

Management and nutrition strategies to reduce the breeding season in beef cows

Estratégias de manejo e alimentação para reduzir o período de monta em vacas de corte

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SUMMARY

Effects of temporary calf removal and phosphorus supplementation on conception rate in a 60 or 120 day breeding season period was observed in several trials conducted over three years on Nelore cows. Experiment I involved 47 acyclic Nelore cows with suckling calves ranging in age from 55 to 70 days. Calves were temporarily removed from their dams for 48h at the beginning of the trial or stayed with the dams throughout the trial. The proportion of cows that cycled during the breeding season was 5 out of 25 (20%) in the control group and 15 out of 22 (68%) in the group whose calves had been removed ($p < 0.05$). In Experiment II, 66 acyclic Nelore cows, averaging 60 ± 0.57 ($x \pm SE$) days post-partum were allocated at random in three groups as follows: A, calves temporarily removed from their dams for 48h on the first day of the breeding season; B, similar to Group A, except that calves were removed for 72h and C, control group (no calf removal). The percentage of pregnant cows at the end of the breeding season was 54.6 in control cows compared with 50.0 in the 48h removal group and 63.6 in the 72h removal group. In Experiment III, 75 pregnant cows were selected in the final trimester of gestation. Cows were allocated at random in four groups: Group A, the cows received a free choice mineral mixture with 12% P during three months before and three months after the calving season, furthermore, calves were temporarily removed from their dams on first day of breeding season for a period of 96h; B, same as Group A, except that the calves were not removed; C, same as Group A, except that the mineral mixture had 8.8% P; and D: same as Group C, except no calf removal. More cows receiving 12% P were cycling ($p < 0.05$) at 30, 60 and 90 days into the breeding season. Under these trial conditions, restricted suckling for 48, 72 or 96h prior to the breeding season caused inconsistent results on pregnancy rates. However, the restricted suckling of cows with marginal range plasma phosphorus (< 4.0 mg/100 ml) enhanced ovarian function.

UNITERMS: Nelore cows; Restricting suckling; Mineral supplements; Conception rate.

INTRODUCTION

The cattle population of Brazil exceeds 145×10^6 (Cardelino; Castro²). Most of these animals are maintained under extensive management and graze native pastures without additional supplemental feeding, so that many show energy, protein and mineral deficiencies De Brum *et al.*⁴; Pott *et al.*¹⁹; Santiago *et al.*²². The current production efficiency is around 50-55% annual calf crop. If this could be increased to 70%, an additional 6 or 7 x 10^6 calves would be born each year.

Many beef cows in the São Paulo State and throughout the country are of the Nelore type; a breed that is adapted to survive in tropical climates, but features late maturity, short oestrous periods and long intervals of post-partum acyclicity Galina; Arthur⁹. Calving and weaning results collected over a prolonged period indicate, that this genotype is more productive than several other locally popular breeds Meirelles *et al.*¹³.

Beef calves running with their dams contribute to delayed post - partum ovarian activity and reduce the reproductive efficiency. A number of reviews emphasize the serious extent of this factor

affecting post-partum acyclicity in suckled cattle. The primary defect that exists in the postpartum cow is a low serum concentration of LH caused by a low-frequency pulsatile secretion pattern of LH and presumably GnRH Short *et al.*²⁴. Weaning the calf would be an obvious technique to hasten oestrus Carter *et al.*³; Oxenreider¹⁷. Restricting suckling during a 48, 72 or 96h period, in the second month postpartum has been reported to provide stimulation of ovarian activity Forrest *et al.*⁷. However, 72h calf removal does not always improve post - partum reproductive performance Bonavera *et al.*¹.

The targets of this study were: I) To observe the effects of temporary calf removal from acyclic cows on the onset of ovarian activity and subsequent conception rate; II) To observe the effects of pre and post-partum phosphorus (P) supplementation on the onset of ovarian activity and conception rate.

