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Factors influencing pregnancy per artificial insemination in repeat-breeder cows induced to ovulate with a CIDR-based protocol

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ABSTRACT

The aim of this study was to determine, using multiple logistic models, factors affecting pregnancy per AI (P/AI) following fixed-time artificial insemination (FTAI) in repeat breeders cows (RBC) treated with rbST throughout lactation. 498 RBC received a CIDR device and 100 μg of GnRH on day 0. CIDR removal and $PGF_{2\alpha}$ (25 mg) treatment were done concurrently on day 7. Estradiol benzoate (EB, 1 mg) was injected on day 8 and GnRH on day 9; cows were inseminated 16–20 h later. Cows with an average milk protein <3% were 43% more likely ($P < 0.05$) to become pregnant at FTAI than cows with milk protein ≥3%. Cows with <6 services had significantly increased chances of becoming pregnant than cows with ≥6 services at FTAI (P/AI 36 vs. 27%; $P < 0.05$). CIDR-treated cows with less than three lactations were 1.7 times more likely (P/AI 35 vs. 21%; $P < 0.05$) to become pregnant than cows in third or greater lactation. Cows with peak milk yields lower than 55 kg were 1.5 times more likely to get pregnant than cows with peak milk yields greater than 55 kg (P/AI 37 vs. 28%; $P < 0.05$). P/AI was lower (30 vs. 35%; $P < 0.01$) for cows with dry periods <62 days than cows with dry periods ≥62 days. Cows subjected to FTAI with a temperature–humidity index (THI) <76 were 45% more likely ($P < 0.05$) to become pregnant than cows inseminated at a THI ≥ 76. It was concluded that an acceptable proportion (32%) of RBC can become pregnant with the protocol used in the present study. Also, subfertility in CIDR-treated cows was associated with high peak yields, high milk protein, increased service, increased lactation, high THI at AI and short dry periods.

1. Introduction

In intensively managed dairy cows repeat breeding can be a major factor involved in infertility. This reproductive disorder leads to large economic losses for the dairy producer due to increased calving intervals, more inseminations (wasted semen and insemination costs), increased culling and replacement costs, and loss of genetic gain through the increased generation intervals (Bartlett et al., 1986; Lafi et al., 1992; Canu et al., 2010; Yusuf et al., 2010). In dairy herds of adequate fertility, where conception rates are commonly at 50–55%, about 14–24% of the cows present the repeat breeding syndrome (Bartlett et al., 1986; Moss et al., 2002; Yusuf et al., 2010). These figures are much higher in dairy operations in zones of intense heat load due to the adverse effect of high ambient temperature on all aspect of the reproductive process (Sepulveda, 2009). In the particular case of dairy operation of northern Mexico, the chronic high ambient temperature coupled with the use of rbST throughout lactation results in a high number of cows unable to become pregnant around 200 DIM (Sepulveda, 2009).

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Cows under these circumstances become candidates to be culled, but high culling rates are very costly to dairy producers. There is a tremendous opportunity to improve profitability by decreasing the number of subfertile cows culled when lactations can be extended beyond 15 months. With prolonged lactations it could be economically advantageous to get cows pregnant even after 200 DIM.

On possible alternative to avoid culling of subfertile cows unable to become pregnant after multiple services is to get them pregnant with fixed-time artificial insemination (FTAI) using a CIDR-based protocol. This technique allows for 100% of the cows to be submitted to AI, without the need for estrous detection (Pursley et al., 1995; Kim et al., 2005). Moreover, an advantage in pregnancy rate of TFAI over insemination at detected estrus has been observed in some cases (Pursley et al., 1997a,b; Cartmill et al., 2001; Amiridis et al., 2009), but not in others (Lima et al., 2009).

This reproductive tool applied to cows with advanced lactation can only be commercially viable if lactations can be substantially extended by increasing persistency and rebreeding cows to calve every 17 rather than 12 months. This can be achieved with simple management procedures such as chronic application of rbST (in countries where this hormone is legally permitted) throughout lactation and three milkings per day. Thus, the aim of this study was to establish the factors influencing P/AI of subfertile cows unable to become pregnant around 200 DIM, and treated with a CIDR-based protocol for FTAI in a hot arid environment. An additional objective was to assess the suitability of extended lactations (around 450 days) for farms where cows are chronically treated with rbST, so that inseminations of low-fertility cows around 200 days of lactation can be justified.

