EFFECTS OF EARLY WEANING ON CALF PERFORMANCE AND ON REPRODUCTION IN MATURE COWS

By

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EFFECTS OF EARLY WEANING ON CALF PERFORMANCE

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CHAPTER I

INTRODUCTION

Early weaning may be an alternative for improving the breeding performance of beef cows under certain circumstances. Early weaning may be the only alternative to achieve a high conception rate in cows too thin at the beginning of the breeding season. Early weaning may allow cattlemen to save that amount of supplemental feed needed to achieve a high conception rate in thin cows by feeding smaller amounts of high energy rations to the calves and maintaining the cows on less expensive roughage. Furthermore, cows with early-weaned calves should require less feed the following year due to their better body condition in the next season. Early weaning may be a reasonable alternative during times of forage scarcity, dry seasons or severe winters, since purchased feed may be more efficiently fed directly to the early-weaned calf than to the lactating cow.

These potential benefits of early weaning can be obtained only if calves can be successfully and economically raised with minimal labor and facilities.

The purpose of this study was: (1) to study the management of early-weaned calves with minimal labor and facilities and (2) to evaluate the possibility of using early weaning to accelerate rebreeding of mature beef cows.

CHAPTER II

REVIEW OF LITERATURE

Introduction

This review will be divided into three parts: (1) the factors that influence the length of the interval from parturition to first estrus (postpartum interval) and conception rate of beef cattle, (2) the effects of early weaning on the performance of calves and on reproduction of cows, and (3) the management of the early-weaned calf.

Factors Influencing Postpartum Interval and Conception Rate of Beef Cattle

Suckling

The effect of suckling on the length of the interval from parturition to first estrus (postpartum interval) in beef cows has been well documented. Clapp (1937) was the first to suggest that suckling prolonged the postpartum interval compared to milking. Wiltbank and Cook (1958), in a herd of 141 Milking Shorthorn cows, found that the postpartum interval was 30 days longer ($P<.01$) in nursed cows than in cows milked twice daily. Casida et al. (1968), in a review on the postpartum cow, summarized results on the length of the interval from parturition to first estrus from various studies involving different breeds of dairy and beef cattle. The average length of the postpartum interval ranged from 30 to 72 days for the dairy cows. Comparable figures for the beef cows were 46 to 104 days. Although the authors admitted that differences in management of the two classes of cows prevented a judgement of the cause of the difference in interval, they made the observation that the interval was prolonged, on the average, by suckling as compared to 2, 3 or 4 milkings per day. In a study on the postpartum beef cow, it was concluded that the interval to first estrus was 35 to 54 days longer in suckled than in non-suckled cows (Graves et al., 1968).

Oxenreider (1968) evaluated the influence of suckling on postpartum reproductive function in 12 pluriparous Aberdeen Angus cows. The postpartum interval was shorter ($P<.01$) in non-suckled cows than in cows suckled by two calves or cows suckled by single calves (10, 55 and 53 days, respectively). Short et al. (1972) studied the effect of suckling on postpartum reproduction in 25, three-year-old Angus cows. Twelve cows were suckled intact and 13 were non-suckled intact. The calves were removed from the non-suckled cows at birth and calves from the suckled cows were run continuously with their dams. All cows were fed to approximately maintain their immediate postpartum body weight. The postpartum interval was 40 days longer ($P<.05$) in suckled than in non-suckled cows, although all cows had similar postpartum weight losses. Wettemann et al. (1978) studied the effect of suckling intensity on reproductive performance in 30, six-year-old crossbred cows (Hereford X Holstein). Sixteen cows were suckled by single calves and 14 were suckled by two calves. The additional calf was adopted at the day of parturition. Although all cows had similar postpartum weight losses, the postpartum interval was longer ($P<.05$) in cows suckled by two calves (94.6 days) than in cows suckled by single calves (67 days).

Consequently, the authors stated that increasing the intensity of suckling increased the length of the postpartum interval independent of nutritional influences.

