FERTILITY OF HEIFERS AFTER SYNCHRONIZATION OF ESTRUS USING GnRH, $PGF_{2\alpha}$, AND PROGESTERONE (CIDR)

A. M. Richardson, S. K. Johnson[1], B. A. Hensley
T. J. Marple, and J. S. Stevenson

Summary

Our objectives were to determine fertility of heifers after estrus synchronization using $PGF_{2\alpha}$ preceded by either progesterone, GnRH, or both. Beef (n = 193) and dairy (n = 246) heifers were assigned randomly to three treatments: 1) 50 µg of GnRH and a used intravaginal progesterone-releasing insert were administered on day −7, followed by 25 mg of $PGF_{2\alpha}$ on day −1, and CIDR removal on day 0 (CIDR + GnRH + PGF); 2) the same as 1) but without the GnRH (CIDR + PGF); and 3) the same as 1) but without the CIDR (GnRH + PGF; modified Select Synch). Rates of estrus detection were lower in dairy than in beef heifers, and greater in heifers treated with the CIDR. In dairy heifers, conception and pregnancy rates were greatest in the CIDR + PGF treatment, followed by the CIDR + GnRH + PGF and GnRH + PGF treatments. The opposite trend was observed among treatments in beef heifers. All estrus-synchronization treatments produced acceptable estrus detection and pregnancy rates.

(Key Words: Estrus, Heifers, CIDR-B, Fertility.)

Introduction

The importance of dairy and beef heifers as future replacements cannot be overstated. Estrus can be synchronized either by shortening the luteal phase with $PGF_{2\alpha}$ or by artificially extending the luteal phase with progestins. The "gold standard" for synchronizing estrus in beef heifers is the MGA + PGF protocol (feed 0.5 mg of melengesterol acetate [MGA] per day for 14 days and then inject $PGF_{2\alpha}$ 17-19 days later). The major disadvantage of that protocol is its long duration (31-33 days) before insemination begins.

Introduced in the early 1980's, the CIDR-B device (Controlled Internal Drug Release; InterAg, Hamilton, NZ) is an intravaginal insert that provides controlled release of exogenous progesterone. Similar to using MGA, behavioral estrus and ovulation are suppressed during treatment with the CIDR. But unlike MGA, fertility is normal at the first estrus after CIDR treatment. Short-term treatment with the CIDR produced tight synchrony of estrus, but conception rates were variable and related to treatment duration.

Our objectives were to determine estrual characteristics and fertility of heifers after synchronization using $PGF_{2\alpha}$ preceded by either progesterone, GnRH, or both.

Procedures

Holstein heifers (n = 246) averaged 13 ± 0.1 months of age (12 to 20 months) and weighed 886 ± 4 lb (754 to 1236 lb) prior to treatment. Sixteen replications of the treat-

[1]Extension Specialist, Northwest Area Extension Office, Colby

ments (ranging from 6 to 29 heifers per replication) were conducted between November 1998 and August 2001.

Beef heifers at the Manhattan location (April 2001) consisted of purebred Angus, Herefords, and Simmentals. Average age was 14 ± 0.1 mo (12 to 15 mo). Beef heifers at Hays (April 2001) were Angus crosses and averaged 13 ± 0.1 mo (11 to 15 mo) of age. Only one beef heifer was less than 12 mo of age at the initiation of treatments.

Heifers were assigned randomly to three treatments (Figure 1): 1) 50 µg of GnRH (injected i.m., Cystorelin, Merial, Iselin, NJ) and a used intravaginal progesterone-releasing insert (CIDR-B, InterAg, Hamilton, NZ) were administered on day −7, followed by 25 mg of $PGF_{2\alpha}$ (i.m., Lutalyse, Pharmacia Animal Health, Kalamazoo, MI) on day −1, and CIDR removal on day 0 (CIDR + GnRH + PGF); 2) the same as 1) without the GnRH (CIDR + PGF); and 3) the same as 1) without the CIDR (GnRH + PGF; modified Select Synch).

