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Reproductive Research in Jersey Cows

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Introduction

A very simple search through the National Center for Biotechnology Information database demonstrates the relative lack of information about reproductive management of Jersey cows. While the search for 'Holstein cows and reproduction' results in 2,383 publications, the search for 'Jersey cows and reproduction' results in 268 publications. This is probably a direct consequence of the composition of the US dairy herd. In 2005, it was estimated that the genetic composition of the US dairy herd was 0.4% Ayrshire, 1.0% Brown Swiss, 0.4% Guernsey, 90.8% Holstein, 6.5% Jersey, 0.2% Milking Shorthorn, and the remaining 0.7% composed of other or unknown breeds (Powell et al., 2005). Nonetheless, the interest for Jersey cattle and crossbred animals, particularly sired by Jersey bulls, has increased in the past two decades. While 0.4 and 0.7% of cows born in the US in 1990 and 2000, respectively, were crossbred, in 2005, 1.6% of cows born were crossbred (Powell et al., 2005). And, while until the end of the 1990s the most commonly used sire breed in crossbreeding was Holstein, it was estimated that sire breeds for crossbreds born in 2005 was 42% Jersey, 27% Holstein, 13% each for Brown Swiss and Milking Shorthorn, and 5% for all other breeds (Powell et al., 2005).

Because of researchers' focus on Holstein cows, some aspects of reproductive physiology and management of Jersey cows are unknown. In this paper we will discuss some of the possible differences in reproductive physiology between Holstein and Jersey cows that could affect reproductive management and performance.

Energy Balance and Resumption of Ovarian Cycles

It has been demonstrated that Jersey cows have milder negative energy balance during early lactation than Danish Holsteins (Friggens et al., 2007). Considering that interval to first postpartum ovulation is related to time of nadir of negative energy balance (Butler, 2000), it is not surprising that Jersey cows have shorter interval from parturition to first postpartum ovulation and service (Washburn et al., 2002).

Researchers in New Zealand have demonstrated that Jersey cows had greater LH pulsatility early postpartum (8 to 12 d postpartum) than Friesian cows (Nation et al., 2000). Consequently, dominant follicles of the first follicular wave were greater for Jersey cows at 8 d after parturition (9.1 ± 0.7 vs. 6.8 ± 0.7 mm) and dominant follicles of the first follicular wave reached their maximum diameter earlier in lactation (10.5 ± 0.8 vs. 12.6 ± 0.7 d postpartum), but maximum diameter of the dominant follicle of the first follicular wave was not different between breeds (Nation et al., 2000). This resulted in earlier emergence of the second follicular wave in Jersey cows than Friesian cows (10.4 ± 0.7 and 13.1 ± 0.6 d postpartum).

Interestingly, when anovular cows were treated with intra-vaginal progesterone devices, Jersey cows had greater concentrations of estradiol than Friesian cows after device removal (Nation et al., 2000). The greater pulsatility of LH and greater increase in estradiol concentration early postpartum in Jersey cows results in greater detection of estrus in the first three estrous cycles postpartum (47 to 83%) compared with Holstein cows (12 to 43%) (Fonseca et al., 1983).

Although, much of what was discussed in the above paragraphs is referent to dairy cattle that might be significantly different from the dairy cattle currently present in the US, if the differences described above exist between Jersey and Holstein American cows and these differences are sustained throughout the lactation, some considerations should be made in regards to the reproductive programs currently used in US dairy herds.

If higher pulsatility and concentrations of LH are observed during normal estrous cycle of Jersey cows, and length of luteal phase is similar to that of Holstein cows, it is possible that growth of follicles in Jersey cows would be expedited, which may result in greater proportion of Jersey cows with three follicular waves than Holsteins. Furthermore, if Jersey cows have greater concentrations of estradiol during proestrus, it would be expected that the interval from luteolysis to ovulation would be shorter in Jersey cows than Holsteins. Although these are suppositions, we are not aware of data that refute them and they are of importance when determining reproductive management to be applied to Jersey cows. We will evaluate the most commonly used reproductive programs in the US believing that the suppositions made above are possible.

Critical Steps of Timed AI Programs

Considering that US dairies have relied heavily on timed AI programs in the past 10 years, we will discuss some of the most important considerations to be made when implementing such programs. We will base this discussion on protocols that rely on prostaglandin (PG) F2α and gonadotropin releasing hormone (GnRH), which are labeled for lactating dairy cows in the US, and based on data from Holstein cows. The protocols that will be discussed are the Presynch (two injections of PGF2α given 14 d apart) and Ovsynch (GnRH, 7 d later PGF2α, 56 h later GnRH, and 12-16 h later AI) protocols.

The first critical step of the timed AI programs is the response to the first GnRH injection. Vasconcelos et al (1999) demonstrated that ovulation in response to the first GnRH injection is greatest when it is given between d 5 and 9 of the estrous cycle, because within this interval it is possible to predict with more certainty that lactating dairy cows will have a large dominant follicle. When cows do not ovulate in response to the first GnRH injection, the period of dominance of the follicle that ovulates at the end of the timed AI program (ovulatory follicle) is extended, resulting in reduced embryo quality and fertility (Chebel et al., 2006; Cerri et al., 2009). To assure maximum ovulation in response to the first GnRH injection, cows are presynchronized with two injections of PGF2α (14 d apart) with the last injection given 12 d before the start of the timed AI protocol (Moreira et al., 2001). By doing so, the majority (~ 85%) of cyclic cows would display estrus 2 to 7 d after the second PGF2α injection and would be around estrous cycle d 5 to 10 at onset of the timed AI protocol.