Body Condition and Weight Change

Body condition at parturition and weight change before parturition are important factors in determining the length of the postpartum interval and conception rate in beef cows. Whitman et al. (1975) concluded that the probability of estrus in cows 60 to 90 days postpartum increased ($P<.05$) as body condition at parturition improved from thin to moderate to good. Corah et al. (1975) reported that there was a tendency for a higher percentage of heifers that gained 36.1 kg before parturition to show estrus by 40 days postpartum (41% compared to 26% for heifers that lost 5.8 kg). In another study, it was shown that spring calving heifers in a good prepartum body condition had shorter postpartum intervals ($P<.01$), greater numbers exhibiting estrus before the breeding season ($P<.05$) and tended to have a higher conception rate than heifers in a moderate prepartum body condition (Bellows and Short, 1978).

Wettemann et al. (1980) reported an 85% conception rate for spring calving cows that were in a moderate body condition at parturition compared to a 70.6% conception rate for cows that were in a thin body condition at parturition. Also, 20% more of the cows that were in a moderate body condition were observed in estrus by 80 days postpartum.

Similarly, body condition and weight changes following parturition have been shown to influence estrus activity and conception rate in beef cows. However, their effects on the occurrence of estrus are not clearly understood yet. Data presented by Wiltbank et al. (1962) indicated that body condition at parturition was more important in determining the onset of estrus in mature, spring-calving cows than condition change following parturition. The postpartum interval was shorter ($P<.01$) and the incidence of estrus was higher in cows that had lost 1.4 units (6.5 to 5.1) of their prepartum condition score by 90 days postpartum (43 days and 86%) than in those that had gained .8 units (4.4 to 5.2) of their prepartum condition score by 90 days postpartum (65 days and 85%).

Wiltbank et al. (1964) showed that an improvement in body condition after parturition appeared to have a favorable effect on conception rate of mature, thin and spring-calving cows. The conception rate was 92% for cows that had gained 3.4 units (3.9 to 7.3) from their 24-hr. postpartum condition score by 84 days postpartum compared to a 78% conception rate for cows that had gained 1.0 unit (4.0 to 5.) from their 24 hr. postpartum condition score by 84 days postpartum. Dunn et al. (1969) found that conception rate was higher ($P<.05$) in two-year-old first-calf heifers that gained 118 kg in their weight from parturition to 120 days postpartum (87%) than in those that lost 28 kg of their weight from parturition to 120 days postpartum (64%). Similarly, the incidence of estrus was higher ($P<.01$) in heifers that gained weight (100%) than in those that lost weight (85%). However, 36% of heifers that lost weight had exhibited estrus by 40 days postpartum compared to only 11% of heifers that gained weight. After 60 days postpartum, the incidence of estrus was still higher in heifers that lost weight (64 vs 51%). By 80 days postpartum, the occurrence of estrus was higher in heifers that gained weight (90 vs 81%).

Forero et al. (1969) reported a 94% conception rate in fall-calving cows that lost 7% of their postpartum weight compared to 50, 76, 53 and

44% conception rate (P<.05) for cows that lost 16, 17, 18 and 21% of their postpartum weight, respectively.

Postpartum Hormone Levels

An inadequate secretion of gonadotropins after parturition may result in the lack of follicular development, which in turn delays the onset of estrus in many range beef cows. Arije et al. (1974) found that plasma luteinizing hormone (LH) concentrations of multiparous cows increased periodically up to 3 ng/ml after two weeks postpartum until estrus, when a peak of 42 ng/ml occurred 27 hr. before ovulation. The length of the postpartum interval was 98 days. Data presented by Wettemann et al. (1978a) suggested that a reduced secretion of gonadotropins may limit follicular growth following parturition. The ovaries of anestrous cows secreted estradiol in response to pregnant mare serum gonadotropin (PMSG) and progesterone was secreted after endogenous or exogenous gonadotropin stimulation. Cows were treated with different doses of PMSG or gonadotropin releasing hormone (GnRH) at 45 ± 2 days postpartum.