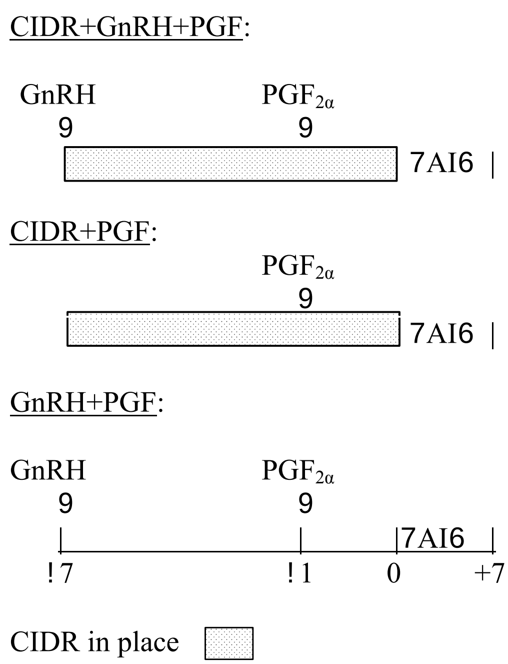


Figure 1. Experimental Protocols.

Blood samples were collected for later analyses of progesterone concentration. Prepubertal heifers had only low (<1 ng/mL) concentrations of progesterone on days −7, −1, and 0.

Beef heifers were observed for estrus multiple times during daylight hours beginning the day of $PGF_{2\alpha}$ injection. Dairy heifers had HeatWatch patches attached for continuous detection of estrus. All heifers were examined for pregnancy once between 27 and 34 days after insemination by transrectal ultrasonography. Rates of estrus detection (number of heifers detected in estrus during 7 days after $PGF_{2\alpha}$), conception (number of pregnant heifers divided by number of heifers inseminated), and pregnancy (number of pregnant heifers after synchronized insemination divided by the number of heifers treated) were calculated. Intervals from injection of $PGF_{2\alpha}$ to visual observation of estrus were determined. Measures of estrus-detection rate, conception rate, pregnancy rate, and interval from $PGF_{2\alpha}$ to estrus, were analyzed using a model consisting of treatment, group (beef vs. dairy), and their interaction.

Results and Discussion

Summarized in Table 1 are the estrus-detection rates of the dairy and beef heifers. The rates varied from 74 to 91% and were greater ($P<0.05$) in both heifer groups treated with the CIDR. The estrus detection rates tended ($P=0.07$) to be lower for prepubertal heifers (61%) than for cycling heifers (85%) and less ($P=0.06$) for all heifers that had low progesterone levels (no corpus luteum) (69%) than for heifers with high progesterone levels (corpus luteum present) (86%). Average interval from $PGF_{2\alpha}$ to estrus was greater ($P<0.01$) for both CIDR treatments (3 ± 0.1 days) than for the GnRH + PGF treated heifers (2.2 ± 0.1 days). In addition, estrus-detection rates were 10% greater ($P<0.05$) in beef than dairy heifers.

Distribution of estrus after $PGF_{2\alpha}$, based on continual surveillance of the dairy heifers by the HeatWatch system, is illustrated in Figure 2. More ($P<0.01$) dairy heifers in the CIDR + PGF (67%) and CIDR + GnRH + PGF (75%) treatments began estrus between 48 and 71 hours after $PGF_{2\alpha}$ than those in the GnRH + PGF treatment (40%). In contrast, more ($P < 0.05$) heifers in the GnRH + PGF treatment began estrus between 24 and 47 hours (44%) after $PGF_{2\alpha}$ than in other treatments (<10%). The peak in estrus expression was confined to a 24-hour period for those heifers treated with the CIDR compared to those receiving only GnRH before $PGF_{2\alpha}$.

In Figure 3, the pattern of estrus expression of the beef heifers (based on multiple daily visual observations during daylight hours) was similar to that of the dairy heifers (Figure 2). Most of the beef heifers showed estrus on day 2 after $PGF_{2\alpha}$. More ($P < 0.01$) beef heifers in the CIDR + PGF (74%) and CIDR + GnRH + PGF (74%) treatments were in estrus on day 2, whereas fewer ($P < 0.05$) heifers in the GnRH + PGF treatment (44%) were detected on day 2.

