CHAPTER III

EXPERIMENT 1

EFFICIENCY COMPARISON ON ESTRUS SYNCHRONIZATION PROTOCOLS AND ARTIFICIAL INSEMINATION IN GOAT

3.1 Experiment 1.1: Comparison the efficiency of short-term and long-term synthetic progesterone on plasma progesterone concentrations in Thai-native goat

3.1.1 Introduction

Estrus synchronization is a key element of all the assisted reproductive technologies (ARTs) protocols in livestock animals and has a major influence to increase the overall efficiencies of reproduction (Baldassarre and Karatzas, 2004). Estrus synchronization plays a major role in fixed time breeding. The value of estrus synchronization is vital in goats as the duration of both estrous cycle and estrus is variable and estrous detection cannot be accomplished safely without a buck (Rahman et al., 2008). The most widely used procedures for estrus synchronization and induction of estrus in small ruminants are a combination of an intravaginal devices impregnated with 0.3 g of progesterone (controlled internal drug release, CIDR) with an intramuscular injection of PMSG and $PGF_{2\alpha}$. An alternative means of supplying continuous, exogenous progesterone (P4) has been the CIDR developed for goats in New Zealand. The CIDR device is constructed from natural P4 impregnated medical silicone elastomer molded over a nylon core. CIDR contain low natural doses of P4 and CIDR device were developed for use with the long treatments (Wheaton et al., 1993).

Proven protocols for estrus synchronization in small ruminant consist of a long-term intravaginal treatment with progestagens or progesterone for 12–14 days (Abecia et al., 2011; Viñoles et al., 2001), resulting in a high percentage of animals in estrus but a variable fertility (Menchaca and Rubianes, 2004). Recently, with the objective to avoid prolonged P4 exposure, a new short-term protocol has been developed in sheep and goats (Menchaca and Rubianes, 2004). This protocol uses a short progestin exposure (i.e., 5–7 days) associated with a prostaglandin $F_{2\alpha}$ injection at the beginning of the treatment. Usually, a small dose of eCG (200–350 IU) is

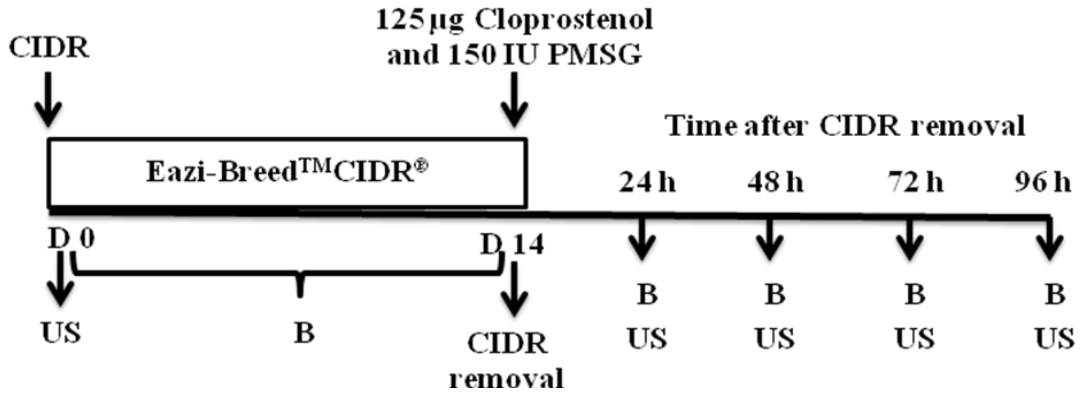
included at the end of progestin exposure. Ungerfeld and Rubianes (1999) reported that short term (6 days) progestagen priming, those results in greater progestagen concentrations at the time of device removal, is at least as effective as traditional priming (12–14 days) to obtain an out-of-season estrus. Since these earlier publications, many papers were published using this method in goats (Fonseca et al., 2005; Menchaca et al., 2007). Therefore, the objective of the present study was to compare the efficiency of short-term and long-term synthetic progesterone on estrus synchronization in Thai-native goat.