This reduced secretion of gonadotropins may be caused by suckling and/or the level of nutrition. Carter et al. (1980) concluded that calf removal within 24 hr. after birth hastened reestablishment of postpartum reproductive activity in cows by eliminating a suppressive effect on pituitary gonadotropin release caused by suckling, which in turn hastened ovarian follicular development. The average daily luteinzing hormone (LH) concentrations in plasma during the first 25 days postpartum were higher in non-suckled (2.4 ± .4 ng/ml) than in suckled cows (1.5 ± .3 ng/ml) because no ovulations occurred in suckled cows. Follicular development as indicated by follicular volume is greater ($P<.01$) on the ovaries of non-suckled cows (1,194 mm^3) than on those of suckled cows (195 mm^3) on day five postpartum. The postpartum interval was longer ($P<.01$) in suckled (61.5 days) than in non-suckled cows (14 days). Beal et al. (1978) concluded that pituitary content was lower ($P<.01$) in cows fed a low energy ration (3.2 mg) than in those fed a high energy ration (4.0 mg). Similarly, plasma LH concentration was lower ($P<.05$) in cows fed the low energy ration (2.0 vs 2.5 mg). Lishman et al. (1979) showed that plasma LH concentrations of cows were affected by plane of nutrition ($P<.01$). Cows were treated with GnRH at 33 days postpartum.

Effects of Early Weaning on Calf Performance and on Cow Reproduction

The use of early weaning to accelerate rebreeding rate of beef cows necessitates the weaning of the calf before 80 days of age. Research on the effects of early weaning beef calves at 30 to 80 days of age on the performance of the calf and on reproduction of the cow is limited.

Smith and Vincent (1972) concluded that spring-calving cows with calves weaned at 30 ± 2 days of age had a 16 days shorter postpartum interval ($P<.01$) and tended to have a higher conception rate than cows that raised their calves (58 vs 38%). Laster et al. (1973) reported that weaning calves at 55 ± 21 days of age increased the percentage of cows exhibiting estrus from calving through breeding, 29.0% ($P<.05$) in two-year-olds, 26.7% ($P<.05$) in three-year-olds and 16.3% in cows four years and older. Weaning also increased overall conception rate by 25.9% ($P<.05$) in two-year-old cows, 15.6% ($P<.05$) in three-year-old and 7.9% in four years and older. The author suggested that this effect of early weaning on the occurrence of estrus in the young, growing cows compared to its non-significant effect in mature cows could be explained by the cessation of suckling and the associated increase in the nutritional status of the young cows due to the cessation of lactation. In another study, it was shown that three-year-old cows with calves weaned at 80 days of age had a higher percent calf crop born ($P<.05$) than cows that raised their calves during a year of extreme drought (Ray et al., 1973).

Lusby and Wettemann (1980) concluded that weaning calves at 42 to 56 days of age improved conception rates in thin, first-calf heifers from 59 to 97%. Heifers with early-weaned calves gained 40 kg more in the fall and weaning weights of early-weaned calves were similar to weights of calves raised by their dams (169.6 and 196.2 kg). McKee et al. (1977) concluded that calves weaned at 50 ± 25 days of age and creep-fed for 107 days in a drylot gained more ($P<.05$) than calves raised by their dams (121.5 vs 49.74 kg).

Management of the Early-Weaned Calf

The age at which the rumen starts to function depends on the nature of the diet consumed by the young calf. Tamate et al. (1962) observed a rapid increase in the empty tissue weight, capacity and papillary growth of the rumen of dairy calves receiving whole milk, hay, and grain from 3 to 28 days of age compared to a slow increase in the capacity and empty tissue weight and a decrease in the papillary growth of the rumen of those receiving whole milk for the same period. Bremer et al. (1968) showed that the rumen of beef calves weaned at 56 days of age and creep fed for about a month before weaning was normally functioning as indicated by a rumen pH of 6.28 ± .52 and a concentration of volatile fatty acids (acetic, propionic and butyric) of 11.57 mM/100 ml of rumen fluid. Although the rumen was relatively immature in grazing beef calves suckling their dams at 63 days of age, it was demonstrated that calves weaned at 63 days of age and fed a high concentrate diet ad libitum up to 98 days of age had a greater increase in the empty organ weight, weight of contents, and papillary growth of the rumen than those that remained with their dams up to the same age (Stewart, 1971).

Okamoto et al. (1959) showed that dairy calves were unable to utilize sucrose, dextrin, or starch for the first 42 days of life. Similarly, it was shown that dairy calves were unable to efficiently utilize protein of vegetable origin for the first 26 to 30 days of life (Noller et al., 1956).

