POST-PARTUM ANOESTRUS IN BEEF CATTLE: A REVIEW

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SUMMARY

The effects of suckling stimulus, level of nutrition, body condition, breed and age of cow and calving difficulty on the post-partum anoestrous interval are discussed. It is concluded that the adoption of sound management policies will shorten the interval.

INTRODUCTION

For optimum reproductive performance a beef cow must raise a live calf during each year of her productive life with a calving interval of 12 months or less. Unfortunately, it is difficult to achieve this goal because all cows fail to resume cyclical ovarian activity for a period of time following calving. This period of time is commonly referred to as the post-partum anoestrous interval. Its extent and consequence are demonstrated by the New Zealand data (R. W. Moore and J. F. Smith, unpublished) in Table 1. It can be seen that the post-partum interval is so lengthy that a mean 365-day calving interval was not achieved in any of the classes of cattle.

TABLE 1: MEAN POST-PARTUM INTERVAL AND CALVING INTERVAL IN MIXED BREED CATLE

Cow Age (*years*)	*Calving to 1st oestrus* (*days*)	*Calving Interval* (*days*)
2	113	405
3-4	91	377
5-6	84	373
7-10	92	380
Mixed	95	385

The duration of the post-partum anoestrus is very variable (Fig. 1). All cows appear to have a minimum period of time prior to which post-partum oestrus will not occur. The duration of the post-partum interval beyond this minimum time is influenced by many factors of which suckling stimulus, level of

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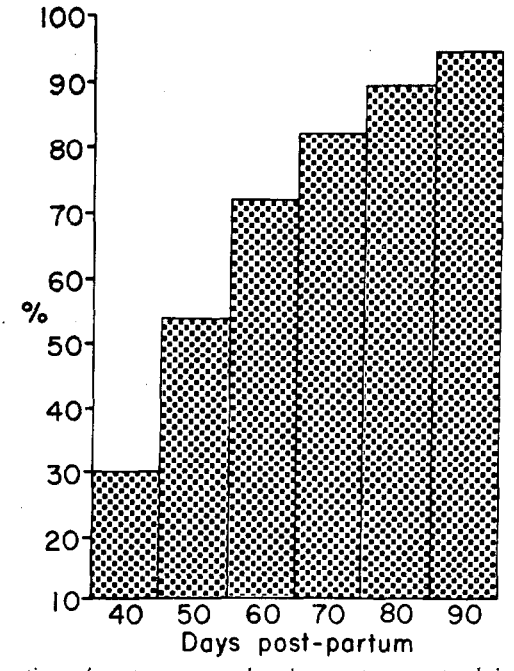

FIG. 1: *Proportion of mature cows showing oestrus post-calving (Wiltbank, 1973).*

nutrition, body condition, breed and age of cow and calving difficulty appear to be the most important. The post-partum anoestrous interval for an individual cow is thus determined by the combined influence of all these factors. Although the relative importance of each factor is impossible to assess, for purposes of clarity, data pertaining to the various factors will be discussed separately in this review.

FACTORS AFFECTING THE POST-PARTUM ANOESTROUS INTERVAL

SUCKLING STIMULUS

Suckling is known to increase the interval to first oestrus (Table 2).

Suckling intensity influences the interval since beef cattle suckling twins show oestrus significantly later than single-suckled animals (95 *v.* 65 days; Wettemann *et al.*, 1976) and beef animals suckled *ad libitum* have a much longer interval than animals suckled for 30 minutes once a day (116 *v.* 69 days; Randel and

TABLE 2: EFFECT OF SUCKLING ON THE MEAN INTERVAL (DAYS) FROM PARTURITION TO FIRST OESTRUS
(Graves *et al.*, 1968)

Trial	*Suckled*	*Non-suckled*	*Difference*
1	54	18	+ 36
2	65	30	+ 35
3	75	30	+ 45
4	93	41	+ 52
5	78	24	+ 54

Walker, 1976). However, it has also been observed in multiple-suckled dairy cows (2, 3 or 4 calves) that the severity of anoestrus is affected more by the duration of the suckling period than the suckling intensity (Kaiser, 1975).

The effect of the mammary gland and suckling on the post-partum interval has been further demonstrated in experiments where beef cows were subjected to mastectomy at 150 days of gestation (Table 3). The mastectomized cows showed oestrus significantly earlier than either the suckled or non-suckled ani-

TABLE 3: EFFECT OF SUCKLING AND MASTECTOMY ON POST-PARTUM INTERVAL
(Short *et al.*, 1972)

Cow type	*No. of Animals*	*Interval (days)*
Suckled (S)	12	65
Non-suckled (NS)	13	25
Mastectomized (M)	9	12

S *v.* NS + M, $P < 0.01$; NS *v.* M, $P < 0.01$

mals. However, a recent study has, rather surprisingly, shown that mammary gland denervation in suckled beef cows does not decrease the post-partum interval (Short *et al.*, 1976).

