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STUDIES ON POST-PARTUM ANOESTRUS IN ALENTEJANO BEEF COWS *

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Abstract

STUDIES ON POST-PARTUM ANOESTRUS IN ALENTEJANO BEEF COWS.

Post-partum ovarian activity in Alentejano beef cows maintained on natural pastures was monitored by measuring plasma progesterone levels using the radioimmunoassay method. Post-partum anoestrus was compared in cows calving in two different seasons (winter and summer). Differences between primiparous and multiparous cows, the effect of short term nursing interruption (72 hours by the 20th day post-partum) and the dam's body weight at calving (BWC) were also considered with respect to their influence on the onset of post-partum ovarian activity. Fertility after two breeding seasons of natural mating (April-May and November-December) was also studied. Post-partum anoestrus was significantly longer in winter calving cows than in those calving in summer, in both multiparous and primiparous cows (73.9 versus 33.1 and 111.1 versus 35.6 days, respectively; $P < 0.001$). Primiparous cows took a significantly longer period to resume cyclicity alter calving than multiparous cows, during the winter season ($P < 0.001$). BWC was significantly lower during the winter season, in both multiparous and primiparous cows (565.8 versus 642.8 and 435.8 versus 577.0 kg, respectively; $P < 0.001$). Short term calf removal accounted for a shorter post-partum anoestrus only during the summer season (30.01 versus 39 days; $P < 0.05$). BWC and the interval between calving and 21 June (C - 21J) were significantly correlated with the duration of the post-partum anoestrus ($y = 162.17 - 0.222.(BWC) + 0.316.(C - 21J)$; $r2 = 0.41$; $P < 0.03$). Because of a longer post-partum anoestrus, fertility was reduced in cows calving during the winter season compared with those calving in summer in all three years of the study (63.9 versus 76.9%, 57.8 versus 62.9% and 36.5 versus 60.6%, for 1984, 1985 and 1986, respectively). The results presented show that the winter period in Portugal impairs the return to ovarian activity post-partum in this breed. The seasonal effect seems to be associated with a decrease in food supply during winter. Temporary calf removal stimulates the onset of ovarian function only during the summer season. Primiparous cows, during the winter season, need a significantly longer time to resume cyclicity after calving than multiparous cows.

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1. INTRODUCTION

The effects of seasonality on the reproduction of domestic breeds of cattle have been reported previously [1]; it was shown that calving intervals are longer in winter calving cows than in those calving in summer. Suckling, milk yield, uterine involution, nutrition and some factors related to season (photoperiod) are generally accepted components influencing the onset of ovarian activity in the post-partum cow, either directly or indirectly [2, 3].

It has been shown that post-partum ovarian activity in both dairy and beef cattle is resumed later in suckling than in milking cows [4-6]. Although longer acyclic periods have been observed in cows selected for high milk yield compared with control animals [7, 8], Boyd [9] pointed out that it is difficult to separate the effects of milk yield from other factors, particularly nutritional status.

Peters [2] stated that inadequate nutritional status may be a cause of the detrimental effects on reproduction in high yielding dairy cows. In beef cows, too, nutritional status around the time of parturition is an important determinant of the post-partum acyclic period, whilst post-partum body weight changes do not appear to influence anoestrus duration [10].

Although short day length and low nutritional status interact in delaying the return of ovarian function post-partum [10, 11], winter calving influences the resumption of ovarian cycles even when a constant high plane of nutrition is provided [12].

On the basis of twice-weekly progesterone determinations during one year in 16 Alentejano beef cows, it was sho,vn that ovarian activity was not continuous throughout the year [13], periods of acydicity being longer during the January-May period. A negative correlation between daily photoperiod during late pregnancy and the onset of ovarian cycles post-partum has previously been reported [14].