Wing (1959) observed no differences in general appearance and health between dairy calves fed a concentrate mixture containing 18% crude protein and 6% crude fiber from 4 to 60 days of age and those fed a concentrate mixture containing 17.8% crude protein and 13.9% crude fiber for the same period. In addition, no scours or other abnormalities were found. All calves were vigorous. In another study, it was concluded that there was no need for feeding a concentrate mixture containing more than 15.9% crude protein to dairy calves weaned at 35 days of age for achieving maximum live-weight up to the age of 84 days (Stobo et al., 1967).

Bellows et al. (1974) reported that the total weight gain (58.84 kg) and the average daily gain (.65 kg/day) of beef calves, weaned at 35 days of age and fed a concentrate mixture and alfalfa hay ad libitum up to 90 days of age, were normal compared to the total weight gain (77.78 kg) and the average daily gain (.86 kg/day) of those which remained with their dams up to the same age. Neville et al. (1977) reported an average daily gain of .87 kg/day and a feed conversion of 3.49 kg feed/kg gain for 81-day-old beef calves receiving a concentrate mixture containing 18.9% crude protein compared to average daily gains of 1.09 and 1.20 kg/day and feed conversions of 4.64 and 5.00 kg feed/kg gain for calves receiving concentrate mixture containing 18.9 and 14.5% crude protein, respectively. All calves were weaned from 21 to 60 days of age. The authors stated that the minimum protein content of the diet required to obtain the best gain and feed efficiency of early-weaned beef calves does not remain constant but is dependent on the calf's age. In a study on the response of dairy calves to early weaning, it was concluded that healthy male calves may be weaned successfully at 21 days of age onto a complete starter ration, but that some calves weaned at less than 21 days of age may encounter problems in adapting to dry feed (Winter, 1978).

Van Horn et al. (1980) reported average daily gains of .81 and .79 kg/day and feed intakes of 4.40 and 4.42 kg/day for dairy heifers receiving concentrate mixtures containing two different levels of cottonseed hulls from 80 to 180 days of age (40 and 55%, respectively). Miller et al. (1969) found no significant differences in feed intake, weight gains, feed conversion, general appearance and health between dairy calves fed a complex starter from 7 to 56 days of age and those fed a simplified starter for the same period. A level of 10% cottonseed hulls was added to both starters. Both starters were fed *ad libitum*. Lusby and Wettemann (1980) encountered sorting problems with a ration for early-weaned beef calves including alfalfa pellets and cottonseed hulls as sources of roughage and 3% molasses. Consequently, they recommended that rations fed to early-weaned calves should be either pelleted or formulated with sufficient molasses to prevent sorting. Also, alfalfa pellets should be ground if they are to be used. However, feed conversions for early-weaned calves were very good (4.67 kg feed/kg gain).

CHAPTER III

EFFECTS OF EARLY WEANING ON CALF PERFORMANCE AND ON REPRODUCTION OF MATURE COWS

Summary

Forty-eight, spring-calving, mature, thin cows were allowed to receive one of two treatments: (1) to have their calf weaned at 42 to 56 days of age and (2) to remain with their calf until a normal weaning age of seven months. Early-weaned calves were fed rations containing corn and soybean meal with cottonseed hulls as the sole roughage source, in a drylot. Early-weaned calves were hand-fed for the first ten days, after which time, they were fed *ad libitum* from a self-feeder. Calves to be normally raised, their dams and dams of early-weaned calves grazed on bermuda pastures during the summer.

Weaning weight and average daily gain of early-weaned calves (214.64 kg and .89 kg/day) were greater ($P<.01$) than those of normal-reared calves (164.01 kg and .63 kg/day). Feed intake and feed conversion of early-weaned calves were 4.01 kg/day and 4.06 kg dry matter/kg gain.

Weight change from early weaning to end of the breeding season of cows with early-weaned calves were greater ($P<.05$) than that of cows with suckling calves (58.49 and 48.84 kg). Weight change from end of the breeding season to weaning of cows with early-weaned calves were also greater ($P<.01$) than that of cows with suckling calves (39.12 and -2.14

kg). Body condition score change from early weaning to end of the breeding season was similar for both groups (1.1 and .8). However, the change in body condition score from end of the breeding season to weaning of cows with early-weaned calves was greater ($P<.01$) than that of cows with suckling calves (.79 and -.02).