NUTRITION

Nutrition studies have generally indicated that adequate energy intake is more critical than protein intake for maintaining reproductive function in cattle. Various authors have shown that both pre-partum and post-partum energy intake can affect reproductive performance. This is demonstrated in Table 4.

The pre-calving energy level exerted the greatest influence in the early post-partum period. By 40 days after calving, 25% of the cows fed the high pre-calving energy level had shown

TABLE 4: PERCENTAGE OF FIRST CALF HEIFERS SHOWING OESTRUS BY VARIOUS INTERVALS AFTER CALVING AS INFLUENCED BY ENERGY INTAKE
(Dunn *et al.*, 1969)

Energy intake	*Days after calving* 40	60	80	100	120
139 days pre-calving:					
A 8.7 Mcal/day	6*	44**	80*	93	96
B 17.3 Mcal/day	25	69	88	92	93
120 days post-calving:					
C 14.2 Mcal/day	36	64	81	81**	81**
D 27.3 Mcal/day	14	64	82	92	96
E 48.2 Mcal/day	11	51	90	98	100

Difference between energy levels: $*P < 0.05$; $**P < 0.01$

oestrus compared with only 6% of those on the low level. This difference was even more pronounced 60 days post-partum. However, after 100 days post-calving, the effects of pre-calving energy level were negligible. The post-calving energy level affected the occurrence of oestrus only late in the post-partum period. In this experiment mating began 60 days post-partum and it was found that the pregnancy rate following a 60-day mating period was directly related to the post-calving energy level and weight gain. Eighty-seven percent of the cows fed the high energy level after calving were pregnant compared with 72% of those fed the moderate and 64% of those fed the low energy level ($P < 0.05$). The main causes of low pregnancy rate were failure to show oestrus and failure to conceive at the first service. The pre-calving energy level affected the pregnancy rate during only the first 20 days of mating. Similar effects of pre- and post-calving energy levels have been recorded in older beef animals (Wiltbank *et al.*, 1962; Hight, 1968).

Although it is generally accepted that restricting energy intake prior to calving delays the onset of post-partum oestrus, dramatic effects such as those seen in Table 4 have not always been evident (Corah *et al.*, 1975). It has been suggested that at least some of the variation observed between experiments can be attributed to differences in body condition of the cows either at the start of the experiment or at calving. Whitman *et al.* (1975) reported that body condition at calving accounted for a significant portion of the variation in likelihood of oestrus and that, for each 10-day interval 60 to 90 days post-partum, likelihood of oestrus increased ($P < 0.05$) as body condition at calving improved from thin to moderate to good. Similarly, Meaker (1975) found

a highly significant correlation between conception rate during the breeding season and body mass at the start of the breeding season.

Breed and Age of Cow

Results from Whatawhata (D. C. Dalton *et al.*, unpublished) show a significant effect of breed of 2-year-old cow on post-partum interval. In this instance purebred Friesians had the longest interval (110 days), purebred Angus and Hereford × Friesian crossbreeds had an intermediate interval of 103 days and Simmental × Friesian crossbreds had the shortest interval at 95 days. Similarly, Knight (unpublished) showed a difference of 14 days between those breeds having the shortest (Friesian × Jersey; 74 days) and longest (Friesian × Angus; 88 days) intervals.

First calf beef heifers invariably show a longer interval from calving to first oestrus than cows of any other age (Table 5).

TABLE 5: EFFECT OF BREED AND AGE OF COW ON THE POST-PARTUM INTERVAL
(Germ Plasm Evaluation Programme, 1975)

Breed	*2 year*	*3 year*	*4 year*
Hereford cross	83.7[1] (331)[2]	62.9 (229)	55.1 (131)
Aberdeen Angus cross	85.3 (304)	62.8 (198)	60.2 (99)

1 = days 2 = No. of cows

Calving Difficulty

The effect of calving difficulty on the subsequent reproductive performance of mixed-age beef cattle is demonstrated by the data of Laster *et al.* (1973a), Table 6.

TABLE 6: EFFECT OF CALVING DIFFICULTY ON SUBSEQUENT FERTILITY

	Dystocia	*No Dystocia*	*Difference*
45-day A.I. period[1]:			
% cows[2] detected in oestrus	60	74	— 14 ($P < 0.005$)
% cows[2] pregnant	54	69	— 15 ($P < 0.01$)
Total mating period[3]:			
% cows[2] pregnant	69	85	— 16 ($P < 0.005$)

1 = A.I. period commenced approximately 60 days after calving.
2 = % of total experimental animals.
3 = The A.I. period was followed by pasture mating for 25 days.

