Reproductive Performance according to Ovarian Status, Postpartum Uterine Treatment, and Calving Season in Estrus Synchronized Dairy Cows

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ABSTRACT

A study on estrus synchronized dairy cows using progesterone intravaginal device was done to classify each cow's reproductive status from calving to synchronization and to evaluate the reproductive performance according to ovarian and uterine status, and calving season. From calving to estrus synchronization, silent heat or error of estrus detection among ovarian status and endometritis among uterine disorders were exposed in the most distribution (75.4% and 48.3%, respectively). The pregnancy rate of cows with inactive ovaries was lower than those in the follicular and luteal phase. And according to the uterine status before estrus synchronization, the pregnancy rate was similar in three groups; normal, endometritis, and pyometra (70.9, 69.1 and 100%, respectively). The interval from calving to conception was shorter (p<0.05) in cows calved during autumn than in cows calved during spring and winter.

(Key words : estrus synchronization, CIDR, calving season, pregnancy rate, ovarian and uterine status)

INTRODUCTION

Dairy cow is economic animal, and its productive and reproductive performance is very important in order to maximize the income of the dairy farm. The factors affecting in productivity include the increased calving interval, abortion, dystocia and metabolic disorder. Ideal calving interval for high reproductive performance of dairy cows is 365 days (Houghton *et al.*, 2000; Asimwe and Kifaro, 2007). The female beef cattle should be pregnant within 80~85 days to have 12-month calving interval.

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). Causes of prolonged open days were housing management as error of estrus detection (Melendez *et al.*, 2008), ovarian disorders as ovarian cysts, and uterine disorders as uterine involution, endometritis, and pyometra (Short *et al.*, 1990; Deutscher *et al.*, 1991).

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). 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). Consequently, postpartum dairy cow has 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 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 (Pursley *et al.,* 1995; Martinez *et al.,* 2001; Kim *et al.*, 2005; Alnimer *et al.*, 2009).

Loyacano *et al.* (1974) demonstrated that the cows calved during the winter had higher conception rates than the cows calved during the summer, even though the body weight loss in the winter was larger than in the summer. Kim *et al.* (2009) reported that interval from calving to conception in summer was the shortest in four seasons in Korean Native cows. Melendez *et al.* (2008) reported that conception risk within season

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was lower during summer within the third period than during the rest of the seasons. The negative effect of heat stress on conception in dairy cattle, especially from the day of service to 6 d after breeding, is well established (Wolfenson *et al.*, 2000; Morton *et al.*, 2007).

This study was carried out to evaluate the subsequent reproductive performance according to ovarian status at controlled internal drug releasing (CIDR) administration, history of uterine treatment, and calving season in postpartum estrus synchronized dairy cows, using data collected over a period of 5 years.

MATERIALS AND METHODS

1. Experimental 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. Cow were observed for the estrus condition twice daily. One hundred fourteen lactating Holstein-Friesian cows were selected as postpartum and postinsemination subestrus dairy cows for this study. Postpartum and postinsemination subestrus dairy cows were defined as cows were not detected estrus postinsemination or during above 60 days postpartum. 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 described in 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 injection of 250 μg gonadorelin (GnRH; Fertagyl, Intervet, Holland) or 2 mg estradiol benzoate (EB) (SY Esrone; Samyang, Seoul, Korea; Day 0), injection of 5 mg $PGF_{2\alpha}$ (Lutalyse® Upjeon, USA) and removal of the device on Day 7, injection of 250 μg GnRH or 2 mg EB 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. Examination of Reproductive Tract

The animal's reproductive tract were examined by rectal palpation and transrectal ultrasonography (Sonoace 600 with a 7.5 MHz linear array transducer; Medison, Seoul, Korea). The ovarian status was classified into luteal or follicular phase, and inactive ovaries based on ovarian structures (corpus luteum, follicle, cysts, cystic wall thickness) by rectal palpation and ultrasonography. The cows with uterine disorders were treated by infusion of 100~150 ml povidone-iodine or injection of 5 mg $PGF_{2\alpha}$. before CIDR administration. The uterine status was classified into endometritis and pyometra based on echogenicity of the uterine cavity.