The postpartum interval to estrus was shorter ($P<.01$) in cows with early-weaned calves than in cows with suckling calves (49.0 and 86.6 days). The postpartum interval to conception was also shorter ($P<.05$) in cows with early-weaned calves than in cows with suckling calves (66.2 and 86.7 days). Conception rate tended to be higher, although not significantly so in cows with early-weaned calves (100%) than in cows with suckling calves (87%).

These results indicate that calves can be early weaned at 42 to 56 days of age with minimal labor and facilities and that early weaning can improve the breeding performance of mature thin cows.

Introduction

Many range beef cows have long intervals from parturition to breeding. Consequently, they do not conceive during a regular breeding season.

A significant increase in conception rate and a significant decrease in the interval from parturition to breeding was observed in young cows with early-weaned calves (Laster et al., 1973). Thin heifers with early-weaned calves gained 40 kg more ($P<.05$) from calving to weaning than those with suckling calves for the same period (Lusby and Wettemann, 1980). Similarly, early-weaned calves gained 71.76 kg more ($P<.05$) during a 107-day period than those that remained with their dams for the same period (McKee et al., 1977). Early-weaned calves were able to utilize dry feed from 63 to 98 days of age as indicated by their rumen development (Stewart, 1971).

In spite of those favorable effects on calf performance and on cow reproduction and performance, early weaning may increase the cost of raising calves (labor, equipment, and rations). Early weaning may be a reasonable alternative to improve the breeding performance of beef cows under certain situations such as: cows that are too thin at the start of the breeding season to achieve a high conception rate and during times of forage scarcity, dry seasons or severe winters, when purchased feed may be more efficiently fed to the early-weaned calf than to the lactating cow depending on the price of concentrates and hay.

In a previous study, complex early weaning rations included oats and alfalfa pellets were fed to early-weaned calves from first-calf heifers (Lusby and Wettemann, 1980). So far, no study has been done on the effect of early weaning on reproduction of mature, thin beef cows.

The purpose of this study was: (1) to study the response of early-weaned calves to more simplified rations and their management with minimal labor and facilities and (2) to evaluate the feasibility of using early weaning to accelerate rebreeding of mature, thin cows.

Experimental Procedure

The experiment was conducted during a 189-day period from April 28 to November 5, 1980 at the O.S.U. Research Range Cow Center near Stillwater, Oklahoma. Forty-eight Hereford cows were utilized. Most of the cows were mature and calved late in the calving season. The calving season was from February 28 to April 30. Cows were allocated by date of calving into two treatments. The treatments consisted of either cows having their calf early weaned or of cows remaining with their calf until a normal weaning age of seven months.

Calves to be early weaned were weaned at 14-day intervals starting at the time the oldest calf was 56 days of age (April 28) and ending on June 10. Therefore, calves were early weaned between 42 and 56 days of age. At the time of early weaning, all calves were vaccinated for Blackleg, Malignant Edema, Infectious Bovine Rhinotracheitis (IBR), and Virus Pneumonia (PI-3). Calves to be normally raised were returned to their dams. Cows suckling calves and cows with early-weaned calves were maintained on a bermuda (Cynodon dactylon) pasture throughout the summer. However, cows whose calves had been early weaned were kept separate from nursing calves for four weeks to eliminate the possibility of calves suckling cows with early-weaned calves. Early-weaned calves were placed in a covered barn with an outside pen measuring 36 square meters. Water and feed were easily available at all times. The starter ration (Table I) was high in crude protein (15.01%), high in energy (73.54% TDN) and contained 10% cottonseed hulls as the sole roughage source. Two, four- to five-month-old calves were kept with each new group of early-weaned calves since a previous study showed that the older calves seemed to reduce the stress of early weaning and lead the young calves to feed and water (Lusby and Wettemann, 1980).