The Alentejano, numbering about 20 000 animals in all, is a beef breed living in the central southern regions of Portugal in large herds on natural pastures. In Spain, the same breed is called Retinta and totals about 137 000 animals. In herds devoted to reproducing pure-bred and/or F_1 cross-bred animals for meat production, females are bred throughout the year, but the main breeding season is usually between October and March. Climatic conditions are similar to those found in the Mediterranean areas (Fig. 1), with a marked difference between mean maximum and minimum temperatures (31 and 15°C and 13 and 6°C, respectively) in summer and winter.

In this paper, results are presented from studies on the effects of season, parity, nursing and body weight at parturition on the length of post-partum anoestrus in the Alentejano beef cow, and their consequences for fertility [15-17].

2. MATERIALS AND METHODS

A total of 290 calvings of Alentejano beef cows were surveyed for studying the onset of post-partum ovarian activity over a three year period. The animals were maintained on lowland natural pasture. Two seasons of calving were considered (January-March and August-October); natural service was practised in April-May and October-November. Bulls were equipped with coloured markers (Sire Sine crayons) in order to identify the date of service by twice-daily observation of marked cows. Calves were weaned at the end of the subsequent mating season. In one of the years of this study, 111 cows were weighed during the week after parturition.

The influence of temporary calf removal on the onset of post-partum ovarian activity was tested in one of the years of this study by separating the calves from their mothers for 72 h, 20-30 days post-partum.

The onset of post-partum ovarian activity was detected by measuring plasma progesterone levels once weekly between parturition and the resumption of normal cyclic activity. Ovarian cycles were considered to start when progesterone had risen to 0.5 ng/mL and was sustained thereafter. Progesterone analyses were made by radioimmunoassay using a method described previously [13].

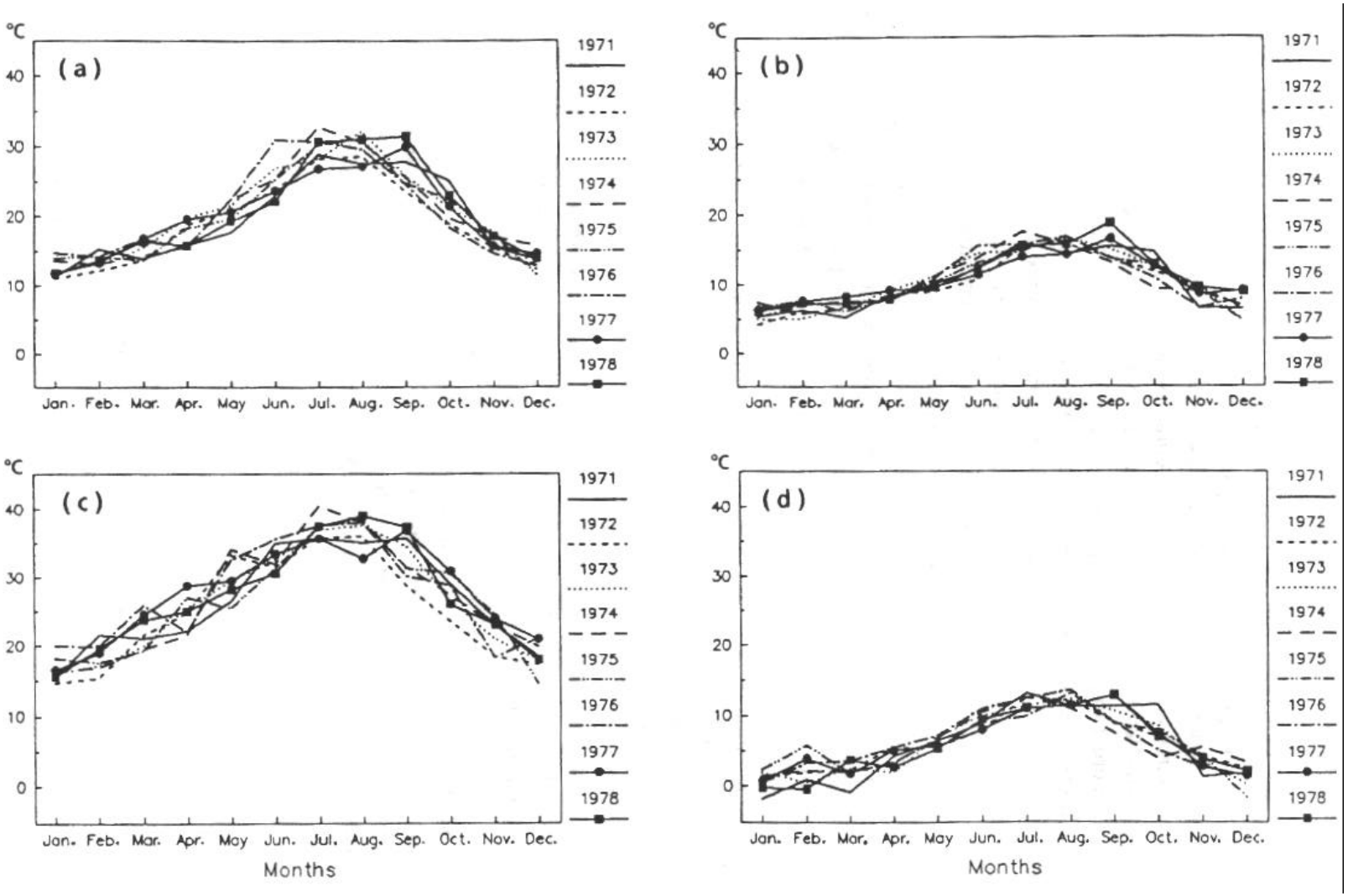
The duration of post-partum acyclicity in multiparous and primiparous cows and with respect to season of calving was investigated. Pregnancy diagnosis was done by measuring progesterone concentrations 20-24 days after service and by rectal palpation 45-65 days post-service. Fertility was calculated using the formula: (calved cows/cows to be mated) x 100.

