Effects of Days Open on the Subsequent Reproductive Performance Following to CIDR-Based Estrus Synchronization in Lactating Dairy Cows

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ABSTRACT

The purpose of this study was to evaluate the effects of days open on subsequent reproductive performance following to estrus synchronization in the 114 lactating dairy cows. The animals were divided into two groups according to the time of estrus synchronization; viz, ≤85 days, and >85 days postpartum, respectively. The estrus synchronization protocol consisted of insertion of a controlled internal drug release (CIDR) device containing 1.9 g progesterone with an injection of 250 μg gonadorelin (Day 0), an injection of $PGF_{2\alpha}$ and removal of the device on Day 7, an injection of 250 μg GnRH on Day 9, and TAI 17 h later. Pregnancy diagnosis was determined at 30 to 60 days after TAI using both ultrasonography and rectal palpation. The body condition score (BCS) gradually increased over the postpartum period. In estrus synchronized cows until 85 days, conception rate on first service, number of service per conception, interval from estrus synchronization to conception, and interval from calving to conception were not significantly different among two farms ($P>0.05$). In estrus synchronized cows after 85 days postpartum, conception rate on first service, number of service per conception and interval from calving to conception were significantly different ($P\leq0.05$) between herds A and B (26.8 vs 50.0%; 2.1±1.35 vs 1.37±0.54 times, 237.3±97.8 vs 164.7±69.3 days, respectively). In estrus synchronized cows after 85 days postpartum interval from estrus synchronization to conception was greater ($P<0.01$) in herd B than in herd A (63.6±57.4 vs 26.1±24.9). These results indicate that the time of estrus synchronization for maximized the reproductive performance is before 85 days postpartum and feeding and management is important factor for high reproductive performance.

(Key words : dairy cows, reproductive performance, postpartum, estrus synchronization)

INTRODUCTION

The calving interval for high reproductive performance of the dairy farm industry is 365 days (Houghton *et al.*, 2000; Asimwe and Kifaro, 2007). To maintain the 365-d calving intervals, the animals should be conceive within 85~90 days postpartum (Hafez and Hafez, 2000). An increased calving to conception interval is correlated with a few factors, including the late involution of uterus (Short *et al.*, 1990), inadequate nutrition (Spitzer *et al.*, 1995; Morrison *et al.*, 1999; Moreira *et al.*, 2000; Wettemann *et al.*, 2003), short estrous cycle (Short *et al.*, 1990), calving season (Asimwe and Kifaro, 2007; Gebeyehu *et al.*, 2007; Ansari-Lari and Abbasi, 2008), poor estrus detection (Son *et al.*, 2001; Melendez *et al.*, 2008), parity (Asimwe and Kifaro, 2007; Walsh *et al.*, 2007; Kim *et al.*, 2009), and high incidence of silent heat or subestrus (Kang *et al.*, 1995).

Rapid progress in genetics and management in the dairy industry has resulted in increased milk production per cow (Sakaguchi, 2011). Metabolic demands for more milk production negatively impact the reproductive function of postpartum cows (Beam and Butler, 1999). As the results, postpartum dairy cow have a short estrus behavior, deferred commencement of ovulation and estrus expression, declined estrus detection, reduced pregnancy rate, and also increased postpartum anestrus and subestrus cow (Honparkhe *et al.*, 2008). The exact detection of estrus is essential component of postpartum breeding programs that depend on overt signs of estrus for optimal timing of insemination (Alnimer *et al.*, 2009; Roelofs *et al.*, 2010). The inefficiency in estrus detection can increase the average interval between successive insemination to limits both reproductive efficiency and profitability. Timed artificial insemination (TAI) has been advised to overcome the problem of inefficiency estrus detection (Alnimer *et al.*, 2009).

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Estrus synchronization and artificial insemination (AI) are reproductive management tools that have been available to dairy farm industry. Estrus synchronization has the potential to shorten the calving season, control of the reproductive management, increase calf uniformity, and facilitate the use of AI. AI corroborate to producers the opportunity to infuse superior genetic traits into their cattle at costs far below those of purchasing a herd sire of similar standards (Lamb *et al.*, 2010).

Controlled internal drug release (CIDR)-based TAI program use to solve the problem of estrus detection (Day *et al.*, 2000; Kim *et al.*, 2007). Various CIDR-based TAI protocol reported perviously researchers (Day *et al.*, 2000; Stevenson *et al.*, 2000; Kim *et al.*, 2005). Also, Ovsynch protocols have been successfully utilized to treat subestrus cows (Mialot *et al.*, 1999).

This study was carried out to evaluate the effects of days open on subsequent reproductive performance following to CIDR-based TAI in postpartum dairy cows, using data collected over the approximately 5-year period.