After 10 to 14 days on the starter ration, the early-weaned calves were moved to a .2 hectare drylot pen and fed to weaning from a self-feeder. Ration II (Table I) was fed for approximately six weeks after which Ration III (Table I) was fed until weaning. Water and feed were offered <u>ad libitum.</u>

TABLE I

COMPOSITION, CRUDE PROTEIN, AND ENERGY CONTENT OF EARLY WEANING RATIONS

Ingredients	Ration (% as fed basis)		
	Starter	Ration II	Ration III
Rolled Corn	64.0	56.5	50.0
Soybean Meal	20.0	17.0	12.0
Cottonseed Hulls	10.0	20.0	33.0
Cane Molasses	5.0	5.0	3.0
Dicalcium phosphate	----	----	0.5
Limestone	0.5	0.5	0.5
Potassium chloride	----	0.5	0.5
Salt	0.5	0.5	0.5
Vitamin A (30,000 IU/gm)	1 lb/ton	1 lb/ton	½ lb/ton
Deccox[a] (for prevention of coccidiosis)	1 lb/ton	0.8 lb/ton	----
Crude Protein	15.01	13.42	11.09
TDN	73.54	68.87	63.51

[a]Trade name for Decoquinate product of Hess and Clark, Ashland, Ohio.

All cows were exposed to Hereford bulls for a 62-day period from May 13 to July 14. Bulls were equipped with chin-ball markers for estrus detection and pregnancy was determined by rectal palpation 48 days after the end of the breeding season.

Calves were weighed at birth. Calf weights, cow weights, and cow body condition (degree of fatness) scores were taken at early weaning, at 28-day intervals and at weaning after overnight wighdrawal from feed and water. Cow body condition scores were determined visually by using a scale from 1 to 9 with 1 equal to very thin and 9 being very fat. Calf weights at early weaning were adjusted to a 47-day basis. Weaning weights were adjusted to a 205-day, mature (age of the dam in years) and steer equivalent (sex of the calf) basis. The following equations were used:

47-day weight = Birth weight + |(Actual early weaning weight - Birth weight) X 47/Actual early weaning age in days|.

205-day age adjusted weight = Birth weight + |(Actual weaning weight - Birth weight) X 205/Actual weaning age in days|.

If the calf was a heifer, the 205-day age adjusted weight was multiplied by 1.05. If the age of dam was three-years-old, the 205-day adjusted weight was multiplied by 1.10, regardless of sex of calf.

Weaning and early weaning weights of calves of mature cows were only adjusted to a 205-day basis and to a 47-day basis, respectively. Average daily gain from early weaning to weaning was calculated for all calves by using the following equation:

Average daily gain = (Adjusted weaning weight - Adjusted early weaning weight)/(205-47) days.

Feed intake and feed conversion were calculated for early-weaned calves for the entire experimental period. Feed intake was recorded at different intervals of time by measuring the amount of feed refused and subtracting the total added to the self-feeder during those intervals of time. The postpartum interval to conception was calculated for cows with early-weaned calves and cows suckling calves by using the following equation:

Postpartum Interval to Conception = (Calving date in 1981 - Calving data in 1980) - 283 days.

Crude protein and total digestible nutrients (TDN) were calculated for each of the rations based on the chemical composition of feed commonly used in beef cattle diets (NRC, 1976). One calf on pasture was removed due to an abcessed leg and one early-weaned calf died of intersticial pneumonia on October 2. Data from both calves and their dams were discarded. Six cows suckling calves were sold at the end of the experimental period.

Data were analyzed by using the general models procedure (SAS, 1979).

Results and Discussion

Weaning weight and average daily gain (Table II) of early-weaned calves (221.5 kg and .93 kg/day) were greater ($P<.01$) than those of normal-reared calves (170.3 kg and .67 kg/day). These results are in agreement with McKee et al. (1977) who reported that early-weaned calves

TABLE II

PERFORMANCE OF EARLY WEANED AND NORMAL WEANED CALVES

	Treatments			
	Early Weaned		Normal Reared	
	Mean[a]	S.E.[b]	Mean	S.E.[b]
No. of Calves	23	----	23	----
Calf weights (kg)				
At birth	31.61	1.6	31.11	1.9
At early weaning	74.0	5.8	64.39	6.6
At normal weaning	221.5[c]	10.6	170.3[d]	12.1
Ave. daily gain (kg/day)				
Early weaning to Normal weaning	.93[c]	.04	.67[d]	.05
Feed Intake (kg/day)	4.01			
Ration I	1.15			
Ration II	1.65			
Ration III	5.20			
Feed Conversion (kg feed/ kg gain)				
As fed basis	4.51			
Dry matter basis	4.06			

[a]Least square means
[b]Standard error
[c,d]Means on the same line with different superscript letter differ (P<.01).

creep fed for a 107-day period gained 71.76 kg more ($P<.05$) than calves that remained with their dams for the same period.