MATERIAL AND METHOD

This study was carried out during the period from November 1991 to March 1992 at a private 600 ha ranch located in São Pedro, São Paulo State, Brazil, at lat.: 22.32 S, long.:

47.55 W, altitude of 870 m. Sequential plasma progesterone profiles, compiled during ten weeks immediately after parturition, were used to select 113 acyclic Nellore cows with suckling calves ranging from 55 to 70 days of age. Ovarian activity was monitored by determining plasma progesterone concentration in blood samples collected twice per week using FAO/IAEA solid phase radioimmunoassay kit Plaizier¹⁸. Cows were considered acyclic if plasma progesterone values of consecutive sampling was below 1 ng/ml for 10 days interval McLeod; Williams¹². Blood sampling continued throughout the breeding season. Pregnancy diagnosis was confirmed by rectal palpation 60 days after the end of the breeding period. Cows in both groups were exposed continuously over a 60 day period to bulls (1/15 cows), previously evaluated for breeding soundness. Animals grazed an 80 ha grass pasture (*Brachiaria decumbens*) with continuous access to water and mineral supplement in feeders without rain protection. Animals were evaluated over 4 months for live weight change, plasma inorganic phosphorus (P) Fiske; Subbarow⁵ total plasma protein Gornal *et al.*¹⁰ and glucose Miller¹⁴ analyses. Dams were weighted and body conditions were scored (scale 1 to 5) at monthly intervals during the study.

Continuous data was analyzed by analysis of variance and multivariate analysis of variance. Chi square analysis was used to evaluate the conception rate Freund *et al.*⁸.

Trial I

Forty seven acyclic Nellore cows were divide into two groups:

T – Treated group (n = 22). Calves were temporarily removed from their dams for 48h at the beginning of the trial;

C – Control group (n = 25). Calves stayed with the dams throughout the experiment.

Cows in both groups were exposed continuously over 60 day period to bulls (1/15 cows), previously evaluated for breeding soundness. Animals were evaluated over 4 months for live weight change, plasma inorganic phosphorus and glucose. Pregnancy diagnosis was confirmed by rectal palpation 60 days after the end of the breeding period.

Trial II

Sixty acyclic Nellore cows, averaging 60 ± 0.57 days post-partum., were selected. Only cows with critical plasma phosphorus concentrations (<4.0 mg/100 ml %) were included in this trial.

The cows were allocated at random in three groups as follow:

A – Calves temporarily removed from their dams for 48h on the first day of the breeding season (n = 22);

B – Similar to Group A, except that the calves were removed for 72h (n = 22);

C – Control Group, no calf removal (n = 22).

The three groups were maintained on the same grass pasture (*Brachiaria humidicula*) separated by fences. Glucose, and P were determined on days 60, 90, 120 and 150 post-partum. Live weights (BW) were measured in the same days of blood sampling collection.

Trial III

In this experiment 75 pregnant cows were selected in their final trimester of gestation. Cows were allocated at random in four groups.

A – Cows (n = 19) received a free choice mineral mixture with 12% P during three months before and three months after the calving season. Calves were temporarily removed from their dams on the first day of the breeding season for a period of 96h;

B – Like Group A (n = 20), except that the calves were not removed;

C – Like Group A (n = 17), except that the mineral mixture had 8.8% P;

D – Like Group C (n = 19), except that there was no calf removal.

Cows in all treatments were bled two consecutive weeks before and after the breeding season (4 months) to determine plasma progesterone concentration. Blood samples were collected monthly for glucose, P and total plasma protein analyses.

Chemical composition of mineral salt and dry matter rumen degradability pasture and crude protein content of pasture were evaluated at the beginning and end of the breeding season. Dams were weighed and body conditions were scored (scale 1 to 5) at monthly intervals during the study.

RESULTS AND DISCUSSION

Trial I

Mean dry matter, mineral matter, crude protein (CP) and P content of the pasture during the breeding season were: $33.26 \pm 0.52\%$, $7.47 \pm 0.27\%$, $6.04 \pm 0.99\%$, $0.12 \pm 0.03\%$, respectively. CP and P content declined about 50% and degradability went down about 10 units suggesting that the pasture quality decreased as the trial progressed.

A cow with a 450 kg BW requires 18 g P/day. In this study P level in the pasture was about 0.12%, which represents only 67% of P requirement. Considering an intake of 10 kg DM/day, the animal would be supplied with only 12 g P/day. Since the mineral P content was only 8%, it is unlikely that any of the cows would consume sufficient to satisfy their requirements. This is a common situation in many areas of Brazil, where producers often fail to provide an adequate mineral supplement De Brum *et al.*⁴; Pott *et al.*¹⁹. P concentration in plasma of both groups was 3.82 mg/100 ml in December at the beginning of the observation period, but the calf removal group showed higher mean values at the end (3.99 ± 0.2 vs. 3.11 ± 0.2 mg/100 ml, $p < 0.05$ (Tab. 1). However, values in both groups were in the marginal range Thompson Jr.²⁶. This may be reflecting the low P content in the pasture during the last two months. In cattle grazing low quality forage, supplementation with P did not improve reproductive performance or weight gains Nierkerk; Jacobs¹⁶; Sasser *et al.*²³; Teleni *et al.*²⁵ unless cattle received sufficient protein Holroyd *et al.*¹¹. However, in a borderline P deficient area in Australia, P supplementation improved reproductive performance NRC¹⁵.