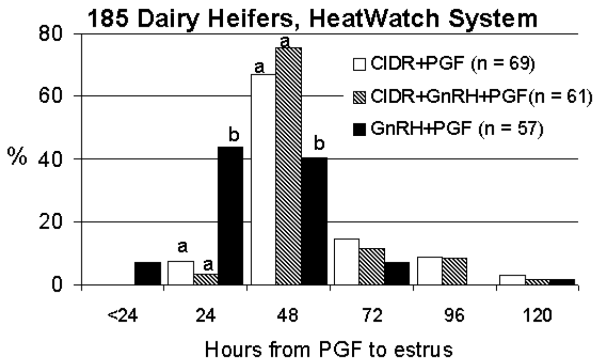
Average heifer group conception rates varied little, from 54 to 59%, but a treatment × group interaction ($P<0.05$) was detected (Table 1). This interaction carried over to pregnancy rates as well. In the dairy heifers, conception and pregnancy rates were greatest in the CIDR + PGF treatment and least in the GnRH + PGF treatment, whereas those in the CIDR + GnRH + PGF treatment were intermediate. In contrast, conception and pregnancy rates in the CIDR + PGF treatment were the least in beef heifers, and those in the CIDR + GnRH + PGF and GnRH + PGF treatments were similar.

These data provide evidence that administration of progesterone for only 7 days before $PGF_{2\alpha}$ produced superior conception and pregnancy rates in dairy heifers. But for beef heifers, an injection of GnRH may be necessary at the time of CIDR insertion to maximize conception and pregnancy rates.

We cannot explain the difference between beef and dairy heifers in their response to these treatments. We can only speculate that perhaps the progesterone in the CIDR was able to prevent formation of persistent follicles in dairy heifers whose corpus luteum regressed early after CIDR insertion. In beef heifers, without the GnRH injection, the CIDR + PGF did not produce acceptable fertility. Likewise, for the GnRH + PGF in dairy heifers, level of fertility observed was not acceptable.

We anticipate that the CIDR will provide a viable alternative treatment protocol of short duration compared to the MGA (14 days of feeding) + PGF (injected 17 to 19 days after MGA) protocol for synchronizing estrus in beef heifers.

Note: The administration of progesterone via a CIDR as described in this study has not been approved by the United States Food and Drug Administration. It is anticipated to be market-available late in 2002.



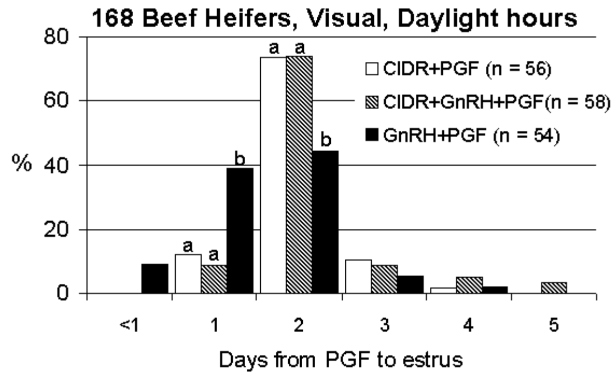


Figure 2. Percentage Distribution of Estrus After $PGF_{2\alpha}$. Continuous Surveillance by HeatWatch System. [a,b]Different (P<0.01) within interval

Figure 3. Percentage Distribution of Estrus After $PGF_{2\alpha}$. Visual Observation, Daylight Hours. [a,b]Different (P<0.01) within day.

Table 1. Reproductive Traits of Dairy and Beef Heifers in Response to CIDR, CIDR+GnRH, or GnRH

		Treatment[a]			
Item	Group	CIDR + $PGF_{2\alpha}$	CIDR+GnRH + $PGF_{2\alpha}$	GnRH + $PGF_{2\alpha}$	Group Avg.
No. of heifers					
	Beef	64	64	65	193
	Dairy	83	81	83	247
	Total	147	145	148	
Estrus-detection rates[b], %					
	Beef	89	91	83	88
	Dairy	86	79	74	79
	Total	87	84	78	
Conception rates[c], %					
	Beef	46	59	59	54
	Dairy	69	58	48	59
	Total	59	58	53	
Pregnancy rates[c], %					
	Beef	41	53	49	48
	Dairy	59	46	35	47
	Total	51	49	41	

[a]See Figures 2 and 3 for description of treatments.
[b]Effects of group (P<0.05) and CIDR (P<0.05).
[c]Treatment × group interaction (P<0.05).