Differences in the frequency ofpost-partum acyclicity between cow groups and body weight at parturition were computed by analysis of variance and least significant differences. Interaction of season with parity was checked by a multifactorial analysis of variance (Statgraphics 2.0 computer program).

Relationships between the body weight of dams at calving and the interval between calving and the longest day of the year with the duration of post-partum anoestrus were computed by their determination coefficient, and a multiple regression equation was calculated using the stepwise method (Statgraphics 2.0 computer program).

3. RESULTS

The resumption of post-partum ovarian activity occurred significantly earlier in summer calving cows than in those which calved in the winter (33.1 ± 16.4 versus 73.9 ± 36.4 days for multiparous cows and 35.6 ± 19.7 versus 111.1 ± 39.0 days for primiparous cows, respectively; $P < 0.001$, Table I). During the winter season, primiparous cows took a significantly longer period to resume their ovarian activity than multiparous cows ($P < 0.001$).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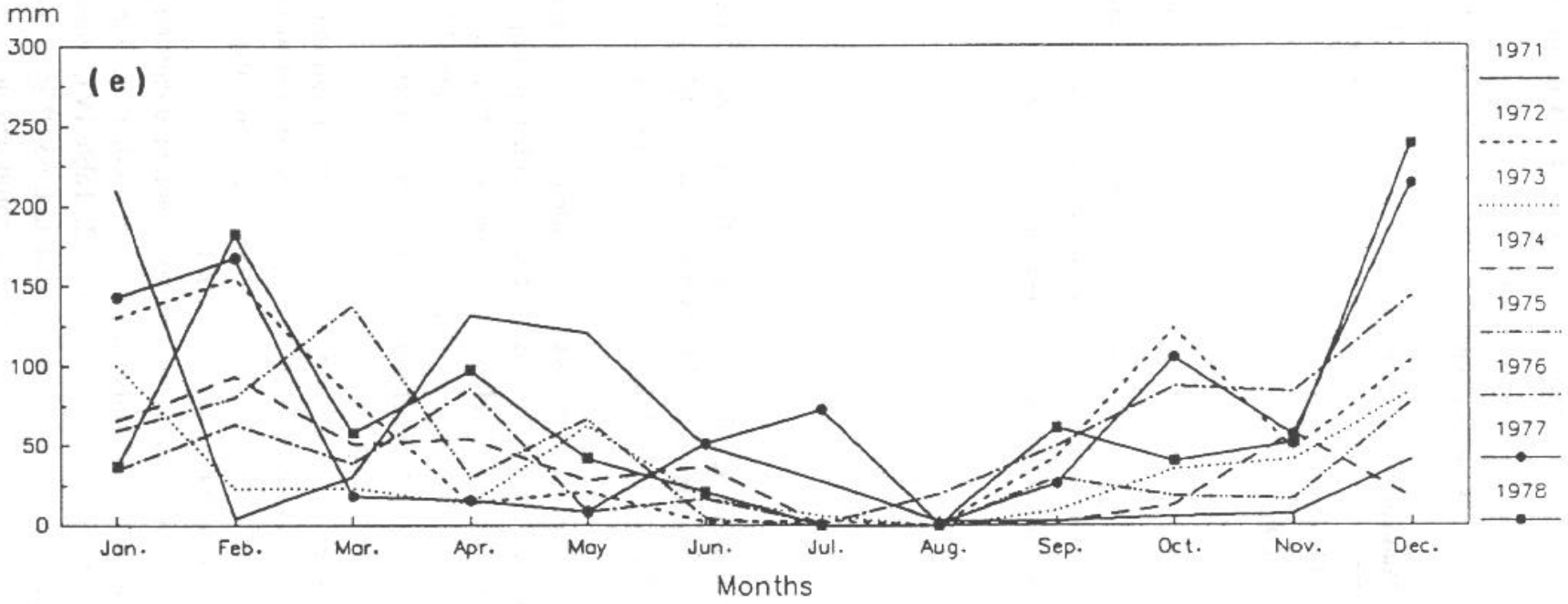

FIG. 1. Climatic data of a representative area in Alentejo Province (1971–1978). (a) Mean maximum temperature; (b) mean minimum temperature; (c) maximum temperature; (d) minimum temperature; (e) total precipitation.

TABLE I. POST-PARTUM ANOESTRUS DURING TWO CALVING SEASONS IN MULTIPAROUS AND PRIMIPAROUS ALENTEJANO BEEF COWS

	Winter calving		Summer calving	
	Multiparous	Primiparous	Multiparous	Primiparous
n	142	45	75	28
Mean (d)	73.9 [a]	111.1 [b]	33.l [c]	35.6 [c]
SD	36.4	39.0	16.4	19.7
variation (%)	49.3	31.1	49.7	55.3
Confidence limits (d)	70.2-77.8	103.2-119.0	30.5-35.6	30.8-40.4

Note: Means with the same superscripts are not significantly different (P > 0.05).

The body weight of dams at calving was significantly lower in winter than in summer (565.8 ± 66.0 versus 642.8 ± 65.3 kg for multiparous cows and 435.8 ± 41.5 versus 577.0 ± 59.0 kg for primiparous cows, respectively; P < 0.001, Table II).

During the winter season, there was no evident effect of temporary calf removal on the duration of post-partum anoestrus in either primiparous or multiparous cows (P > 0.05, Table III). However, separation of the calf from its dam for 72 hours during the summer season in multiparous cows resulted in a significant reduction in the duration of post-partum anoestrus (30.1 ± 11.4 versus 39.0 ± 21.7 days; P < 0.05, Table III).

There was a significant variation between years in the duration of post-partum anoestrus in multiparous cows, especially during the winter season (53.9 ± 28.8, 92.5 ± 38.5 and 62.8 ± 23.8 days for 1984, 1985 and 1986, respectively, all the averages being statistically different at P < 0.001).