Dystocia had a significant negative effect on the percentage of cows detected in oestrus during the 45-day A.I. period, pregnancy rate during the A.I. period and total pregnancy rate. It had no appreciable effect on the number of inseminations required per conception. Thus, it can be concluded that calving difficulty decreases pregnancy rate because it results in fewer cows returning to oestrus. Brinks *et al.* (1973) also showed that calving difficulty affected subsequent reproductive performance since heifers having difficulty as 2-year-olds weaned 11% fewer calves of those born the first year and 14% fewer calves per cow exposed the next year. The calves born the second year were an average of 13 days later and were 21 kg lighter at weaning than calves born to cows which did not have difficulty as 2-year-olds.

SHORTENING OF THE POST-PARTUM ANOESTROUS INTERVAL

When a farmer is faced with an unacceptably long calving interval, shortening of the post-partum interval to first oestrus can contribute to a shortening of the calving interval. Also, under all mating situations it is desirable to have as short a post-partum interval as possible. This ensures that most cows are cycling at the commencement of the breeding season and, since many will be mated at their second oestrus, the conception rate is high. The post-partum interval can be shortened by several procedures.

Early or Temporary Weaning of Calves

Weaning of calves 3, 10 or 30 days post-partum has been shown to significantly decrease the post-partum interval in beef cattle (Bellows *et al.*, 1974; Smith and Vincent, 1972). In the latter study, weaning 30 days post-partum was also shown to decrease the average interval from calving to conception by 13 days. Laster *et al.* (1973b) examined the reproductive performance of cattle weaned just prior to the commencement of the breeding season. Their data (Table 7) show that weaning had no effect on the post-partum interval or interval from calving to conception but increased significantly the proportion of 2- and 3-year-old cows exhibiting oestrus and the proportion conceiving during the 42-day breeding period.

MacPherson *et al.* (1976) weaned calves from 2-year-old cows 58 days post-partum and, in contrast to the previous study, showed no differences in pregnancy rate following the breeding season but suggested that cows whose calves were weaned conceived earlier than control cows. Baker (1969) showed that weaning

TABLE 7: EFFECT OF EARLY WEANING AND COW AGE ON REPRODUCTIVE PERFORMANCE

Variable	*Weaned at 55 days*			*Not weaned*		
	2	*3*	*> 4*	*2*	*3*	*> 4*
Cows in oestrus by 107 days post-partum (%)	92[a]	97[a]	98	63[b]	70[b]	81
Calving to first oestrus (days)	62	55	50	61	54	60
Cows conceiving during breeding season (%)[1]	71[a]	76[a]	71	46[b]	60[b]	63
Calving to conception (days)	96	88	85	99	87	87

1 — Breeding commenced 65 days post-partum and continued for 42 days.
Within each variable and age, a *v.* b, $P < 0.05$.

influenced the incidence of pregnancy only if the cows were not in good condition. These results suggest that weaning can influence reproductive efficiency but in all studies except Bellows *et al.* (1974) weaning and nutrition were confounded. Weaning at these early ages would probably not suit New Zealand farming conditions because of the intensive feeding required for satisfactory calf growth.

In America, a hormone treatment (Synchromate B, G. D. Searle and Co) used to induce and synchronize oestrus in beef cattle has been coupled with calf removal for 48 hours. The whole treatment is referred to as the "Shang" treatment and the effectiveness of it and calf removal alone for 48 hours is demonstrated by the data of Smith *et al.* (1976) in Table 8. Calf removal did not affect the incidence of oestrus or pregnancy after 4 days compared with controls but had a marked effect on occurrence of oestrus and pregnancy after 21 days. In the steroid treated animals, calf removal resulted in a greater proportion of animals exhibiting oestrus during the first 4 days of breeding

TABLE 8: EFFECTS OF STEROIDS AND 48-HOUR CALF REMOVAL IN ANOESTROUS COWS

Treatment	*No. Cows*	*Proportion in Heat (pregnant) After*	
		4 days' breeding	*21 days' breeding*
Control	53	12 (8)	31 (17)
48-hour calf removal	53	19 (12)	62 (44)
Synchromate B	53	60 (27)	66 (40)
Synchromate B + calf removal ..	53	85 (35)	91 (58)
		$P < 0.05$	$P < 0.05$

and a higher incidence of oestrus and pregnancy after 21 days of breeding. Thus calf removal, either alone or in conjunction with steroid treatment, can improve reproductive performance.