2. Materials and methods

2.1. Study herd, housing and feeding

The experimental procedures and animal care conditions were approved by the Ethics Committee of the Research Department of the Agrarian Autonomous University Antonio Narro. This study was conducted on a commercial dairy farm located in northern Mexico (latitude 26° 23′ N, longitude 104° 47′ W; mean annual temperature 27 °C) during 2010 and 2011.

The herd consisted of approximately 3000 lactating Holstein cows housed in open-dirt pens with fans and sprinklers for forced evaporative cooling during the warm weather. A total of 498 Holstein cows of all parities that calved between January and December 2010, and that were unable to get pregnant with more than three services were included in the study.

Cows were fed diets formulated to provide recommended total daily nutrients for 670-kg dairy cows producing >33 kg of milk/day (NRC, 2001). Cows were fed total mixed diets (49% forage and 51% concentrate; DM basis) that were formulated to provide at least 1.62 Mcal/kg NEl and contained 18% crude protein. Diets contained soybean meal and ground shelled corn as the base ingredients of the concentrate mix; the forage portion of the diet was 50% corn silage and 50% alfalfa hay (DM basis). Cows were fed ad libitum for a daily feed refusal of approximately 10% of that offered, 4 times daily at 06:00, 10:00, 12:00, and 16:00 h. Only during summer, 80% of diet is offered in the evening and 20% in the morning.

Lactating cows were allocated to 3 lactation stage groups (70 ± 13, 145 ± 12 and $\geq 210 \pm 9$ days in milk; mean ± SD). Cows included in the study were in their first to eight lactation, with body condition score ranging from 2.75 to 3.5 (scale 1–5).

Cows were milked thrice daily (04:00, 12:00, and 20:00 h), and the annual rolling herd average was 13,600 kg throughout the duration of the study. All cows were subjected to recombinant bovine somatotropin (rbST; lactotropin, 500 mg of zinc bovine somatotropin, Elanco Animal Health, Mexico) administered subcutaneously every 14 days beginning at 60 DIM and continuing until 2 weeks before drying off.

2.2. Reproductive management

All cows were routinely vaccinated against diseases that impair reproduction functions, such as bovine viral diarrhea, infectious bovine rhinotracheitis, bovine respiratory syncytial virus, para-influenza and leptospirosis (5-varieties). Herd personnel examined fresh cows weekly to identify and treat cows with postpartum reproductive disorders such as retained placenta, metritis, and pyometra. Cows became eligible for insemination after exceeding the voluntary waiting period of 50 DIM.

Cows had an average of 239 days in milk (DIM; SD = 42) when subjected to the FTAI treatment, and the range of unsuccessful inseminations was 3–12; mean = 5.6). The average (±SD) duration of the dry period was 79 ± 33, 12–223) days. Detection of estrus was initiated at the end of the voluntary waiting period, with the aid of pedometers, and AI was conducted based on visual observation of estrous behavior, following the standard a.m./p.m. rule. Commercial frozen-thawed semen from multiple sires was used across all months of the year.

Cows not pregnant around 200 DIM and with more than 3 services without subsequent calving, with clear estrous signs and no clinically detectable reproductive disorders were considered repeat breeders and submitted for FTAI (CIDR-based protocol). Cows were induced to ovulate by inserting, at a random stage of the estrous cycle, an intravaginal device containing 1.9 g of progesterone (CIDR®, Pfizer, Cambridge, USA) and 100 mg GnRH (Fertagyl®, Intervet, Mexico, im, day 0). Seven days later, the CIDR was removed and cows were treated with 25 mg PGF2α (5 ml of Lutalyse®, Upjhon, Mexico, im., day 7). At 24 h after PGF2α, cows received 1 mg of estradiol benzoate (ECP® Pfizer, Mexico; day 8); one day later (day 9) a second dose of 100 mg GnRH was administered and FTAI was performed 16–20 h later. The designated farm inseminator performed all AI, using commercial frozen-thawed bull semen of known acceptable fertility.

Pregnancy was detected by palpation of the uterus per rectum about 50 days post AI. All pregnancy examinations