A negative correlation was found between body weight at calving and the duration of post-partum anoestrus in primiparous (r = -0.60; P < 0.001, Table IV) but not in multiparous cows (r = -0.16; P = 0,182, Table IV), when calvings for both seasons were considered. That correlation rose to 0.63 (P < 0.001) when data from both primiparous and multiparous cows were combined in the same equation (Table IV).

TABLE II. BODY WEIGHTS OF DAMS JUST AFTER CALVING IN WINTER AND SUMMER SEASONS

	Winter calving		Summer calving	
	Multiparous	Primiparous	Multiparous	Primiparous
n	42	34	29	6
Mean (d)	565.8a	435.8b	642.8c	577.0a
SD	66.0	41.5	65.3	59.0
variation (%)	11.6	9.5	10.2	10.2
Confidence limits (d)	553.0-578.5	421.5-449.9	627.4-658.1	543.2-610.7

Note: Means with the same superscripts are not significantly different (P > 0.05).

TABLE III. INFLUENCE OF TEMPORARY CALF REMOVAL (72 h AT 20 d OF AGE) ON THE ONSET OF POST-PARTUM OVARIAN ACTIVITY

	Winter calving		Summer calving	
	Multiparous	Primiparous	Multiparous	Primiparous
Interrupted suckling (n)	24	20	27	6
Mean pp interval (d)	64.2 ^{a1}	118.4 ^{b1}	30.l ^{c1}	53.7 ^{a}
SD	28.5	39.4	11.4	21.3
Confidence limits (d)	52.1-76.2	100-136.8	25.6-34.6	31.3-76.0
Continuous suckling (n)	19	14	29	---
Mean (d)	63.3 ^{a1}	l18.5 ^{b1}	39.0 ^{c2}	---
SD	18.5	30.9	21.7	---
Confidence limits (d)	54.4-72.2	100.7-136.3	30.8-47.3	---

Note: Within columns, values with different number superscripts are significantly different (P < 0.05). Within rows, values with different letter superscripts are significantly different (P < 0.05).

TABLE IV. REGRESSION EQUATIONS

(a) Regression equation (y = mx + c) between duration of anoestrus, y (d), and either body weight at calving, BWC (kg), or interval between calving and 21June, C - 21J (d)

	m	x	c	r	r^2	P
Primiparous	-0.367	BWC	276.13	-0.60	0.36	<0.001
	0.926	C - 21J	-17.36	0.51	0.26	<0.001
Multiparous	-0.054	BWC	85.41	-0.16	0.03	0.182
	0.634	C - 21J	-7.72	0.45	0.21	<0.001
All cows	-0.263	BWC	217.25	-0.63	0.40	<0.001
All cows	0.718	C - 21J	-11.14	0.46	0.21	<0.001

(b) Stepwise multiple regression equation between duration of anoestrus, y (d), and both body weight at calving, BWC (kg), and interval between calving and 21 June, C - 21J (d)

All cows $y = 162.17 - 0.222(BWC) + 0.316(C - 21J)$
$n = 111; r^2 = 0.41; P < 0.03$

The interval from calving to the longest day of the year was positively correlated with the resumption of ovarian activity in both primiparous and multiparous cows (r = 0.51 and r = 0.45, respectively; P < 0.001, Table IV). This correlation was 0.46 (P < 0.001) when data from both cow groups were combined in the same equation (Table IV (a)).

The influence of the two aforementioned independent variables (body weight at calving and the interval from calving to the longest day of the year) on the duration of anoestrus for all cows was computed to devise a stepwise multiple equation (r^2 = 0.4I; P < 0.03, Table IV (b), Fig. 2).

The fertility of the cows (percentage of cows calved of those served) over the three year study was lower during the spring mating season than during the autumn (63.9% versus 76.9%, 57.8% versus 62.9% and 36.5% versus 60.6%, for 1984, 1985 and 1986, respectively). The lower fertility during the spring mating season was a consequence of the greater number of acyclic cows at the end of the winter calving period.