Data for blood glucose did not show significant difference between the treatments, however, the concentration was low in both groups at 60 days breeding season (5.88 ± 1.1 mg/100 ml) but

Table 1

Least square means and standard error for inorganic phosphorus (100 mg/ml) and glucose (100 mg/ml) in plasma of cows (n = 22 per group) with calves removed or not for 48 hours at the beginning of the trials I and II. Piracicaba, 1994.

Group	Inorganic phosphorus		Glucose			
	Initial	Final	Days post-partum			
			60	90	120	150
Control	3.82 ± 0.21	3.11 ± 0.21	59.0 ± 1.1	100.0 ± 3.4	100.2 ± 2.5	105.6 ± 7.0 ^a
Treated	3.82 ± 0.25	3.99 ± 0.19 ^b	58.8 ± 1.1	93.98 ± 3.6	94.3 ± 2.7	99.9 ± 7.4

^{a,b} Different superscripts within a column mean statistical differences in Tukey's Test (p<0.05).

increased to 105.6 ± 7.0 mg/100 ml during the next three months (Tab. 1). The absence of feed supplementation probably increased the period of negative energy balance as revealed by the glucose profile. However, live weight changes during the 4 months breeding period were 11.6 and 10.0 kg for the control and the treated group, respectively.

The proportion of cows that cycled during the breeding season was 5 out of 25 (20%) in the control and 15 out of 22 (68%) in the treated groups (X² = 11.1, p<0.001). True pregnancy rate was 20% in control and 55% in calf removal groups (X² = 4.66, p<0.05). Calf removal substantially increased the reproductive performance in this trial, but results must be interpreted cautiously, because the number of cows per treatment was small.

Trial II

Body weight and condition changed somewhat during the observation period. However, analysis of variance using square root transformation of BW and BCS showed differences between 90 and 60 days as well as between 150 and 120 days, and this indicated that the results were not different (p>0.05).

In this trial, calf removal for 48 or 72h did not improve the post-partum reproductive performance. The percentage of

pregnant cows at the end of the breeding season was 54.6 in the control cows compared to 50.0 in the 48h removal group and 63.6 in the 72h removal group. The relatively small number of cows per treatment group may have prevented the demonstration that the pregnancy rate recorded after 72h was actually higher than the control value.

Trial III

The chemical composition and digestibility of pasture presented in Tab. 2 show that P was low and degradability declined throughout the experimental period. A treatment effect on BCS was observed between groups supplemented with mineral containing 12.0 or 8.8% P (Tab. 3), but the metabolic profile

Table 2

Rumen degradability, dry matter (60°C) and phosphorus content of the pasture (x ± se). trial III. Piracicaba, 1994.

Period of collection	Dry matter (%)	Phosphorus (%)	Ruminal degradability (%)
Before calving	32.71 ± 7.55	0.1 ± 0.1	43.1 ± 3.7
After calving	33.81 ± 2.82	0.1 ± 0.1	32.9 ± 3.0

Table 3

Least square means and standard error for plasma protein, plasma p and body condition score (bcs) at the end of the breeding season and body weights (bw) on days 0 and 120 of the breeding season. Acyclic and cyclic cows percentage at 30 days of the breeding season and actual pregnancy rate. trial III. Piracicaba, 1994.

Parameter	Treatment			
	Calf removal 12%P	No calf removal 12%P	Calf removal 8.8%P	No calf removal 8.8%P
Plasma protein (g/100ml)	7.55 ± 0.27	7.27 ± 0.23	7.65 ± 0.27	7.41 ± 0.29
Plasma P (mg/100ml)	5.13 ± 0.14	5.04 ± 0.20	4.64 ± 0.23	4.94 ± 0.16
BCS (1 to 5)	2.73 ± 0.05 ^a	2.73 ± 0.05 ^a	2.68 ± 0.05 ^{ab}	2.57 ± 0.05 ^b
BW at day 0 (kg)	376.5 ± 12.3	387.5 ± 12.7	380.6 ± 15.3	361.2 ± 10.7
BW at day 120 (kg)	377.9 ± 10.7	379.3 ± 9.8	374.5 ± 12.6	368.1 ± 8.5
Acyclic cows 1	42	50	76	79
	(n = 8)	(n = 10)	(n = 13)	(n = 15)
Cyclic cows 1	58	50	24	21
	(n = 11)	(n = 10)	(n = 4)	(n = 4)
Actual pregnancy rate 2	84	70	59	79
	(n = 16)	(n = 14)	(n = 10)	(n = 15)

