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OBSERVATIONS WITH HEATWATCH® TO DETECT ESTRUS BY RADIOTELEMETRY IN CATTLE

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Summary

In Experiment 1, the effectiveness of two estrus-detection methods (visual observation vs radiotelemetric, pressure-sensitive, rump-mounted devices [HeatWatch®]) were compared in heifers. A pressure sensitive device containing a battery-operated radio transmitter was affixed to the tailhead rump area of each of 41 heifers. Activation of the sensor sent a radiotelemetric signal to a microcomputer via a fixed radio antenna. Heifer identification, date, time of day, and duration of standing events were recorded. Estrus was synchronized, and heifers were observed visually for signs of estrus. Number of standing events during estrus, determined by the radiotelemetric device, averaged 50.1 ± 6.4 per heifer, with the duration of estrus ranging from 2.6 to 26.2 hr (average = 14 ± .8 hr). Number of standing events and duration of estrus were greater, but duration of standing events was similar, for heifers identified in estrus by both methods compared to those identified by the radiotelemetric device alone, indicating that heifers with a limited number of standing events and estrus of shorter duration were missed by visual observation. In Experiment 2, the average number of standing events during estrus was greater when estrus was induced early (days 6 to 9) in the cycle by $PGF_{2\alpha}$ compared to those induced later (after day 10) in the cycle. Regardless of when injections of $PGF_{2\alpha}$ occurred during the cycle, duration of standing events and duration of estrus were unaffected. Radiotelemetric devices are useful in identifying a greater proportion of heifers in estrus (increased efficiency) compared to visual observation with similar accuracy.

(Key Words: Radiotelemetry, Pressure Sensors, Estrus, Heifers, Heat Detection.)

Introduction

Failure to detect estrus or misdiagnosis of estrus accounts for an estimated annual loss of over $300 million to the U.S. dairy industry. Insufficient time allocation for detection of estrus contributes to lower efficiency and missed periods of estrus, particularly in cattle in which estrus is of lesser intensity and shorter duration. Many aids, including tail paint or chalk, chin-ball markers fitted to androgenized females or sterile bulls, heat-mount patches, video cameras, dogs trained to detect estrus-related odors, and pedometers have been developed for detection of estrus. Some methods improve detection efficiency when used simultaneously with visual observation; however, when used alone, their overall benefit is sometimes less effective. Systems that use a radiotelemetric, pressure-sensitive device, which attaches to the rump of the female and interfaces with a microcomputer, are available. Studies have demonstrated some promise for this technology to resolve estrus-detection problems in dairy cattle. The objectives of our study were to: 1) compare the efficiency and accuracy of a radiotelemetric system and the traditional visual method of detecting estrus; 2) characterize sexual behaviors in estrus-synchronized heifers; 3) and determine whether stage of the estrous cycle when estrus is induced by $PGF_{2\alpha}$ would alter various characteristics of estrus measured by the radiotelemetric system.

Procedures

Experiment 1. This experiment was conducted at the Kansas State University Agricultural Research Center-Hays in November, 1991. Forty-one crossbred (Angus × Hereford × Brahman) yearling beef heifers were maintained in a pasture of dormant native grass. Heifers were given ad libitum access to forage sorghum hay, and diets were supplemented with additional sorghum grain, soybean meal, vitamins, and minerals.

Estrus was synchronized by feeding melengestrol acetate (MGA; .5 mg per head/d) for 14 d, followed by injecting (i.m.) 25 mg of $PGF_{2\alpha}$ (Lutalyse®) 17 days after the last daily dose of MGA. Heifers were fitted with a radiotelemetric, pressure-sensitive device (DDX, Inc., Boulder, CO) 5 days before the injection of $PGF_{2\alpha}$ for a total of 17 days. Each single-unit device was held in a saddle-type patch that was glued to rump hair anterior to the tail head. The radiotelemetric device was connected to a battery-operated radio transmitter. The pressure-sensitive sensor was activated by the weight of a mounting female, which sent a radiotelemetric signal to a microcomputer via a fixed radio antenna adjacent to the dry lot pen holding the heifers. The signal transmitted heifer identification, date, time of day, and duration of sensor activation, which were recorded and stored in individual files for each heifer. This system was an earlier generation model of what now is marketed as the HeatWatch® (American Breeders Service, DeForest, WI).

Following the injection of $PGF_{2\alpha}$, heifers were observed visually for estrus twice daily (minimum of 45 min) at 0730 and 1630 and inseminated according to the AM-PM rule (12 to 16 hr after the first visually detected standing event) by the same individual using semen from two Angus sires. Timing of inseminations was based on visual observations made by the herdsman without knowledge of the radiotelemetric determinations to prevent potential bias in the comparison of two methods. If estrus was not detected by 72 hr after $PGF_{2\alpha}$, all remaining heifers were given one fixed-time insemination at 72 hr. If estrus was detected by the herdsman after the fixed-time insemination, a second insemination was not given. Pregnancy status was determined by palpation of the uterus and its contents 60 days after insemination.

Experiment 2. This experiment was conducted at the KSU Dairy Teaching and Research Center in the summer of 1995, using the HeatWatch® heat detection system marketed by American Breeders Service (ABS, DeForest, WI). Twenty-two Holstein dairy heifers were treated with $PGF_{2\alpha}$ on three occasions to induce estrus. The first two injections were given 14 days apart and then one-half of the heifers were injected on days 6 to 9 or the remaining half were injected on days 11 to 16 of the estrous cycle to determine if the various characteristics of estrus differed according to the stage of cycle in which $PGF_{2\alpha}$ was administered.

In both experiments, the following measurements were made: interval from the injection of $PGF_{2\alpha}$ to estrus, number and duration of standing events per period of estrus, and duration of estrus.