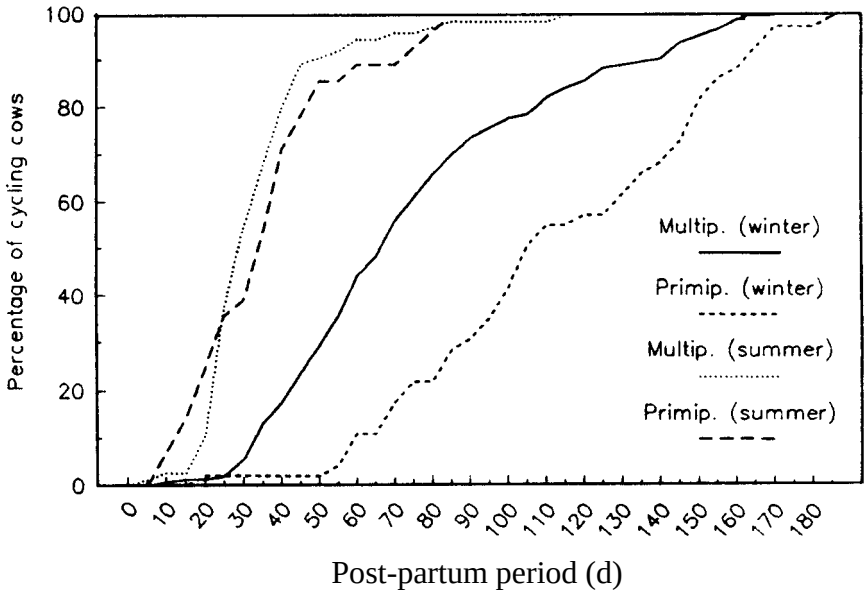

FIG. 2. Cumulative percentage ofcycling cows by, various intervals post-partum.

4. DISCUSSION

The above results are in agreement with an earlier report [13] in which the decreased ability of the Alentejano cow to cycle normally during the winter season was reported.

Winter calving primiparous cows exhibited significantly longer post-partum acyclicity than did their multiparous counterparts, signifying an effect of age/parity upon ovarian activity. This is in agreement with other work [14, 18] in which the negative correlation between the length of the acyclic period and parity is reported.

The lack of an effect of parity on the duration of the post-partum anoestrus in the summer calving season when three consecutive years were considered suggests that an interaction of season and parity exists.

In this work, both the interval from calving to the longest day of the year and the body weight of dams at calving were identified as two seasonal factors which interfere with the resumption of ovarian cycles post-partum. This is in agreement with the results of Peters and Riley [10, 14], who concluded that short winter days during the last stages of pregnancy interact with low nutrition in delaying the onset of oestrus post-partum. However, when only multiparous cows were considered in a univariate equation for body weight, correlation with the duration of the acyclic period was not significant, in spite of the significant differences in body weights between seasons. This agrees with the views of Montgomery et al. [12], who stated that calving season influences the resumption of ovarian cycles even when a constant high plane of nutrition is provided, and that the season of calving interacts with nutrition such that the effects of season are more likely to be expressed under conditions of low nutrition. The results of the present study also show that primiparous cows are greatly affected by low body weights at calving causing a delay in the resumption of post-partum cyclicity.

The positive effect on resumption of cydicity in cows of temporary calf removal early in the post-partum period was only found in the summer calving season. This suggests that the seasonal factors responsible for decreasing the ability of cows to resume cyclicity during the post-partum period have a stronger effect than suckling interruption. According to Edwards [19], the stimulation of post-partum ovarian cycles by interrupting suckling (for 72 hours at 30 days post-partum) seems to act through a positive effect on the hypothalamus of the acyclic cows, since the levels and the frequency of LH pulses increased 48-56 hours after calf removal.

Since ovarian acyclicity post-partum reduces the fertility of Alentejano cows during the winter calving season, studies aimed at reducing the negative effects of seasonal factors on the resumption of ovarian activity should continue. Better nutrition together with hormonal stimulation/synchronization during the winter period should be considered in future research work in this breed.