^{a,b} Least square means in the same row with different superscripts, p = 0.0017; X² = 8.173, p = 0.046; X² = 2.592; p = 0.4589.

was not affected and plasma inorganic P in all groups was within the normal range Thompson²⁶. Although there was no significant difference in plasma P values detected in this trial, animals with more P in their diets showed a trend toward higher plasma concentrations. In non-lactating, feed-restricted beef cows, oestrus cycles ceased when body condition fell below 3.5 on a 1 to 9 assessment scale Richards *et al.*²¹. In other trials similar severe reduction in BW in cattle causes quiescent ovaries and cessation of oestrus cycles Fordyce *et al.*⁶.

Significant differences were detected between Groups A, B, C and D for the percentage of cows cycling by 30, 60 and 90 days in the breeding season and between groups that received mineral mixture containing 8.8% or 12.0% P. There were no differences in pregnancy rate among the Groups A, B, C, and D after the 120th day of the breeding season (Tab. 3). It was observed that with a higher level of P in the mineral mixture there is a tendency to increase the pregnancy rate and plasma P values, showing the importance of this element Read *et al.*²⁰.

CONCLUSIONS

Under the conditions in these trials, restricted suckling for 48.72 or 96h prior to the breeding season caused inconsistent results on pregnancy rates. However, the restricted suckling of cows with marginal range plasma phosphorus (<4.0 mg/100ml) enhanced ovarian function.

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RESUMO

Estudou-se o efeito da desmama temporária e a suplementação de fósforo sobre a taxa de concepção aos 60 e 120 dias da estação de monta. A avaliação foi feita mediante diversos ensaios levados a cabo durante três anos utilizando vacas Nelore. O Experimento I incluiu 47 vacas Nelore acíclicas com bezerro ao pé e com idades que flutuavam entre 55 e 70 dias. Um grupo de bezerros foi separado de suas mães por 48h no início do experimento e outro permaneceu com suas mães durante todo o período experimental. A proporção de vacas que ciclaram durante a estação de monta foi de 5 sobre 25 vacas (20%) no grupo controle e de 15 sobre 22 (68%) no grupo em que o bezerro foi separado ($p<0,05$). No Experimento II, 66 vacas Nelore acíclicas com média de $60 \pm 0,57$ dias ($x \pm EP$) pós-parto foram distribuídas ao acaso nos três grupos seguintes: Grupo A, bezerros separados de suas mães por 48 h no primeiro dia da estação de monta; Grupo B, similar ao grupo A, mas os bezerros foram separados por 72h; e Grupo C, grupo controle (o bezerro não foi separado). As porcentagens de vacas gestantes no final da estação de monta foram de 54,6 no grupo controle, de 50,0 no grupo de 48h de separação e de 63,6 no grupo de 72h de separação. No Experimento II, 75 vacas gestantes foram selecionadas no terço final da gestação. As vacas foram distribuídas ao acaso em quatro grupos: Grupo A, as vacas receberam uma mistura de sal mineral *ad libitum* contendo 12,0% P durante os três meses posteriores à estação de monta, e os bezerros foram separados de suas mães no primeiro dia de monta por um período de 96h; Grupo B, similar ao grupo C, mas os bezerros não foram separados; Grupo C, similar ao Grupo A, mas a mistura mineral continha 8,8% P; e Grupo D, similar ao grupo C, mas os bezerros não foram separados. Um maior número de vacas que receberam 12% P estiveram ciclando aos 30, 60 e 90 dias ($p<0,05$) do início da estação de monta. Sob as condições destes ensaios, a amamentação restringida por 48, 72 ou 96h no início da estação de monta deu resultados inconsistentes na taxa de gestação. Sem dúvida, a amamentação restringida em vacas com níveis marginais de fósforo plasmático (<4,0 mg/100 ml) melhorou a atividade ovárica.

UNITERMOS: Gado Nelore; Amamentação restringida; Suplementos minerais; Taxa de concepção.

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