Feed intakes were relatively low for Ration I and II (Table II) and support the need for high energy and protein contents in these rations. Intakes increased on Ration III (Table II) and approached 3% of body weight on a dry matter basis.

The efficient gains of the early-weaned calves were expected with young, rapidly-growing calves having good feed consumption. No sorting of ingredients was observed with these rations containing cottonseed hulls as the sole roughage source as was noticed with alfalfa pellets in a more complex ration fed to early-weaned calves in a previous study (Lusby and Wettemann, 1980).

Miller et al. (1969) found no significant differences in feed intake, weight gains, feed conversion, general appearance, and health of dairy calves fed either a complex ration or a simplified ration, each containing 10% cottonseed hulls, from 7 to 56 days of age.

The use of two older calves during the critical first 10 to 14 days of early weaning (Lusby and Wettemann, 1980) again appeared beneficial since the young calves were often seen to follow the older calves to feed and water.

Other than the cases already mentioned in the experimental procedure, the only serious health problem encountered during the experiment was the incidence of coccidiosis in two early-weaned calves in late October. Both calves were treated with a coccidiostat (Table I) and responded rapidly to treatment. This indicates that the coccidiostat, fed with Ration I and II, should have been fed again with Ration III to the early-weaned calves. Early-weaned calves were moved to Ration III after the consumption of Ration II had increased sufficiently to cause some diarrhea.

The effects of early weaning on cow performance are shown in Table III.

Weight change from early weaning to end of the breeding season of cows with early-weaned calves were greater ($P<.05$) than that of cows with suckling calves (58.49 and 48.84 kg). Weight change from end of the breeding season to weaning of cows with early-weaned calves were also greater ($P<.01$) than that of cows with suckling calves (39.12 and -2.14 kg). Body condition score change from early weaning to end of the breeding season was similar for both groups (1.1 and .8). However, the change in body condition score from end of the breeding season to weaning of cows with early-weaned calves was greater ($P<.01$) than that of cows with suckling calves (.79 and -.02). The weight and body condition losses from end of the breeding season to weaning of cows with suckling calves can be explained by the consumption of low-quality forage due to the hot, dry weather conditions encountered during the study and the nutritional stresses of lactation. The better body condition of the cows with early-weaned calves should reduce the supplement requirements of these cows the following winter. The weight and body condition score changes during the breeding season were not determined since some cows did not have their calves early weaned until the beginning of the breeding season.

The effects of early weaning on cow reproduction are shown in Table IV. The postpartum interval to estrus was shorter ($P<.01$) in cows with early-weaned calves than in cows with suckling calves (49.0 and 86.6 days). The postpartum interval to conception was also shorter ($P<.05$)

TABLE III

EFFECTS OF EARLY WEANING
ON COW PERFORMANCE

	Treatments			
	Early Weaned		Normal Reared	
	Mean[a]	S.E.[b]	Mean	S.E.
No. of Cows	23	----	23	----
Cow weights (kg)				
Early Weaning	357.19	21.7	348.34	24.8
Weight Change (kg)				
From early weaning to end of breeding season	58.49[c]	7.7	48.84[d]	7.3
From end of breeding season to weaning	39.12[e]	7.5	-2.14[f]	8.5
Cow Body Condition Scores				
Early Weaning	5.02	0.15	4.77	0.2
Body Condition Changes				
From early weaning to end of breeding season	1.1	.1	.8	.2
From end of breeding season to weaning	.79[e]	.1	-.02[f]	.1

[a]Least square means
[b]Standard error
[c,d]Means on the same line with different superscript letters differ ($P<.05$).
[e,f]Means on the same line with different superscript letters differ ($P<.01$).