The second critical step is that, even though the currently used timed AI programs have been designed for Holstein cows, it appears that even when ovulation to the first GnRH occurs, the period of dominance of the ovulatory follicle is too long and may affect fertility. Chebel et al. (2008) demonstrated that when the interval from initiation of the timed AI program to the induction of ovulation (last GnRH injection) is reduced from 10 to 8 d, conception rate of lactating Holstein cows was increased in approximately 6.6 percentage units. However, because response of functional corpus luteum (CL) to PGF2α is reduced when given on or before d 5 of the estrous cycle, two injections of PGF2α have to be given to achieve maximum luteolysis (Chebel et al., 2008).

As a third source of variation in the success of timed AI programs is the fact that only approximately 75 to 85% of cows have luteolysis after one injection of PGF2α. Therefore, a relatively high proportion of cows might have high concentrations of progesterone around or at the time of insemination, which results in reduced fertility.

Finally, the fourth critical step of the timed AI programs would be the time of the last GnRH injection and the moment of insemination. Initial studies by Pursley et al. (1998) demonstrated that higher fertility would be achieved when AI occurs between 8 and 24 h after the last GnRH injection (given 56 h after the PGF2α). This makes biological sense considering that ovulation occurs approximately 30 h after the last GnRH injection of the timed AI program (Pursley et al., 1995), which is a similar interval between onset of spontaneous estrus and ovulation, and higher fertility is observed when cows are inseminated 4 to 12 h after onset of spontaneous estrus (Dransfield et al., 1998). As for the interval from the PGF2α injection to the last GnRH injection, recent studies have demonstrated that the ideal interval is 56 h as initially thought, because when GnRH injection and AI occur concurrently at 48 or 72 h after the PGF2α injection, reduced fertility is observed (Brusveen et al., 2008).

Reproductive Programs and the Jersey Cow

Perhaps the most important issue to be considered when determining the reproductive program to be used in Jersey herds, as in any other herd, is the current estrous detection rate. Herds that do not implement timed AI programs and have estrous detection rate > 60% are unlikely to benefit from timed AI programs, because in our experience herds that implement aggressive reproductive management (timed AI for first postpartum AI and re-insemination of non-pregnant cows + daily observation for estrus) have estrous detection rate between 65 and 75%.

For Jersey herds with high estrous detection rate we would recommend treatment of cows with two injections of PGF2α (14 d apart), with the last injection given at the end of the voluntary waiting period (VWP). Cows observed in estrus should be inseminated and those not observed in estrus 14 d after the end of the VWP should receive PGF2α every 14 d until observed in estrus and inseminated. Cows not observed in estrus by approximately 90 DIM should be examined and possibly submitted to a timed AI protocol. Cows diagnosed not pregnant should receive PGF2α and should be inseminated upon estrous detection and those not re-inseminated by 12-14 d after non-pregnancy diagnosis should be submitted to timed AI protocols.

If estrous detection rates are low (< 60%) it is recommended that timed AI programs are implemented. At the moment, because it is not clear whether the estrous cycle of Jersey cows differ significantly from Holstein cows, we would recommend that the Presynch + Ovsynch protocol for first postpartum AI and that resynchronization of non-pregnant cows with Ovsynch be implemented. Although we are not aware of data that compared fertility of Jersey cows inseminated at timed AI to those inseminated upon estrous detection, anecdotal data indicate that the Presynch + Ovsynch protocol and the Ovsynch based resynchronization protocol result in acceptable fertility, even though conception rates are slightly smaller than when cows are inseminated on estrus. It is possible, however, that differences in the follicular growth and estrous cycle of Jersey cows compared to Holstein cows may result in slightly different pattern of response to the different treatments given during the timed AI programs. Therefore, further research is necessary to determine the ideal reproductive program to be implemented in Jersey cows.

Dose of Reproductive Hormones

One of the most basic questions that we can ask ourselves when discussing reproductive management of Jersey cows is: what is the minimum effective dose of PGF2α and GnRH to cause luteolysis and ovulation, respectively?

It is widely accepted that doses of 25 mg of dinoprost tromethamine and 500 µg of cloprostenol are efficient in causing luteolysis. However, a study demonstrated that reduced doses of cloprostenol are effective in causing luteolysis in adult and nulliparous Portuguese-Holsteins (Horta et al., 1986).

Similarly, the most commonly used and accepted dose of GnRH to cause ovulation has been 100 µg; however, most existing data is from studies conducted with Holstein cows. Recently, Souza et al. (2009) demonstrated that half dose of GnRH (50 µg) results in smaller peak of LH, which could potentially result in reduced proportion of cows ovulating, and consequently reduced fertility.

Considering that Jersey cows are considerably smaller than Holstein cows (~ 400 lb), it would not be surprising if the effective luteolytic and ovulatory doses of PGF2α and GnRH, respectively, were smaller for the former.

Focus of Future Research

We propose that research efforts about reproductive management of Jersey cows should be focused on: effective doses of PGF2α and GnRH to cause luteolysis and ovulation, respectively; onset of responsiveness of corpus luteum to PGF2α; minimum size of dominant follicle responsive to GnRH injection; interval from GnRH injection to ovulation; and pattern of follicular wave development and steroidal hormone profile during normal estrous cycles. Other issues that need to be characterized for American Jersey cows are pattern of postpartum uterine involution, interval from parturition to resumption of normal ovarian cycles, and ideal voluntary waiting period.

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