Results and Discussion

Experiment 1. Interval to estrus after $PGF_{2\alpha}$ for both heat-detection methods is summarized in Table 1. Interval to estrus, determined by the radiotelemetric devices, was not different between methods (Table 1). Mean interval to estrus after $PGF_{2\alpha}$ for heifers detected by the herdsman tended to be greater ($P = .16$) than that detected by the radiotelemetric devices (58.2 ± 9.3 hr vs 51.5 ± 3.3 hr). This difference of 6.7 hr is to be expected because of the lower frequency of visual observation compared to a potential 24-h surveillance offered by the device. Heifers identified by both methods had more ($P < .001$) standing events (60.5 ± 10.3) than heifers identified in estrus by the radiotelemetric device alone (19.3 ± 10.3). With such high activity, it was not surprising that these 30 heifers were identified in estrus by visual observation.

Among the 11 heifers detected in estrus by the radiotelemetric devices alone, first standing events were distributed unequally throughout the 24-h day: one first stood between midnight and 0600; two between 0601 and noon; three between noon and 1800; and five between 1801 and midnight. Five heifers had five or fewer standing events during estrus.

Fewer ($P < .01$) total heifers were detected in estrus by visual observation (30 of 41) than by the radiotelemetric devices (41 of 41). Accuracy of detected estrus in 30 heifers was 100% by both methods, whereas the radiotelemetric devices detected 11 additional heifers in estrus that were not observed by the herdsman. Therefore, the efficiency of visual observation (detection of all periods of estrus; 73%) was less ($P < .01$) than that achieved by the radiotelemetric devices (100%). Although timing of detection and detection accuracy might be advantages of using the radiotelemetric devices, only an increased efficiency of identifying more periods of estrus was achieved in our study.

Duration of standing events was not different between groups, averaging 8 ± .6 sec. Based on the radiotelemetric data, duration of estrus in our study ranged from 2.6 to 26.2 hr and averaged 14 ± .8 hr in 39 heifers for which it could be determined. Duration of estrus was longer ($P < .01$) in heifers identified by both methods than in heifers identified in estrus by radiotelemetric devices alone (Table 3). Eight of 39 (20.5%) heifers had periods of estrus <10 hr in duration, with four of those being <6 hr in duration. Five of those eight heifers were detected only by the radiotelemetric devices.

Pregnancy rate at first service for heifers inseminated after estrus was detected by visual observation and the HeatWatch® system was 15 of 22 (68%). Eight additional heifers were detected in estrus by visual observation after the fixed-time insemination at 72 hr (also detected in heat by the devices), with conception occurring in three of them. Of the 11 heifers detected in estrus by the radiotelemetric device alone, only three conceived.

Experiment 2. Characteristics of estrus in heifers after $PGF_{2\alpha}$ on various days of the estrous cycle are summarized in Table 2. The interval to estrus was greater ($P<.05$) in heifers that were given $PGF_{2\alpha}$ after day 10 of the estrous cycle than in heifers that were injected between days 6 and 9 of the cycle. Shorter intervals to estrus after $PGF_{2\alpha}$ injections early in the cycle are consistent with our earlier observations. The first dominant follicle is capable of ovulating when the corpus luteum is regressed by $PGF_{2\alpha}$ at this early stage of the cycle. Average number of standing events during estrus was greater in the heifers injected early in the cycle compared to those injected later. In contrast, the duration of standing events and duration of estrus were similar regardless of the stage of the cycle in which $PGF_{2\alpha}$was administered to induce estrus.

Summary

Use of radiotelemetric devices increased the efficiency of detecting estrus in estrus-synchronized heifers. This was especially true for heifers that had fewer standing events and(or) shorter duration of standing activity, in which estrus was missed by visual observation at specific observation periods. A radiotelemetric system provides around-the-clock monitoring of standing activity and also might increase accuracy of detected estrus, depending on the skill of those making visual observations. Such a system would be useful and reliable in various applications where behavioral estrus is an important end point, as well as potentially increasing the occurrence of pregnancy per unit of time.

Table 1. Profile of Standing Events in Heifers Classified by Method of Detected Estrus after Synchronization of Estrus with Melegenstrol Acetate (MGA) and $PGF_{2\alpha}$[1]

	Method[2]		
Item	Visual observation + HeatWatch®	HeatWatch®	SE
No. of heifers	30	11	–
Hours from $PGF_{2\alpha}$ to estrus	58.1	66.5	5.7
No. of standing events	60.5[a]	19.3	10.3
Average duration of event, sec	8.0	8.0	1.0
Duration of estrus, hr	15.6[a]	8.4	1.3

[1]Information was derived from a radiotelemetric device attached to each heifer.
[2]Estrus was detected by visual observation and/or by a radiotelemetric device (HeatWatch®) attached to the tailhead of each heifer.
[a]Different (P < .001) from radiotelemetric method alone.

Table 2. Characteristics of Estrus in Dairy Heifers after Injection of $PGF_{2\alpha}$ at Various Stages of the Estrous Cycle[1]

	Stage of cycle when $PGF_{2\alpha}$ was injected	
Item	Days 6 to 9	Days 11 to 16
No. of heifers	8	32
$PGF_{2\alpha}$ to onset of estrus, hr	39.3 ± 4.5[a]	60.7 ± 2.3
No. of standing events	28.2 ± 4.5[b]	16.3 ± 2.2
Duration of standing events, sec	3.3 ± .2	3.1 ± .1
Duration of estrus, hr	11.3 ± 1.8	13.1 ± 0.9

[1]Information was derived from a radiotelemetric device attached to each heifer.
[a]Different (P<.01) from later stage (days 11 to 16).
[b]Different (P<.05) from later stage (days 11 to 16).