MATERIALS AND METHODS

1. Animals

This study was performed from February 2006 through to April 2010 at two dairy farms located in Chungbuk province, Korea. The lactating cows were maintained in free-stall facilities, fed a total mixed ratio and milked twice daily. The cow observed for the estrus condition twice daily. The animals were examined monthly by theriogenology team of Chungbuk National University. The animals had no gross abnormalities of the reproductive tract as determined by rectal palpation and transrectal ultrasonography (Sonoace 600 with a 7.5 MHz linear array transducer; Medison, Seoul, Korea). One hundred fourteen lactating Holstein-Friesian cows were used for this study. The animals were classified into two groups based on time of postpartum synchronization, namely, $\leq$ 85 day, and > 85 days postpartum. The number of lactations, days from parturition to treatment, day from postpartum to first AI, and AI number before synchronization of the selected dairy cows were 2.69 ± 1.69, 131.3 ± 68.8, 98.1 ± 46.8, and 0.70 ± 1.03, respectively (Table 1). All experiments were performed with the approval of the Animal Ethics Committee at the College of Veterinary Medicine, Chungbuk National University (Cheongju, Chungbuk, Korea).

2. Estrus Synchronization

All selected postpartum dairy cows were synchronized as modified CIDR-based TAI protocol (Kim *et al.*, 2007). Briefly, treatment consisted of insertion of a CIDR device containing 1.9 g progesterone (CIDR™; InterAg, Hamilton, New Zealand) with an injection of 250 μg gonadorelin (GnRH; Fertagyl, Intervet, Holland) (Day 0), an injection of $PGF_{2\alpha}$ (Lutalyse® Upjeon, USA) and removal of the device on Day 7, an injection of 250 μg GnRH on Day 9, and TAI 17 h later. All hormone injection were intramuscularly administered. Pregnancy diagnosis was determined at 30 to 60 days after TAI using both ultrasonography and rectal palpation. Pregnancy rate per TAI was defined as the percentage of cows confirmed to be pregnant in a single pregnancy diagnosis after one TAI.

3. Data and Statistical Analysis

The reproductive performance items: days from calving to first service, days from calving to conception, the number of cows conceived on first service, the number of services per conception, and days from synchronization to conception. SAS (1999) ver. 8.1 was used for statistics analysis of these data.

Table 1. Basic informations of 114 postpartum dairy cows at synchronization in two herds

Parameter	Herds		Total
	A	B	
No. of cows	56	58	114
Parity	2.73 ± 1.79	2.66 ± 1.56	2.69 ± 1.69
Days from parturition to treatment	148.6 ± 79.3	114.5 ± 49.3	131.3 ± 68.8
Day from postpartum to first AI*	113.0 ± 47.5	83.6 ± 42.3	98.1 ± 46.8
AI number before synchronization	0.73 ± 1.11	0.67 ± 0.92	0.70 ± 1.03

*AI=artificial insemination.

Each result item was indicated as Mean ± SD. Number of cows conceived on first service and number of cows retreated between the groups were compared by using *Chi*-square test with a 95% level of significance. Number of cows culled between the groups were compared by using Fisher's exact test. Number of services per conception, interval from synchronization to conception, and interval from calving to conception were compared by using Dunkan's multiple range test.

RESULTS

1. Reproductive Performance as to Time of Estrus Synchronization

In the six reproductive traits survey (body condition score (BCS), number of cows conceived on first service, number of service per conception, days from estrus synchronization to conception, number of cows retreated, and number of cows culled), the BCS at estrus synchronization was not different between two herds, whereas the BCS gradually increased over the postpartum period. The conception rate on first service, number of service per conception, interval from estrus synchronization to conception, and interval from calving to conception of estrus synchronized cows until 85 days postpartum were not significantly different among two farms. In estrus synchronized cows after 85 days postpartum, however, conception rate on first service, number of service per conception and interval from calving to conception were significantly different ($P \leq 0.05$) between A and B herds (26.8 vs 50.0; 2.1 ± 1.35 vs 1.37 ± 0.54, 237.3 ± 97.8 vs 164.7 ± 69.3, respectively). Interval from estrus synchronization to conception in estrus synchronized cows after 85 days postpartum was greater ($P<0.01$) in B herd than in A herd (63.6 ± 57.4 vs 26.1 ± 24.9). Number of cows retreated, BCS and number of cows culled were not significantly difference between two farms ($P>0.05$). The reproductive performance of B farm showed desirable than that of A farm in the present results.

DISCUSSION

The reproductive management of the postpartum dairy cows is very important in dairy farm industry. This study was designed to demonstrate the correlation between estrus synchronization time and reproductive performance of lactating cows at two private dairy farms. Numerous factors have been identified to influence the reproductive performance such as BCS (Dobson *et al.*, 2008), parity (Stevenson *et al.*, 1999; Tenhagen *et al.*, 2004; Alnimer and Lubbadeh, 2008), calving season (Asimwe and Kifaro, 2007; Gebeyehu *et al.*, 2007; Ansari-Lari and Abbasi, 2008) and reproductive disorders (Short *et al.*, 1990; Deutscher *et al.*, 1991).