3.1.2 Materials and Methods

1) Animals and treatments

This experiment was carried out at the small ruminant unit, Department of Animal Science, Faculty of Agriculture, Khon Kaen University, located at 16° 26' N latitude and 102° 50' E longitude, Thailand. The experiment was approved by the Animal Ethics Committee of Khon Kaen University (Reference No. 0514.1.12.2/67). Twelve nulliparous Thai-native goats, 9 months of age, the females with a body condition score of 2.5-3.0 and body weight of 16.9 kg, were randomly allocate to two treatment groups using a completely randomized design. Induction of estrus and plasma P4 concentrations of goats in each of the groups was synchronized with one of the following treatment. Treatment 1, long-term protocol (n=6) using CIDR+$PGF_{2\alpha}$ and PMSG: Animal were randomly treated with intravaginal CIDR 0.3 g progesterone (Eazi-Breed^{TM}CIDR$^{®}$, Pfizer, NY, USA) for 14 days (day 0-14), i.m. injections of 0.5 ml of $PGF_{2\alpha}$ (125 µg of cloprostenol, Estrumate$^{®}$, Intervet Ltd., Germany) and 150 IU PMSG (Folligon$^{®}$, Intervet International B.V., New Zealand) were given at the time of CIDR removal (day 14). Treatment 2, short-term protocol (n=6) using CIDR+ $PGF_{2\alpha}$ and PMSG: Animal were randomly treated with intravaginal CIDR 0.3 g progesterone (Eazi-Breed^{TM}CIDR$^{®}$, Pfizer, NY, USA) for 5 days (day 0-5), i.m. injection of 0.5 ml $PGF_{2\alpha}$ (125 µg of cloprostenol, Estrumate$^{®}$, Intervet Ltd., Germany) and 150 IU PMSG (Folligon$^{®}$, Intervet International B.V., New Zealand) were given at the time of CIDR removal (day 5).

Treatment 1: 14 days CIDR, PMSG and $PGF_{2\alpha}$



Treatment 2: 5 days CIDR, PMSG and $PGF_{2\alpha}$

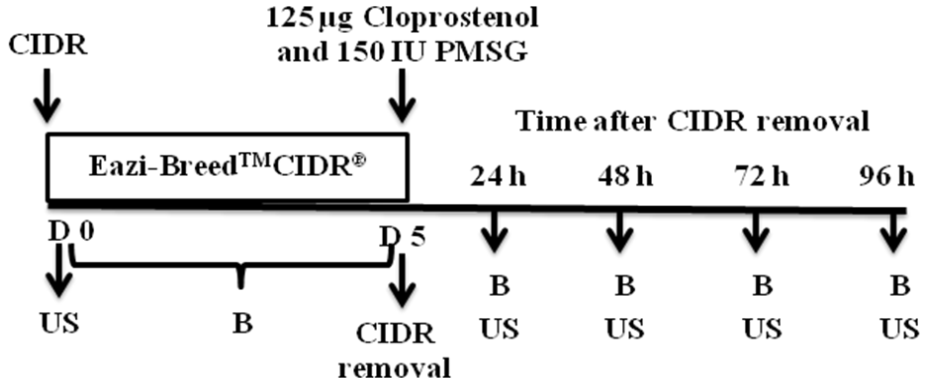


Figure 3.1 Schematic representations comparing the long-term protocol versus the short-term protocol for estrus synchronization in goat. (CIDR = controlled internal drug release, PMSG = Pregnant Mare Serum Gonadotropin, B = Blood sample taken, US = Ultrasonography, D = day, h = hour)

2) Enzyme-linked Immunosorbant Assay (ELISA)

A blood sample (5 ml) for P4 analysis was collected via jugular venipuncture from day-1 to 5 with higher frequency at device insertion (day 0, day 0+4 h, day 0+12 h,) and after CIDR removal at 0-96 h follow by short-term protocol and day -1 to 14 with higher frequency at device insertion (day 0, day 0+4 h, day 0+12 h,) and after CIDR removal at 0-96 h follow by long-term protocol into an EDTA solution, then immediately centrifuged at 1500 × g for 15 min. Blood plasma

samples were harvested and frozen stored at -20 °C until assayed. The P4 concentrations were determined by Enzyme-linked Immunosorbant Assay or ELISA (Cushwa et al., 1992). The intra-assay coefficient of variation was 5.3%, and assay sensitivity was 0.025 ng/ml.

3) Ovarian ultrasonography

Ovulation rate were monitored by transrectal ultrasonography using a 7.5 MHz transducer (HS-2000, HONDA ELECTRONICS, Japan) stiffened with a hollow plastic rod. Ovarian ultrasonography was performed by the same operator 1 day before device insertion and ovulation time was determined every 8 h or until 96 h after device removal (if ovulation was not detected). Ovulation was defined as the collapse or disappearance of a large follicle as described (Martemucci and Alessandro, 2011).

