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FERTILITY AFTER SYNCHRONIZATION OF ESTRUS IN DAIRY HEIFERS USING GnRH, PGF_{2α}, AND PROGESTERONE (CIDR)

*A. M. Richardson, B. A. Hensley,
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Summary

Our objective was to determine fertility of heifers after synchronization of estrus using PGF_{2α}, preceded by progesterone, GnRH, or both. Dairy heifers (n = 246) were assigned randomly to three treatments: 1) 50 µg of GnRH given 6 d before 25 mg of PGF₂ (d -1) plus a used intravaginal progesterone-releasing insert (CIDR-B; d -7 to 0; CIDR+GnRH); 2) same as CIDR+GnRH without the GnRH (CIDR); and 3) same as CIDR+GnRH without the used CIDR (GnRH). All heifers were fitted with Heat-Watch® patches and characteristics of estrus examined before AI included duration of estrus, number of standing events, and total duration of standing events. In addition, all heifers were observed visually twice daily for estrus. Rates of conception and pregnancy differed among treatments. All of the estrus-synchronization treatments produced acceptable estrus detection and pregnancy rates but the CIDR+PGF_{2α} treatment was most effective for improving conception and pregnancy rates.

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

Introduction

The importance of dairy heifers as future replacements has been overlooked, especially in terms of their high fertility and excellent expression of estrus relative to their lactating herd mates. Estrus can be synchronized either by shortening the luteal phase with PGF_{2α} or by artificially extending the luteal phase with progestins. Introduced in the early 1980's, the CIDR-B (Controlled Internal Drug Release; InterAg, Hamilton,

NZ) is an intravaginal insert that provides controlled release of exogenous progesterone to cattle. The CIDR increases plasma concentrations of progesterone in ovariectomized cows. Signs of behavioral estrus and ovulation are suppressed during treatment with progesterone. Short-term treatment with the CIDR produced tight synchrony of estrus, but conception rates were variable and related to treatment duration. Pregnancy rates have been reported to range from 50 to 82%. The objectives of the present study were to determine estrual characteristics and fertility of heifers after synchronization of estrus using PGF_{2α} preceded by 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 treatments (ranging from 6 to 29 heifers per replication) were conducted between November 1998 and August 2001.

The dairy heifers were maintained in dry lots with concrete feed aprons and fed a total mixed diet of chopped prairie or alfalfa hay, corn or milo grain, soybean meal, and minerals and vitamins to exceed NRC (1989) guidelines for growing heifers by 15% for all nutrients. Heifers were assigned randomly to three treatments (Figure 1): 1) 50 µg of GnRH (Cystorelin, Merial, Iselin, NJ) was injected i.m. (d -7), 6 d before 25 mg of PGF_{2α} (Lutalyse, Pharmacia Animal Health, Kalamazoo, MI) was injected i.m. on d -1, plus a used intravaginal progesterone-releasing insert (CIDR-B, InterAg, Hamilton, NZ) (d -7 to 0; CIDR + GnRH + PGF); 2) same

as CIDR + GnRH + PGF without the GnRH (CIDR + PGF); and 3) same as CIDR + GnRH + PGF without the used CIDR (GnRH + PGF).

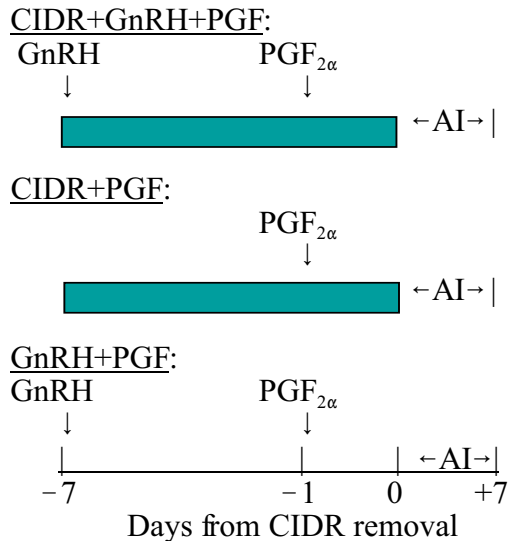


Figure 1. Experimental Protocols.

A HeatWatch® (DDX, Inc., Denver, CO) patch was attached to the rump of each heifer prior to d -7 and maintained in place until pregnancy was diagnosed. All dairy heifers also were observed visually twice daily for signs of estrus beginning on d -1. The following measurements were calculated from the HeatWatch® system: number and duration of total standing time and of each individual standing event, duration of estrus (interval between first and last standing events), and interval from the PGF_{2α} injection to estrus.

Interval from first standing event after PGF_{2α} until insemination was known in over 92% of the dairy heifers; of which over 66% were inseminated between 6 and 16 h after onset of estrus. Two technicians performed inseminations. Pregnancy was diagnosed by transrectal ultrasonography in all heifers once between 27 and 34 d after insemination.