Many researchers reported that various methods were used for improving the reproductive performance in postpartum lactating cows (Roelofs *et al.*, 2005; Miller *et al.*, 2007; Honparkhe

Table 2. Comparison of reproductive performance of postpartum dairy cows that had synchronized at each period in two herds

Parameters	Postpartum days at estrus synchronization (Mean ± SD)			
	≥85		85<	
	A	B	A	B
No. of cows treated	15	20	41	38
Body condition score*	3.3 ± 0.49	3.2 ± 0.49	3.5 ± 0.47	3.5 ± 0.59
No. of cows conceived on first service (%)	5 (40.0)^{a,b}	11 (50.0)^{b}	11 (26.8)^{a}	19 (50.0)^{b}
No. of service per conception	2.1 ± 1.59^{a,b}	1.4 ± 0.81^{b}	2.1 ± 1.35^{a}	1.37 ± 0.54^{b}
Interval from estrus synchronization to conception	36.8 ± 36.59^{c,d}	22.5 ± 34.32^{d}	63.6 ± 57.4^{c}	26.1 ± 24.9^{d}
Interval from calving to conception	82.3 ± 40.5	91.5 ± 36.5	237.3 ± 97.8^{c}	164.7 ± 69.3^{d}
No. of cows retreated (%)	5 (30.0)	6 (33.3)	7 (17.1)	6 (15.8)
No. of cows culled (%)	2 (10.0)	0	6 (14.6)	3 (7.9)

* Classification by Edmondson *et al.* (1989).

^{a,b} Means or variances within row with different superscripts are different ($P \leq 0.05$).

^{c,d} Means or variances within row with different superscripts are different ($P \leq 0.01$).

et al., 2008; Alnimer *et al.*, 2009; Leitman *et al.*, 2009; Lamb *et al.*, 2010; Zuluaga *et al.*, 2010). Roelofs *et al.*, (2010) reported that the exact detection of estrus is an important factor for improving the reproductive performance of dairy cows. However, there is a limit to estrus detection by clinical estrus signs. Also, rapid progress in genetics in dairy industry result in increased milk production and shortened estrus behavior (Beam and Butler, 1999). Moreover, Asimwe and Kifaro (2007) cited the another factor causing prolonged calving interval was the negligence of heat detection. The CIDR-based TAI was developed to combat the problem of estrus detection (Alnimer *et al.*, 2009). Therefore, we used the animal did not showed estrus behavior by farmer in this study.

Cows with severe BCS loss in early lactation can result in a delayed postpartum resumption of ovarian cyclicity (Butler *et al.*, 2006; Lee and Kim, 2006). Also, Gillund *et al.* (2001) reported that cows with severe BCS loss during the postpartum period had a prolonged calving to pregnancy interval and required more inseminations per pregnancy, but calving to first insemination interval was unaffected. In this study, BCS at estrus synchronization was not different between two herds, whereas the BCS gradually increased over the postpartum period. We thought that BCS (3.41 ± 0.52) was recovered as to prolonged interval from calving to estrus synchronization (131.3 ± 68.8).

In comparison on the subsequent reproductive performance following estrus synchronization in two herds, conception rate to first service in herd A was similar to that in herd B until 85 days postpartum (40.0 vs 50.0%), but that of estrus synchronized cow after 85 days postpartum was greater in herd B than herd A (26.8 vs 50.0%) (Table 2). Previous researchers reported that conception rate after estrus synchronization was 22.8 to 67% (Pstpalups and Stevenson, 2005; Stertma*et al.*, 2007; Brusveen *et al.*, 2008; Alnimer *et al.*, 2009; Leitman *et al.*, 2009). Our results are in agreement with the results reported by others (Portaluppi and Stevenson, 2005; Sterry *et al.*, 2007; Brusveen *et al.*, 2008; Alnimer *et al.*, 2009).

Interval from estrus synchronization to conception in estrus synchronized cows after 85 days postpartum was greater in herd B than in herd A (63.6 ± 57.4 vs 26.1 ± 24.9). Interval from calving to conception were significantly different between A and B herds (237.3 ± 97.8 vs 164.7 ± 69.3). Sakaguchi (2011) reported that an onset of estrus activity that is too early or too late increase the days open in high-yielding dairy cows. Increased days open was reduced the reproductive performance in postpartum dairy cows (Alinmer and Lubbadeh, 2008; Ansari-Lari and Abbasi, 2008; Sakaguchi, 2011). In the present study, increased days open was increased interval from calving to conception. In herd A, especially increased days open was declined the conception rate to first service and increased the interval from estrus synchronization to conception.

In conclusion, the subsequent reproductive performance of estrus synchronized cows until 85 days postpartum was not different between herds A and B, but that of estrus synchronized cow after 85 days postpartum was greater in herd B than in herd A. This results may be indicate that feeding and management in herd B is more good than that in herd A. However, that we used only two herds and 114 postpartum dairy cows is the limitation on the our result analysis. The inappropriate management of rearing cattle may lead poor reproductive performance. Therefore, the effect of the subsequent reproductive performance after estrus synchronization in postpartum lactating cows needs to be investigated in further study such as feeding and management, calving season, milk production and reproductive disorders.

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