4. Statistical Analysis

The reproductive performance items: number of conceived cows on first service, days from estrus synchronization to conception, and interval from treatment to conception. The research items of this study: ovarian and uterine status and calving seasons. SPSS ver.12.0 was used for statistics analysis of these data. The ANOVA was performed for the analysis between calving seasons and 1) interval from calving to conception, 2) interval from treatment to conception, 3) number of cows conceived on first services. The reproductive performance according to ovarian, and uterine status before CIDR application were analysed using the chi-square. A probability level of $p<0.05$ was considered significant.

RESULTS

1 Incidence of Reproductive Disorders

The incidence of reproductive disorders according to the ovarian status examined by rectal palpation and ultrasonography in 114 synchronized dairy cows was 86 (75.4%) in silent heat or error of estrus detection, 16 (14.0%) in inactive ovaries, 3 (2.6%) in persistent corpus luteum, 8 (7.0%) in follicular cysts and 3 (2.6%) in luteal cyst (Table 1). The incidence of uterine disorders was 55 (48.3%) in endometritis and 4 (3.5%) in pyometra (Table 2).

2. Reproductive Performance according to Ovarian Status

The conception rate according to the ovarian status at estrus synchronization was shown in Fig. 1. The conception rate was 40.5 % (34/84 cows) on luteal phase, and was 42.1% (8/19 cows) on follicular phase. The cows with inactive ovaries had tendencies that conception rate was low as 36.4% (4/11 cows).

Table 1. Incidence of reproductive disorders according to the ovarian status in 114 synchronized dairy cows

Parameter	No. of cows	Percentage
Silent heat or EED*	86	75.4
Inactive ovaries	16	14.0
Persistent corpus luteum	3	2.6
Follicular cyst	8	7.0
Luteal cyst	1	0.1
Total	114	100.0

*Error of estrus detection.

Table 2. Classification of uterine disorders before estrus synchronization in 114 postpartum dairy cows

Parameter	No. of cows	Percentage
Normal	55	48.3
Endometritis	55	48.3
Pyometra	4	3.5
Total	114	100.0

3. Reproductive Performance according to Uterine Status before CIDR Treatment

In reproductive performance according to the uterine status before synchronization, the conception rate of cows was 70.9% (39/55 cows) in normal uterine status, 69.1% (38/55 cows) in endometritis, and 100.0% (4/4 cows) in pyometra (Fig. 2).

4. Reproductive Performance on Calving Season

The results of reproductive performance according to calving season were shown in Table 3. The number of cows conceived on first service was relatively high in autumn and winter. The interval from estrus synchronization to conception in autumn and summer was the shorter than in spring and winter, but there was no significant different (p>0.05). The interval from calving to conception in autumn was shorter than in spring and winter (p<0.05).

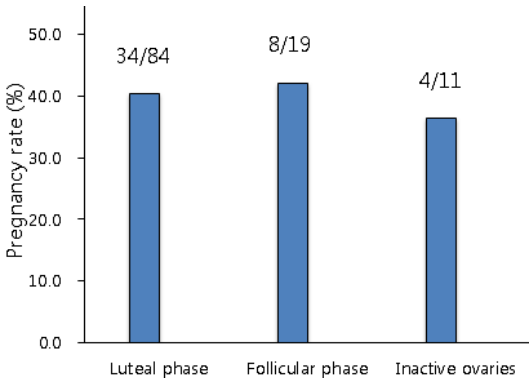

Fig. 1. Reproductive performance according to ovarian status in 114 synchronized dairy cows.

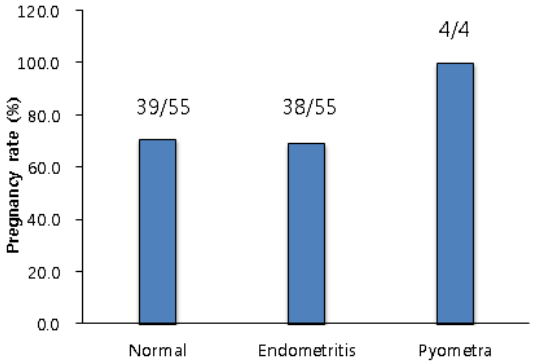

Fig. 2. Reproductive performance as to uterine status before synchronization in 114 dairy cows.

