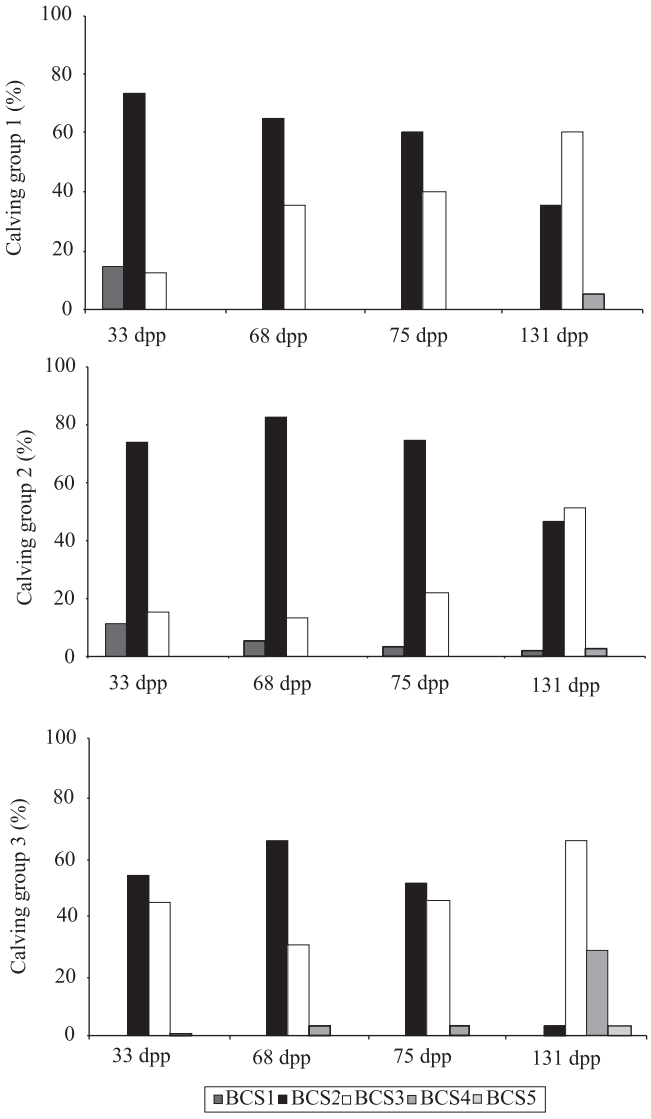

Figure 1. Distribution of body condition score (BCS) during postpartum period in each calving group expressed as days postpartum (dpp) in crossbred suckling cows at a private farm in South Brazil.

The number of cows in each BCS class is presented in Table 2. The overall frequency of cows with a BCS of 3 or greater at the first evaluation time was of 12, 15 and 46% of the cows in calving groups 1, 2 and 3, respectively. And, at the time when artificial insemination was carried out, the respective frequencies were 40, 22 and 49%.

Out of the 314 cows treated with a progestagen impregnated pessary, 86 (27%) were artificially inseminated during the four-day period, when calves were separated from the cows. Out of these, six (14%) were those of the cows calving in group 1, 27 (18%) of the cows calving in group 2, and 53 (44%) of the cows calving in group 3. This indicates different frequencies of estrous behaviour between calving groups ($\chi^2 = 27.440$; 2 DF; $p<0.001$). The result of the logistic regression analysis used to determine whether the calving date could be used to predict the artificial insemination rate after the procedures employed indicated that it was possible to predict a greater artificial insemination rate depending on the calving group ($y = -3.338 + 1.004x$; $\chi^2 = 24.960$; 1 DF; $p<0.001$; $R^2 = 0.07$), with odds ratio of being inseminated in relation to not being inseminated of 0.11, 0.27, and 0.67, respectively, for groups 1, 2 and 3.

Results indicate that the cows calving in the first two calving groups do so too early in the spring, with a high frequency of animals comprising poor BCS. Those in the third calving group had more time after the winter to recover their BCS before calving, allowing a greater number of them to manifest estrous behaviour during the artificial insemination period. Results indicate that the breeding season used in this herd starts too early in the year and should be delayed by approximately six weeks to improve the synchronization between seasonal pasture growth and cow nutritional needs.