Adequate Nutrition of Cows Pre- and Post-calving

The papers reviewed previously show that cattle should be in good body condition at calving and be making some weight gain before and after calving. First calf heifers should be given preferential treatment because they cannot compete for feed with older animals. Energy levels during the last trimester of pregnancy can significantly affect calf birth weights (Hight, 1968; Young, 1970; Laster and Gregory, 1973). However, with the exception of the study of Arnett and Totusek (1963) where heifers were fed a *very* high plane of nutriton, plane of nutrition and body condition have not been found to significantly affect calving difficulty (Young, 1970; Nelson and Huber, 1971; Tudor, 1972; Laster and Gregory, 1973). Therefore maintaining cows in good condition pre-calving will not increase calving problems. Where animals have been unavoidably subjected to a low plane of nutrition pre-calving, placing them on a high plane post-calving will eventually overcome most, but not all, of the detrimental effects of the pre-calving nutrition.

Minimizing Calving Difficulty

At present it appears that the most effective means for minimizing calving difficulty is through sire breed selection accompanied by sire selection within a breed (Laster, 1976).

Treatment with Exogenous Hormones

These treatments have generally been unsatisfactory (*e.g.*, Wagner and Oxenreider, 1971). Current studies include the use of the following treatments:

Gonadotrophin-releasing Hormones (GnRH)

Treatment of suckled cattle with GnRH during the post-partum anoestrous period induces ovulation and this has led to the suggestion that this drug may be useful for stimulating ovarian cycles post-partum. However, results show that the treatment does not shorten the interval to first oestrus or decrease the proportion of cows in anoestrus (*e.g.*, Britt *et. al.*, 1974).

Progestagen Alone or in Combination with Other Drugs

Treatments given early post-partum. Beef cattle have been treated with progestagens and other drugs at various intervals post-partum (Saidudden *et al.*, 1968; Brown *et al.*, 1972). In general the duration of progestagen treatment has been shorter than that used successfuly in the dairy cow (Kordts *et al.*, 1974) and, although treatment with progestagens (with or without oestrogens) has tended to shorten reproductive intervals, the treatments have not been sufficiently reliable to encourage routine use.

Treatments given just prior to the breeding season. These treatments are designed to induce oestrus in anoestrous animals and to synchronize this oestrus and that of the cycling animals. Current treatments involve the insertion of subcutaneous ear implants containing norgestomet (Synchromate B, G. D. Searle) or intra-vaginal silastic coils containing progesterone (Abbott Laboratories) for approximately 12 days. Coincident with device insertion the animals are injected with oestrogen and progestagen. The treatments have successfully induced fertile oestrus in prepuberal beef heifers (Gonzales-Padilla *et al.*, 1975) and induced and synchronized oestrus in suckling beef cattle (Zaied *et al.*, 1976; Roche, 1976). The effectiveness of the treatment is demonstrated in Table 9. Significantly more cows were pregnant following the progesterone treatment. Twenty-nine percent of the cows were diagnosed as being in anoestrus at the start of treatment and it is largely through stimulating these animals that the progesterone treatment has its greater effectiveness. Zaied *et al.* (1976) reported that 9-day treatment with ear implants appeared to induce oestrus in anoestrous cows since 65% of the treated cows were detected in oestrus within 2 days of implant removal compared with 35% of the control cows in 24 days. A similar technique is used in France to overcome anoestrus in nursing cows of the Salers breed (Chupin *et al.*, 1975). The treated animals show precise onset of oestrus (86% show oestrus over 48 hours) and 60% calve to the induced oestrus. These data indicate that the short-term progestagen treatment may become an important therapy for the anoestrous cow.

Numerous other treatments incorporating progestagens have been applied to the post-partum cow but no one treatment has been sufficiently reliable to encourage routine use.

TABLE 9: EFFECTIVENESS OF SHORT-TERM PROGESTAGEN TREATMENT IN SUCKLING BEEF CATTLE
(Roche, 1976)

	2 Injections Prostaglandin			*12 days Progestagen*		
	No. Treated	*No. A.I.'d*	*No. Pregnant**	*No. Treated*	*No. A.I.'d*	*No. Pregnant**
Overall	131	130	42[a] (32%)	143	138	78[b] (55%)
Ovarian status:						
Active	66	66	30 (45%)	75	75	42 (56%)
Inactive	28	28	5[c] (18%)	30	30	17[d] (57%)
Inactive cows as % of herd	30%			29%		

*Conception to timed A.I. a *v.* b, $P < 0.005$; c *v.* d, $P < 0.01$.

Other Hormones

Cows have been treated with human chorionic gonadotrophin or oestrogens alone and, although treatments tend to shorten the interval from parturition to first oestrus and ovulation, they do not appear reliable for routine use.

CONCLUSIONS

The most effective way a beef farmer can minimize the post-partum interval in his herd is to ensure that the animals are in good condition at calving and making some weight gain before and after calving. When this is coupled with management policies which include the early mating of maiden heifers, breeding during a restricted mating period, culling of dry animals, and selection of the early cycling and conceiving cow, then a calving interval of 365 days should be routinely achieved.

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