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Comparison of pregnancy rates in beef cattle after a fixed-time AI with once- or twice-used controlled internal drug release devices

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ABSTRACT

The use of fixed-time artificial insemination (FTAI) provides producers with numerous benefits including the use of superior genetics, shorter breeding and calving seasons, and a more uniform calf crop. However, the cost of implementing FTAI protocols is one of the several drawbacks hindering their use in the beef industry. Potential injection-site lesions from intramuscular injections of the hormones necessary for estrus synchronization are also a cause of concern for carcass quality. The objectives of this experiment were to (1) determine whether or not a twice-used controlled internal drug release (CIDR) device would be effective in an FTAI protocol without adversely affecting pregnancy rate and (2) whether or not the subcutaneous administration of PGF2α affects pregnancy rate. Nulliparous females (n = 99) between 13 and 27 months of age and multiparous cows (n = 43) between 48 and 74 months of age were synchronized for estrus using the 7-day CO-Synch + CIDR protocol. The females were randomly assigned to one of the two treatments: (1) a once-used CIDR (control) or (2) a twice-used CIDR device (treatment) incorporated into their synchronization protocol. The females were also randomly assigned to have their injection of PGF2α administered either intramuscularly or subcutaneously. Blood was taken in a random subset of nulliparous females (n = 52) just before device removal and assayed for concentration of progesterone. The concentration of progesterone was higher (P = 0.01) in the animals that received once-used CIDR devices than that in those received twice-used CIDR devices (3.4 ± 0.5 and 1.4 ± 0.5 ng/mL, respectively). There was no significant effect of parity (P = 0.82), artificial insemination technician (P = 0.60), PGF2α administration (P = 0.83), or treatment (P = 0.67) on pregnancy rates to artificial insemination which were 75.4 ± 6.0% and 71.7 ± 6.4%, for animals that received once- and twice-used CIDR devices, respectively. This study provides evidence that although concentration of progesterone is decreased in animals treated with a twice-used CIDR device, there is still a sufficient release of progesterone from the device to effectively synchronize estrus without adversely affecting the fertility of a herd.

1. Introduction

Artificial insemination (AI) is one of the more widely used assisted reproductive technologies in cattle. It provides producers an effective means of rapidly increasing the genetic progress within their herd [1]. Current recommendations include the utilization of an estrus synchronization protocol to aid in the effectiveness of AI. An estrus

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synchronization program with AI has the potential to shorten breeding and calving seasons resulting in a higher degree of calf uniformity and a decrease in labor costs by reducing the need for daily estrus detection and breeding [2]. Although estrus synchronization and AI may be beneficial for some producers, many beef producers have been reluctant to adopt these technologies for several reasons including the complexity of synchronization protocols, the increased time and labor requirements, cost of implementing the programs, and questionable profitability [3,4].

Many of the current estrus synchronization protocols use a combination of exogenous hormones to regulate the estrous cycle. Prostaglandin (PGF) and GnRH agonists are used to regulate luteolysis and control the emergence of follicular waves and ovulation, respectively. The addition of exogenous progesterone in the form of controlled internal drug release (CIDR) devices to synchronization protocols has been shown to improve pregnancy rates after fixed-time artificial insemination (FTAI) in beef cattle [5]. To date, the 7-day CO-Synch + CIDR FTAI synchronization protocol has been widely accepted by beef producers and used in numerous research projects. Previous research has reported pregnancy rates of 43% to 66%, 45% to 68%, and 51% when animals underwent FTAI 48, 54 to 66, and 72 hours after the injection of PGF, respectively [6–13]. In brief, this protocol starts with GnRH injection to cause follicle turnover concurrently with the insertion of a CIDR device (Day 0). Seven days later, the CIDR device is removed and animals receive an injection of PGF2α to remove any endogenous progesterone sources. Animals receive a second injection of GnRH at the time of insemination 60 to 66 hours after the PGF2α injection to synchronize timing of the LH surge and ovulation. The CIDR device is often used more than once in the industry. Previous studies have implemented CIDR devices in protocols for up to 21 days [14], and although fertility was reduced, the device contained enough progesterone to effectively suppress estrus and created a tightly synchronized group of females. On the basis of these data, one would expect that a CIDR device could still be effective in several shorter estrus synchronization protocols. Studies have reported that once-used devices release progesterone at concentrations similar to those of new devices [15–17] and result in similar pregnancy rates, but plasma progesterone concentrations in animals treated with a twice-used insert were lower than animals treated with a new or once-used device [16,18] which resulted in lower pregnancy rates.

According to Roeber et al. [19], among the top five quality challenges in both beef and dairy market animals, reported by the National Market Cow and Bull Beef Quality Audit 1999, is the incidence of injection-site lesions in the muscle. The development of lesions from injections of reproductive hormones has not been investigated; however, the option of administering PGF subcutaneously as a preventative measure has been studied [20–22], and it is concluded that the CL regresses after a subcutaneous (SC) injection of the recommended dose of PGF. The objectives of the current experiment were to compare the efficacy of a twice-used CIDR versus a once-used device, implemented in a 7-day CO-Synch + CIDR protocol, and an SC versus intramuscular (IM) injection of PGF, in synchronizing estrus and pregnancy rates to FTAI in nulliparous and multiparous beef animals.

2. Materials and methods

All experimental procedures used were approved by the North Carolina State University Animal Care and Use Committee.

2.1. Animals

The animals used in this study were purebred Angus yearling heifers and 2-year-old heifers, held from their first breeding season (n = 99) between 13 and 27 months of age and cows (n = 43) between 48 and 74 months of age housed at the Upper Piedmont Beef Cattle Research Station located in Reidsville, NC, USA. The nulliparous and multiparous animals were maintained on a pasture separated from each other. The animals were fed coastal Bermuda grass hay and pasture and had ad libitum access to water and free-choice mineral mix.

2.2. Intravaginal insert preparation

The CIDR devices used in this study had been used previously either once or twice in animals at the Upper Piedmont Research Station. The once-used CIDR devices were previously used in animals synchronized in a 7-day CO-Synch + CIDR protocol and then washed, air dried, and stored at room temperature. The twice-used CIDR devices were previously used for two 7-day CO-Synch + CIDR protocols, for a total of 14 days. The CIDR devices were washed after the first treatment and again after the second treatment, air dried, and stored at room temperature. The CIDR devices were washed by first being rinsed with water and washed in diluted (one ounce per gallon of water) Nolvasan solution (chlorhexidine diacetate; Fort Dodge Laboratories, Fort Dodge, IA, USA) and rinsed again with water.

2.3. Treatment groups

The nulliparous and multiparous cattle were randomly assigned to one of the two groups; animals that were given a once-used CIDR device served as the control group, whereas animals that received a twice-used CIDR served as the treatment group. All animals were synchronized using the 7-day CO-Synch + CIDR protocol. Briefly, an IM injection of 100-μg GnRH (Cystorelin; gonadorelin diacetate tetrahydrate; Merial, Duluth, GA, USA) was given on Day 0 concurrently with the insertion of a once-used or twice-used Eazi-Breed CIDR (1.38-g progesterone when new; Zoetis, Madison, NJ, USA), and an injection of 25-mg PGF was given either IM or SC (Lutalyse; dinoprost tromethamine; Zoetis) and the device was removed 7 days later. A second IM injection of GnRH and FTAI was performed in all animals 60 to 66 hours after PGF by one of two trained AI technicians. All injections were performed in the neck region of the cattle.