4) Estrus detection

Estrus detection was recorded using a vasectomized buck dairy, at 6.00 A.M. and 5.00 P.M. after device withdrawal. The onset of the estrus was recorded when the female exhibited standing heat by the vasectomized buck with the aid of mounting activity accompanied by other symptoms such as vaginal mucous discharge and swelling of the vulva were considered to be in estrus as described before (Stenbak et al., 2003).

5) Statistical analysis

P4 concentrations were compared by a Student *t*-test. In addition, P4 concentrations were analyzed with a nested analysis of variance with treatment, animal (treatment), and day included in the model (Navanukraw et al., 2004). Percentages of goats in estrus were compared between treatments by the Chi-square test. Data were presented as mean ± SEM, and differences were considered significant when $P<0.05$.

3.1.3 Results

1) Estrus and ovulation

Percentage of goat exhibiting estrous behavior and ovulation were significantly different between groups (100.0 and 33.3%, for long-term and short-term protocol; $P<0.05$).

2) Plasma progesterone (P4) concentrations

The results showed there was statistical difference between the treatment groups in estrous response ($P<0.05$), long-term protocol allows an acceptable estrous response; it was greater than short-term protocol. Similarly plasma P4 concentrations after CIDR removal at 0-96 h in goats received long-term protocol significantly ($P<0.05$) lower than goats received short-term protocol (Figure 3.2). Average plasma P4 concentrations were 5.0±0.4 ng/ml during insertion CIDR of long-term protocol similar with 5.3±0.4 ng/ml of short-term protocol immediately before CIDR insertion (2.3±1.6 and 2.7±0.4 ng/ml, respectively). These data indicate that P4 from the CIDR is readily absorbed through the vagina and rapidly enters the circulation. All CIDR devices of long-term protocol were removed on day 14. Immediately CIDR removal, plasma P4 averaged 5.8±3.1 ng/ml and plasma P4 concentrations continued to decline from the average to 1.5±0.8, 0.6±0.3, and 0.8±0.4 ng/ml at 24, 48, and 72 h after CIDR removal, respectively. Whereas in short-term protocol, plasma P4 concentrations decline less than long-term protocol at 24, 48, and 72 h after CIDR removal (4.0±0.2, 2.9±0.2, and 2.7±0.3 ng/ml, respectively).

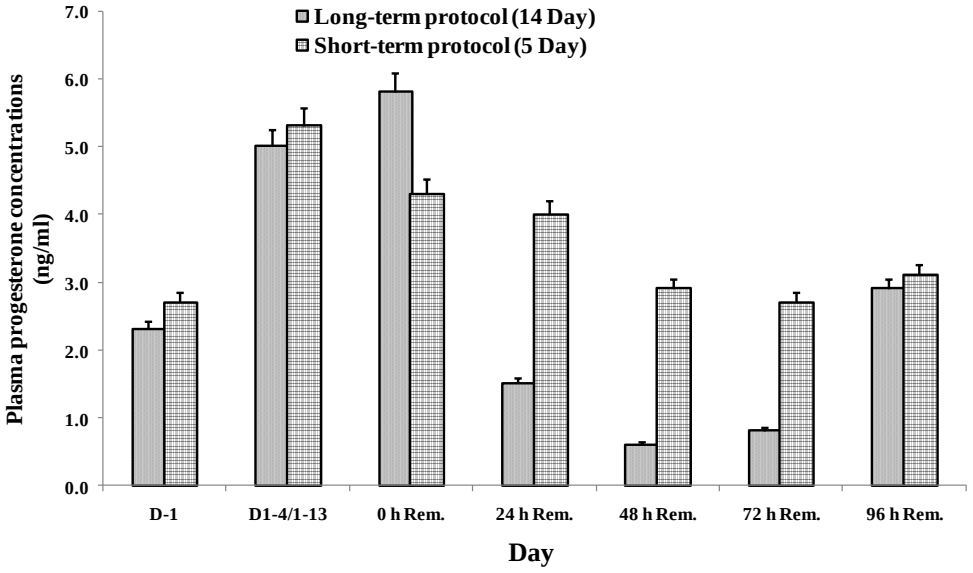


Figure 3.2 Plasma progesterone (P4) concentrations in Thai-native goat receiving long-term (14 days) and short-term protocols (5 days)

3.1.4 Discussion

The most commonly used method to synchronize estrus in sheep and goats consists of a 12–14 days P4 exposure (Corteel et al., 1988; Greyling et al., 1997). The short-term protocol using P4 treatment for 5–7 days appears as a new treatment to control follicular development and luteal activity for fixed-time artificial insemination (TAI) in sheep and goats (Ungerfeld and Rubianes, 1999; Viñoles et al., 2001). This new protocol shortens the traditional P4 exposure of 14 days, with the aim of ensuring greater serum P4 concentrations during the entire treatment, inducing adequate follicular dynamics and ultimately obtaining a high fertility rate (Menchaca and Rubianes, 2004).