The third BCS evaluation was carried out immediately before the artificial insemination period, overall 49% of the cows that presented BCS 3 or greater at this evaluation were artificially inseminated. These results are in agreement with others obtained with suckling cows calving during spring and subjected to the same treatment 60 to 81 days postpartum which allowed approximately 50% of cows in BCS 3 and 4 to be artificially inseminated with a fertility rate of around 70% that resulted in 35% of these cows being pregnant, using semen from progeny tested bulls (Jaume & Moraes, 2001).

Focusing on the prediction of the percentage of cows to be inseminated according to their BCS, in the first evaluation, cows in BCS 3 and 4 had a probability from one to four times greater of being artificially inseminated than cows in BCS 2 and 1 ($y = -4.237 + 1.425x$; $\chi^2 = 32.94$; 1 DF; $p<0.001$; $R^2 = 0.958$). However, at the rest of the evaluations (second to fourth), only cows in BCS 4 and 5 had a probability from one to five times greater of being artificially inseminated. This was probably due to the longer period postpartum that cows calving in group 1 had before breeding season end.

Out of the total treated cows subjected to artificial insemination and natural mating for a total service period of 60 days beginning on the first day of artificial insemination of group 1 99 (32%) were diagnosed as

Table 2. Total number of cows and the percentage of cows submitted to artificial insemination (AI) and the final percentage of pregnant (PRG) cows according to their body condition score (BCS) at the different evaluation times at a private farm on South Brazil.

Calving group	BCS	First evaluation			Second evaluation			Third evaluation			Fourth evaluation		
		AI (%)	PRG (%)	Cows (n.)	AI (%)	PRG (%)	Cows (n.)	AI (%)	PRG (%)	Cows (n.)	AI (%)	PRG (%)	Cows (n.)
1	1	0	0	6	-	-	0	-	-	0	-	-	0
	2	16	25	32	4	18	28	8	12	26	7	7	15
	3	20	40	5	33	33	15	24	41	17	19	31	26
	4	-	-	0	-	-	0	-	-	0	-	50	2
	5	-	-	0	-	-	0	-	-	0	-	-	0
2	1	0	12	17	0	14	7	0	20	5	0	100	1
	2	14	30	111	14	28	125	11	26	113	6	11	70
	3	52	61	23	47	68	19	45	58	33	27	48	77
	4	-	-	0	-	-	0	-	-	0	67	100	3
	5	-	-	0	-	-	0	-	-	0	-	-	0
3	1	-	-	0	-	-	0	-	-	0	-	-	0
	2	37	28	65	33	28	79	32	21	62	33	0	3
	3	52	39	54	68	41	37	56	45	55	38	24	79
	4	100	100	1	50	75	4	67	67	3	53	51	35
	5	-	-	0	-	-	0	-	-	0	100	100	3

pregnant, out of which 10 (23%) of the cows calving in group 1, 49 (32%) of the cows calving in group 2 and 40 (33%) of the cows calving in group 3. Pregnancy rate was similar between the calving groups ($\chi^2 = 1.879$; 2 DF; p = 0.392). The logistic regression analysis indicated that it is not possible to predict gestation rates as a function of the calving group (y = -1.230 + 0.211x; $\chi^2 = 1.41$; 1 DF; p = 0.236; $R^2 = 0.004$), with an odds ratio of being pregnant of 0.35, 0.44 and 0.56 for calving groups 1, 2 and 3, respectively.

The frequency of pregnant cows in each calving group according to the BCS they presented at each BCS evaluation time is also presented in Table 2. Pregnancy rate for the different BCS at the third BCS evaluation time, when breeding began, for all the calving groups was of 22, 49 and 67% for BCS 2, 3 and 4, respectively. Pregnancy rate of the cows that presented BCS 3 and 4 at the time of the third evaluation was 41, 58 and 47% for calving groups 1, 2 and 3, respectively. These results are similar to those that have been observed in other unpublished studies in the same region with data from more than 4,000 suckling cows in different reproductive protocols in which the pregnancy rate of cows in BCS 2, 3 and 4 at BCS evaluation 2 (60–81 days postpartum) was of 30, 56 and 70%, respectively, at the end of the breeding season.

