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Estrous Synchronization Increases Early Calving Frequency, Which Enhances Steer Progeny Value

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Summary

Calving records collected between 2000 and 2008 at the Gudmundsen Sandhills Laboratory, Whitman, Neb., were used to determine the effect of estrous synchronization on calving distribution and the impact of time of calving on carcass characteristics. More synchronized cows calved during the first 21 days compared to non-synchronized cows, and calves born to synchronized dams were heavier at weaning. Calves born in the first 21 days of the calving season had greater carcass weights, marbling scores, and yield grades than later born calves. In addition, the percentage of steers grading premium choice or greater and the total carcass value declined as time of calving increased. Estrous synchronization with natural breeding resulted in cows giving birth earlier, and calves born earlier in the season were heavier at weaning and produced a heavier, more valuable carcass.

Introduction

Estrous synchronization is potentially beneficial to cattle producers using natural mating. Prostaglandin $F_{2\alpha}$ (PGF) causes lysis of the corpus luteum (CL) when administered at least 96 hours after ovulation; however, the corpus luteum is not responsive to PGF prior to this time. Standing estrus will occur between 48 and 96 hours after PGF in cyclic females. Whittier et al. (1991, *Journal of Animal Science*, 69:4670-4677) demonstrated a single PGF injection administered 96 hours after bull turn-in increased the percentage of cows calving in the first 50 days of the calving season. However, they did not detect a difference in the percentage calving in the first 21 days, nor did they measure weaning BW or carcass characteristics of the resulting calf crop. Data from our group indicate more heifers given PGF 96 hours after bull turn-in calve in the first 21 days of the calving season. Further research is needed to evaluate the effect of this system in mature, lactating cows. Thus, data from eight production years were summarized to determine the effect of estrous synchronization on time of calving and subsequent effects of time of calving on carcass characteristics.

Procedure

The University of Nebraska–Lincoln Institutional Animal Care and Use Committee approved the procedures and facilities used in this experiment.

Breeding, calving, weaning, and carcass data were collected from the research herd at the Gudmundsen Sandhills Laboratory (GSL) near Whitman, Neb. The data for the spring calving herd, collected between 2000 and 2008, were used for the purposes of this analysis. Calves born between 2000 and 2006 resulted from non-synchronized 60-day breeding seasons between 1999 and 2005 (n = 2,075). Calves born in 2007 and 2008 resulted from estrous synchronized 45-day breeding seasons in 2006 and 2007 (n = 521). The exception was a subset of cows used in a nutritional experiment exposed to bulls for 60 days during the estrous synchronized spring breeding season in 2007 (118 cows). The breeding season began on approximately June 15. Estrus was synchronized using a single injection of PGF administered 108 hours after fertile, mixed age bulls were turned in with the cowherd. The bull to cow ratio was not greater than 1:25 in all years. Pregnancy was diagnosed via rectal palpation approximately 45 days following bull removal. As varying nutritional and breeding treatments were applied to the yearling heifers during breeding, two year-old cows were removed from this analysis to avoid confounding the results. Weaning data were analyzed for the 2007 and 2008 weaned calves (408 individual records) and compared to calves weaned between 2000 and 2006 (1,790 individual records).

Weaned steers (n = 659) in each year were transported to the West Central Research and Extension Center in North Platte, Neb. The data from these steers were used to determine the effect of early calving frequency on feedlot performance and carcass quality. Steers were fed a common diet in the feedlot within each year for approximately 218 days. Steers were slaughtered at a commercial abattoir when 12th rib fat cover was visually assessed to be approximately .5 in. Routine carcass data were collected after slaughter. Carcass characteristics were evaluated by period of calf birth defined as the first, second, or third 21-day period of the calving season. The continuous data were analyzed using the MIXED procedure of SAS; binomial data were analyzed with the GLIMMIX procedure of SAS. The model included the fixed effects of estrous synchronization and the age of the dam. The model also included the random effects of year and any treatments imposed on each particular herd within each year.

Results

The data demonstrating effects of estrous synchronization on reproduction and calf production are displayed in Table 1.

Calf birth date was similar ($P = 0.23$) for estrous synchronized and non-synchronized cows; however, calf birth BW ($P < 0.001$) and the incidence of dystocia ($P < 0.001$) were lower in calves from synchronized dams. The percentage of male calves was unaffected ($P = 0.62$) by estrous synchronization. Estrous synchroniza-

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Table 1. Effect of estrous synchronization in a natural mating system on reproduction and calf production.

Item	Estrous synchronized		SEM	*P*
	No	Yes		
n	2075	521		
Calf birth date, Julian day	86	85	1	0.23
Calf birth BW, lb	84	82	2	< 0.001
Assisted births, %	4.4	1.7	5	< 0.001
Calved in 1st 21 days, %	61	73	2	< 0.001
Calved in 2nd 21 days, %	33	23	2	< 0.001
Calf sex, % male	51	52	2	0.62
n	1790	408		
Calf weaning BW, lb	483	503	7	< 0.001
Cow BW at weaning, lb	1113	1107	9	0.16
Cow BCS at weaning	5.2	5.2	0.1	0.25
Pregnant, %[1]	95	94	1	0.48

[1] Pregnancy rate after an estrous synchronized or unsynchronized natural mating season.

Table 2. Effect of calving period on feedlot performance and carcass characteristics of steer progeny.