Table 3. Reproductive performance according to calving seasons in 114 synchronized dairy cows

Parameters	Calving seasons (mean±sem)			
	Spring	Summer	Autumn	Winter
No. of treated cows	32	34	24	24
Body condition score	3.3±0.6	3.4±0.6	3.4±0.5	3.6±0.5
No. of cows conceived on first service (%)	11(34.4)	13(38.2)	11(45.8)	11(45.8)
Interval from calving to conception	194.0±25.6[b]	152.6±15.4[a,b]	118.7±10.4[a]	197.2±23.2[b]
Interval from treatment to conception	50.0±13.9	38.8±8.1	28.7±5.9	42.0±11.5

Values with different superscript in the same law were denoted significantly different (p<0.05).

DISCUSSION

The producers all over the world are likely attempting to reach a suggested optimal value of around 12 to 13 months (Radostites, 2001). This study was designed to demonstrate the correlation between reproductive status and reproductive traits at estrus synchronization, and the association between calving seasons and reproductive performance in estrus synchronization dairy cows. The reproductive performance was correlated with numerous factors, including the 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).

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).

In investigation on the incidence of reproductive disorders according to the ovarian status in synchronized dairy cows, the incidence was highest in silent heat or error of estrus detection and endometritis (Table 1). This results indicate that estrus detection was the most difficult problem in dairy industry. The previous researchers reported that estrus detection rate was low as 38 to 51% (Senger, 1994; Stevenson, 2001; Washburn *et al.*, 2002; Stevenson, 2005; Melendez *et al.*, 2008). The best method to overcome the problem of inefficiency of estrus detection was progesterone-based timed artificial insemination (Pursley *et al.,* 1995; Martinez *et al.,* 2001; Kim *et al.*, 2005; Alnimer *et al*., 2009).

This study showed that there was significant correlation between calving season and the reproductive traits of synchronized dairy cows. The figures showed that the reproductive traits (the number of cows conceived on first service, interval from treatment to conception, and interval from calving to conception) of cows calved in autumn were shorter than those of cows in the other seasons in this study. A few researchers (Fallon, 1962; Loyacano *et al*., 1974; Deutscher *et al*., 1991) demonstrated that the calving season was closely related to the subsequent reproductive performance of cows. Deutscher *et al*. (1991) reported that the spring calved cows recovered their reproductive cycles earlier than the winter calved cows. In terms of pregnancy rate, Fallon (1962) found that pregnancy rate of the cows in the hot area was higher than that of the cows in the cold area. Loyacano *et al*. (1974) reported that the winter calved cows had lost their body weights, but pregnancy rates was higher than the spring calved cows. Montgomery *et al.* (1985) reported that later calving in photoperiod, temperature, and pasture availability influenced resumption of varian cycles.

The conception rate according to the ovarian status at estrus synchronization and uterine status from calving to estrus synchronization was shown in Fig. 1 and Fig. 2. The conception rate on luteal and follicular phase was relatively high (40.5 vs 42.1%), but that on inactive ovaries was low (36.4%). Nguyen *et al.* (2011) reported that a higher incidence of abnormal postpartum resumption of ovarian cyclicity leads to reduced reproductive performance. Also, Gautam *et al.* (2010) reported that the days open of cows with delayed resumption of ovarian activity were greater than that of cows with normal resumption of ovarian activity. Postpartum uterine diseases such as metritis and clinical endometritis are common disorders of lactating dairy cows, that negatively affect reproductive performance (LeBlanc *et al.*, 2002; Gilbert *et al.*, 2005), thus diminishing profitability of dairy operations (Overton and Fetrow, 2008). Also, Uterine health disorders (Dubuc *et al.*, 2010) and anovular lactating dairy cows (Bisinotto *et al.*, 2010) have been associated with decreased first-service P/AI and increased pregnancy losses (Ribeiro *et al.*, 2011). In the present study, the uterine status before estrus synchronization had no influence on reproductive performance after estrus synchronization (Fig. 2). After treatment of uterine disorders, CIDR was inserted into the cows with uterine disorders.

The fact that we used only two herds may be criticized. Conducting more comprehensive research by using larger sample size and considering other potentially related variables are highly recommended. However, we hope our present study will provide a framework for such additional studies in the near future.

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