Similar results were reported by Grecellé et al. (2006), observing that the BCS evaluation, before the mating period, was a significant factor to increase fertility in crossbred cows raised under feeding restriction, suggesting that adjustments in breeding season concerning their duration and when to begin are important.

Different combinations of BCS at the four evaluation times were also analysed. Out of the possible combinations, 36 were identified. Seven classes in the first BCS evaluation time began with BCS 1, with 23 animals (7% of the sample). Within this class (1), the most frequent combination was BCS 1, BCS 2, BCS 2, BCS 2 (subclass 1222), in the first, second, third and fourth evaluations, respectively. Fifteen classes were identified that began at the first evaluation with BCS 2 (Class 2), which included 208 (66%) cows. Thirteen classes began with cows in BCS 3 (Class 3) with 82 (26%) cows. The class beginning with BCS 4 (Class 4) had only one cow. Considering the first three classes, the artificial insemination rate was 0%, 22% and 49% for class 1, 2 and 3, respectively ($\chi^2 = 38.566$; 2 DF; p<0.001). These results emphasise the importance of the body condition of the cows at the first evaluation postpartum on the effectiveness of using these reproductive techniques. Cows with BCS 1 and 2 respond very poorly. Similarly the pregnancy rate was 9, 29 and 47%, for classes 1, 2 and 3, respectively ($\chi^2 = 16.031$; 2 DF; p<0.001).

In Table 3 some of the more frequent classes are presented. It is possible to highlight the importance of the nutritional level during the postpartum period, as evidenced by the effect of BCS on reproductive efficiency of suckling cows. The subclass 1222 represents animals that were in very poor condition during the first month postpartum, as a consequence of not being in a very good body condition at the end of autumn. Having lost some body weight during winter, and during the postpartum period, they managed to increase their muscular tissue, but the increase in body condition was not sufficient to enable the cows to manifest estrous behaviour before the end of the breeding season. This resulted in only 9% pregnancy rate. The subclasses 2233 and 2333 are very similar because of the short time interval between the second and third evaluations. These groups perform better because they are improving their body condition over time. Within class 3, subclasses 3223 and 3233 showed a lower artificial insemination rate than the subclasses 3333 and 3334 ($\chi^2 = 10.648$; 3 DF; P = 0.014), but presented similar pregnancy rates at the end of the breeding period ($\chi^2 = 0.903$; 3 DF; P = 0.824).

These results of BCS dynamics during the postpartum period probably were connected with the results observed by Pimentel & Pimentel (1983), concerning to month of calving, which reiterated the importance of postpartum ovulation resumption orchestrated by better feeding availability, resulting in BCS increment. On these grounds, it is important to consider that in short breeding

Table 3. More frequent body condition score (BCS) classes and their contribution to the complete sample in terms of artificial insemination rates and pregnancy rates at a private farm in South Brazil.

Classes of BCS	N. of cows (% of contribution)	Cows artificially inseminated per class (%)	Cows pregnant per class (%)
1222	11(4)	0	9
2222	58(18)	7	14
2223	87(28)	24	28
2233	19(6)	26	53
2333	15(5)	47	47
3223	13(4)	31	38
3233	12(4)	33	42
3333	21(7)	62	48
3334	17(5)	82	59

periods (around 60 days) the BCS scores compatible with good postpartum fertility (BCS>3) were achieved when breeding season ended.

Conclusions

1. Beef cattle breeders comprising low feeding levels in extensive systems should include body condition scoring in their management practices to monitor if the breeding season utilized in their herds is synchronized with the seasonal pasture growth curve.

2. When the objective is to use artificial insemination in cows suckling their calves, the cows should present a BCS of at least 3 at one-month postpartum, and with sufficient feed to allow them to increasing their body weight during the breeding period.

3. With suckling cows maintaining BCS 3 throughout the breeding period, the expected pregnancy rate should be around 50%.

4. To improve overall herd fertility, the breeding season in the herd studied should be delayed by six weeks to allow the cows to improve their BCS to make better use of pasture growth during the spring.

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