TABLE IV

EFFECT OF EARLY WEANING ON COW REPRODUCTIVE PERFORMANCE

	Treatments			
	Early Weaned		Normal Reared	
	Mean[a]	S.E.[b]	Mean	S.E.
Post partum interval to first estrus (days)	49.0[e]	6.0	86.6[f]	8.0
Post partum interval to Conception (days)	66.2[g]	4.0	86.7[h]	5.2
Conception rate (%)	100(23/23)	----	87(20/23)	---

[a]Least square means
[b]Standard error
[c]Means of cows with early weaned calves were based on 23 observations.
[d]Means of cows with early weaned calves were based on 19 observations.
[e,f]Means on the same line with different superscripts differ (P<.01).
[g,h]Means on the same line with different superscripts differ (P<.05).

in cows with early-weaned calves than in cows with suckling calves (66.2 and 86.7 days). This difference could have been even greater because some early-weaned cows cycled before breeding bulls were turned in. Similarly, conception rate tended to be higher in cows with early-weaned calves than in cows with suckling calves (100 and 87%).

This significant increase in estrus activity of cows with early-weaned calves can be explained by the cessation of suckling and the associated increase in the nutritional status of the thin cows due to the cessation of lactation (Laster et al., 1973). The relatively high conception rate of the cows that nursed calves (87%) shows that mature, spring-calving cows can often rebreed even in moderate to thin condition when grazed on summer pasture. The postpartum interval in such cows may still be unacceptable, however.

The improvement of the nutritional status of the thin cows and the cessation of suckling may have had a favorable effect on the postpartum hormonal balance necessary for the reestablishment of normal reproductive activity (Beal et al., 1978; Lishman et al., 1979; Carter et al., 1980).

These results indicate that calves can be successfully weaned at 42 to 56 days of age with minimal labor and facilities. Spring-calving, mature, thin cows with early-weaned calves rebred faster and were in better body condition in the fall than cows with suckling calves. Similarly, conception rate of cows at palpation in the fall with early-weaned calves were higher, although not significantly so, than that of cows with suckling calves.

This study shows that early weaning can be an effective tool to accelerate rebreeding in late calving cows and increase the number of cows calving early in the next calving season. Economic feasibility will depend on the expected improvement in weaning weights from calves born earlier, the price of early weaning rations, the expected savings in wintering dams of early-weaned calves and the anticipated increase in the next calf crop due to early weaning.

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APPENDIX

TABLE V

ANALYSES OF VARIANCE (CALF WEIGHT AND AVERAGE DAILY GAIN)

AOV Table for Calf Weight at Weaning

Source of Variation	df
Total	45
Model	12
Cow age	1
Season group	3
Weaning group	1
Season group X Cow age	3
Weaning group X Cow age	1
Weaning group X Season group	3
Error	33

AOV Table for Calf Average Daily Gain

Source of Variation	df
Corrected Total	45
Model	12
Cow age	1
Season group	3
Weaning group	1
Season group X Cow age	3
Weaning group X Cow age	1
Weaning group X Season group	3
Error	33

TABLE VI

ANALYSES OF VARIANCE (COW WEIGHT CHANGE, CONDITION SCORE CHANGE, POSTPARTUM INTERVAL TO FIRST ESTRUS AND POSTPARTUM INTERVAL TO CONCEPTION)

AOV for Cow Weight Change From Early Weaning to End of Breeding

Source of Variation	df
Corrected Total	45
Model	6
Cow age	1
Season group	3
Sex	1
Weaning group	1
Error	39

AOV for Cow Weight Change from End of Breeding to Weaning

Source of Variation	df
Corrected Total	45
Model	13
Cow age	1
Season group	3
Sex	1
Weaning group	1
Season group X Cow age	3
Sex X Cow age	1
Weaning group X Season group	3
Error	32

TABLE VI (Continued)

AOV for Cow Condition Score Change
From End of Breeding to Weaning

Source of Variation	df
Corrected Total	45
Model	20
Cow age	1
Season group	3
Sex	3
Weaning group	1
Cow age X Season group	1
Cow age X Sex	3
Season group X Sex	1
Season group X Weaning group	3
Sex X Weaning group	1
Season group X Sex X Weaning group	3
Error	25

AOV* for Cow Postpartum Interval to First Estrus

Source of Variation	df
Corrected Total	27
Model	6
Cow age	1
Season group	3
Sex	1
Weaning group	1
Error	21

AOV** for Cow Postpartum Interval to Conception

Source of Variation	df
Corrected Total	36
Model	12
Cow age	1
Season group	3
Weaning group	1
Season group X Cow age	3
Weaning group X Cow age	1
Weaning group X Season group	3
Error	24

* Eighteen missing data.
**Nine missing data.

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