Item	Calving period[1]			SEM	*P*
	1	2	3		
n	347	259	53		
Calf birth BW, lb	81	83	82	1	0.47
Calf weaning BW, lb	515[a]	483[b]	435[c]	12	< 0.001
Pre-weaning ADG, lb	2.12	2.12	2.13	0.05	0.92
Feedlot ADG, lb	3.61	3.62	3.63	0.12	0.90
HCW, lb	816[a]	800[b]	771[c]	11	< 0.001
Marbling score[2]	574[a]	554[b]	527[c]	15	< 0.001
Empty body fat, %	30.4[a]	29.9[b]	29.0[c]	0.4	< 0.001
Yield grade	3.0[a]	2.8[b]	2.6[c]	0.2	< 0.001
Choice or greater, %	84	83	73	8	0.17
Average Choice or greater, %	30[a]	17[b]	12[b]	5	0.001
Carcass value, $	1102[a]	1079[b]	1025[c]	45	< 0.001

[1]1 = calved in the first 21 days; 2 = calved in the second 21 days; 3 = calved in the third 21 days.
[2]500 = small^0.
[abc]Means without a common superscript differ ($P \leq 0.05$).

tion increased ($P < 0.001$) the percentage of cows giving birth in the first 21 days by 12% (73 vs. 61%, estrous synchronized vs. non-synchronized, respectively). This may partially explain the reduction in birth BW. Cows at GSL were calved in a common group and consumed a higher quality diet during calving than during late gestation. Thus, cows calving later were on a higher plane of nutrition during late gestation than earlier calving cows, perhaps leading to heavier calves at birth.

The mechanism underlying this estrous synchronization system relies on the observation that the CL is unresponsive to PGF within 96 hours after ovulation. Thus, bulls were allowed to inseminate cows at natural estrus for approximately 5 days; cows inseminated during this period will not respond to PGF. On day 5, PGF was administered to all cows and the bulls inseminated cows at synchronized estrus following PGF. It was imperative to administer PGF at the correct interval to avoid destroying the CL in cows inseminated on the day of bull turn-in. Calf birth date was unaffected, which may seem counterintuitive. Most likely, cows that failed to conceive at the synchronized estrus were inseminated 21 days later, and thus average calving date was unaffected. As further evidence, 96 and 94% of the 94-95% of cows that became pregnant (estrous synchronized and non-synchronized, respectively), calved within the first 42 days of the season. Regardless, more calves were born early in the season with estrous synchronization.

As more calves were born earlier in the season, one may expect unadjusted weaning BW to be increased. Accordingly, calves from estrous synchronized dams were 20 lb heavier ($P < 0.001$) than calves from non-synchronized dams. This likely made calves from estrous synchronized dams more valuable at weaning, improving profitability.

Although the natural breeding season was shortened when estrous synchronization began, pregnancy rate was unaffected ($P = 0.48$) by synchronization. Perhaps this indicates a more efficient use of bull resources during the breeding season. At pregnancy diagnosis, both cow BW and BCS were similar ($P \geq 0.16$) for estrous-synchronized and non-synchronized cows.

Estrous synchronization increased the percentage of cows calving in the first 21 days of the breeding season (Table 2). This indicates more cows were mated by natural service early in the breeding season. Estrous synchronization increased calf weaning BW and potential value. In addition, the breeding season was shortened from 60 to 45 days between non-synchronized and estrous synchronized seasons, respectively, without negatively affecting pregnancy rate.

When evaluating only steer progeny, male calves born earlier in the season did not have a lighter ($P = 0.47$) birth BW than those born later. As the time of calving became more advanced, steer weaning BW was lower ($P < 0.001$) with each successive interval, likely related to calf age. Neither preweaning ($P = 0.92$) nor feedlot ADG ($P = 0.90$) were affected by time of calving.

Similar to weaning BW, hot carcass weight (HCW) increased ($P < 0.001$) with early calving frequency. Perhaps more interesting, marbling score and the percentage of steers achieving a USDA quality grade of modest or greater were greater ($P = 0.001$) in steers born earlier than those born later. It was, and perhaps still is, a

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common paradigm that intramuscular fat is a late developing trait. These data would support the hypothesis steers born earlier in the calving season are older at harvest. The increase in marbling score cannot be separated from a difference in caloric intake, as DMI was not measured. However, older steers also are fatter, as evidenced by an increase ($P < 0.001$) in yield grade of earlier born steers. As time of calving became more advanced, the percentage of empty body fat ($P < 0.001$) decreased. Thus, it appears as time of calving advanced, carcass fat content in all depots, including intramuscular, decreases. Although later born steers had a slightly lower yield grade, the reduction in marbling score made their carcasses less valuable ($P < 0.001$). The difference in carcass value also was related to the increased HCW of steers born earlier in the calving season. Therefore, carcasses of earlier born steers were more valuable on a weight basis and received a greater premium on a carcass basis than later born steers.

Implications

Estrous synchronization with a single injection of PGF can increase the percentage of cows naturally mated early in the breeding season. This improvement occurs even in a shorter breeding season. Moreover, most cows not mated at the first estrus become pregnant at the second. Steer calves born earlier in the calving season have greater weaning BW, HCW, and marbling scores. Improving early calving frequency may increase progeny value at weaning and enhance carcass value of the steers.

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