Rates of estrus detection (number of heifers detected in estrus during 7 d after PGF_{2α}), 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_{2α} to visual observation or HeatWatch detection of first standing event were determined. Measures of estrus-detection rate, conception rate, pregnancy rate, interval from PGF_{2α} to estrus, and concentrations of progesterone were analyzed using a statistical model consisting of treatment, season, and their interaction.

Results and Discussion

Distribution of estrus after PGF_{2α} based on continual surveillance of the HeatWatch system for the dairy heifers is illustrated in Figure 2. More ($P<0.01$) than 60% of the heifers in the CIDR + PGF (67%) and CIDR + GnRH + PGF (75%) treatments came into estrus in the 48- to 72-h interval after PGF_{2α} than in the GnRH + PGF treatment (41%). However, more ($P<0.05$) heifers in the GnRH + PGF treatment came into estrus during the 24- to 48-h interval (44%) than in the other treatments (<8%).

A delayed interval to estrus after CIDR removal was explained by changes in serum concentrations of progesterone. A CIDR effect ($P<0.001$) was detected on the day of CIDR removal (day 0) where only 29% of the dairy heifers in the GnRH + PGF treatment had elevated (≥ 1 ng/mL) concentrations of progesterone compared to 77% of the dairy heifers in the two treatments with CIDR.

Table 1 summarizes reproductive traits of heifers in response to treatments. The estrus-detection rates varied from 73 to 85% and were not different among treatments. Conception rates varied little, from 47 to 69%, but were greater ($P<0.05$) in the CIDR+PGF treatment compared to the GnRH + PGF treatment. Likewise, pregnancy rates were greater ($P<0.05$) for heifers in the CIDR+PGF treatment.

Table 2 summarizes the estrual characteristics of the dairy heifers in each treatment. Interval from PGF_{2α} to estrus and the total

number of standing events were affected differently by the CIDR. Interval from PGF2" to estrus was prolonged ($P<0.001$) by 18-19 hr in the two CIDR treatments compared to that for the GnRH + PGF treatment. In contrast, the pre-estrous supplementation of progesterone via the CIDR tended ($P = 0.11$) to reduce the number of standing events per estrus by 20%. Duration of standing estrus and total or individual duration of standing events were not altered by treatment.

Seasonal effects were detected for the number of standing events and duration of total and individual standing events. Total

standing time was 69 to 81% greater ($P<0.05$) during spring (100 ± 16 sec) and fall (107 ± 8 sec) than during summer (59 ± 11 sec) and 51% greater ($P<0.05$) during winter (89 ± 10 sec) than summer. These data provide evidence that administration of progesterone for 7 d before PGF2" produced superior conception and pregnancy rates. 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 available within the next calendar year.

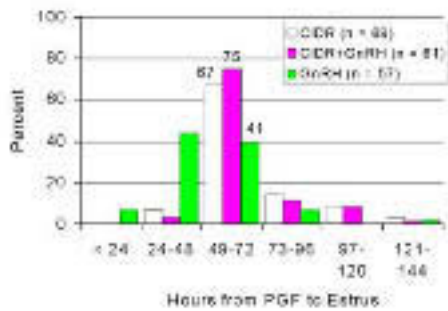


Figure 2. Percentage Distribution of Estrus after PGF2a Injection

Table 1. Estrual and Fertility Traits of Dairy Heifers after Estrus Synchronization.

Item	Treatments ¹		
	CIDR + PGF	CIDR + GnRH + PGF	GnRH + PGF
	----- % (no.) -----		
Estrus-detection rate	85.5 (83)	80.0 (80)	73.5 (83)
Conception rate ²	69.0 ^a (71)	56.3 (64)	47.5 (61)
Pregnancy rate ³	59.0 ^a (83)	45.0 (80)	34.9 (83)

¹See Figure 1 for description of treatments.

²Seasonal effect ($P<0.01$): spring (83.3%; n = 24) vs. summer (50.0%; n = 48).

³Seasonal effect ($P<0.01$): spring (76.9%; n = 26) vs. summer (38.1%; n = 63).

^aDifferent ($P<0.05$) from GnRH+PGF.

Table 2. Estrual Characteristics Based on the HeatWatch® System.

Item	Treatments ¹		
	CIDR + PGF	CIDR + GnRH + PGF	GnRH + PGF
No. of heifers	69	61	57
Hours from PGF to estrus	67 ± 3 ^a	66 ± 3 ^a	48 ± 3
Duration of estrus, h	12 ± 0.7	12 ± 0.6	11 ± 0.7
No. of standing events ²	32 ± 4	31 ± 3	39 ± 4
Duration of standing time ² , sec	84 ± 10	81 ± 9	100 ± 11
Duration of individual standing events ³ , sec	2.5 ± 0.1	2.7 ± 0.1	2.5 ± 0.1

¹See Figure 1 for description of treatments.

²Summer less ($P<0.05$) than other seasons.

³Summer less ($P<0.05$) than autumn.

^aDifferent ($P<0.05$) from GnRH+PGF.