REFERENCES

[1] HAMMOND, J., The Physiology of Reproduction in the Cow, Cambridge Univ. Press, London (1927).
[2] PETERS, A.R., Reproductive activity of the cow in the post-partum period, I. Factors affecting the length of the post-partum acyclic period, Br. vet. J. 140 (1984) 76.
[3] HANSEN, P-J., Seasonal modulation of puberty and the post-partum anestrus in cattle: A review, Livestock Prod. Sci. 12 (1985) 309.
[4] WILTBANK, J-N-, COOK, A-C-, The comparative reproductive performance of nursed cows and milked cows, J. Anim. Sci. 17 (1958) 640.
[5] CARRUTHERS, T.D., HAFS, H.D., Suckling and four-times-daily milking: Influence on ovulation, estrus and serum luteinizing hormone, glucocorticoid and prolactin in post-partum Holsteins, J. Anim. Sci. 50 (1980) 919-925.
[6] STEVENSON, J-S-, SPIRE, M-F-, BRITT, J-H-, Influence of the ovary on estradiol induced luteinizing hormone release in post-partum milked and suckled Holstein cows, J. Anim. Sci. 57 (1983) 692.
[7] WHITMORE, H-L-, TYLER, W-J-, CASIDA, L-E-, Effects of early postpartum breeding in dairy cattle, J. Anim. Sci. 38 (1974) 339.
[8] ELEY, D.S., et al., Periparturient and postpartum endocrine changes of conceptus and maternal units in Jersey cows bred for milk yield, J. Dairy Sci. M (1981) 312.
[9] BOYD, H., Anoestrus in cattle, vet. Rec. 100 (1977) 150.
[10] PETERS, A-R-, RILEY, G-M-, Is the cow a seasonal breeder? Br. vet. J. 138 (1982) 533.
[11] BELLOWS, R-A-, SHORT, R.E., Effects of precalving feed on birth weight, calving difficulty and subsequent fertility, J. Anim. Sci. 46 (1978) 1522.
[12] MONTGOMERY, G-W-, SCOTT, I-C-, HUDSON, N., An interaction between season of calving and nutrition on the resumption of ovarian cycles in post-partum beef cattle, J. Reprod. Fertil. 73 (1985) 45.
[13] MASCARENHAS, R-M-, RIOS VASQUES, M-I-, HORTA, A-E-M-, ROBALO SILVA, J., VAZ PORTUGAL, A., Seasonal variation in the ovarian activity of beef cows assessed by monitoring progesterone concentrations, Anim. Reprod. Sci. 10 (1986) 251.
[14] PETERS, A.R., RILEY, G.M., Milk progesterone profiles and factors affecting postpartum ovarian activity in beef cows, Anim. Prod. 34 (1982) 145.
[15] ROBALO SILVA, J., HORTA, A-E-M-, VASQUES, M-I-, LEITÃO, R-M-, CLAUDIO, D., "The effect of calving season on the duration of postpartum anoestrus in Alentejano

beef cows", Proc. 38th Annu. Mtg of the European Assoc. for Animal Production, vol. 2 (1987) 732.

[16] HORTA, A-E-M-, VASQUES, M.I., LEITÃO, R-M., "The effect of calf removal on the resumption of postpartum ovarian activity in Alentejano beef cows", ibid., p. 730.

[17] HORTA, A.E.M., VASQUES, M-I-, LEITÃO, R-M-, ROBALO SILVA, J., VAZ PORTUGAL, A., Postpartum anoestrus in the Alentejano beef cow: Effect of season and temporary call removal, C. R. Acad. Agric. de France (1988).

[18] TERQUI, M., et al., "Influence of management and nutrition on postpartum endocrine function and ovarian activity in cows", Factors Influencing Fertility in the Postpartum Cow, Nijhoff, The Hague (1982) 384.

[19] EDWARDS, S., The effects of short term calf removal on pulsatil LH secretion in the postpartum beef cow, Theriogenology 23 (1985) 777.