In the present study, we demonstrate that the plasma P4 concentrations after CIDR removal at 0-96 h in goats received long-term protocol significantly lower than goats received short-term protocol indicating that goats responded for long-term protocol than short-term protocol and the estrous response after CIDR removal in long-term was significantly higher than in short-term protocol. Long-term protocol (14 days) with $PGF_{2\alpha}$ and PMSG affected the efficiency of the estrous response and plasma P4 concentrations in goats. This is in agreement with Romano (2004), Dixon et al. (2006) and Motlomelo et al. (2002), who reported 97-100% of animals in estrus after 13, 12, and 16 days protocols with CIDR, respectively, using $PGF_{2\alpha}$ and PMSG. However, studies of Vilariño et al. (2011) and Fleisch et al. (2012) found the short-term protocol (5-6 days) was successful to synchronize estrus and ovulation 90-100% of treated goats and ewes. Lertchunhakiat et al. (2012) reported the percentage of estrus was 100% detected in Thai-native goats receiving 14 days MAP and PMSG or 7 days MAP and PMSG, indicate that estrus and ovulatory response of Thai-native goats are not different between long- term (14 days) and short- term (7 days) protocols. Rubianes and Menchaca (2003) recommended using prostaglandins to cause luteolysis and assure that there are not corpora lutea remaining after progestin removal. In the present study, $PGF_2\alpha$ was used as a luteolytic agent for the elimination of remnant corpora lutea, since exogenous progestin does not affect production of P4 by the corpora lutea (Romano, 1996). Therefore, $PGF_2\alpha$ might affect duration of estrus. Ustuner et al. (2007) reported effects of long- term (12 days) and short- term (6 days) progestin treatments combined with PMSG on estrus

synchronization and fertility in ewes. The estrus occurred between 12-78 h in long-term treatment and 18-90 h in short-term treatment.

This study demonstrated that the length synthetic P4 treatment affected estrous response. Seventy-two hour after CIDR removal, plasma P4 of long-term protocol declined from 5.8±0.4 to 0.8±0.4 ng/ml at CIDR removal and declined more than short-term protocol (2.7±0.3 ng/ml at 72 h after CIDR removal). These data indicate that long-term protocol was more effective than short-term protocol in term of estrus induction in goat. One possible explanation for this fact reduced levels of plasma P4 were not enough to suppress the hypothalamic-pituitary axis, resulting in the estrous response (Romano, 2004, Ungerfeld and Rubianes, 2002).

3.1.5 Conclusion

In conclusion, the use synthetic progesterone (CIDR) on estrous synchronization in long-term protocol was more effective than short-term protocol to induce estrus in Thai-native goat.

3.2 Experiment 1.2: Re-use of controlled internal drug release (CIDR) for estrus synchronization and cervical artificial insemination in Thai-native goat

3.2.1 Introduction

Estrus synchronization is a key element of all the assisted reproductive technologies (ARTs) protocols in livestock animals and has a major influence to increase the overall efficiencies of reproduction (Baldassarre and Karatzas, 2004). Progesterone/progestogen-based protocols are widely used to synchronize estrus and ovulation in several farm animal species (Driancourt, 2001; McCorkell et al., 2007) during the breeding or the non-breeding season (Whitley and Jackson, 2004). In small ruminants, intravaginal polyurethane devices (i.e., sponges) impregnated with progesterone (P4) has already been used, with acceptable success since the 1960s. The controlled internal drug release (CIDR) device is constructed from natural P4 impregnated medical silicone elastomer molded over a nylon core, which is impregnated with 0.3 g progesterone (Wheaton et al., 1993), currently the CIDR and subcutaneous implants are preferable than sponges because they are easy to use (Holtz, 2005), and CIDR does not absorb or obstruct drainage of vaginal secretions, resulting in less foul-smelling discharge upon removal (Motlomelo et al., 2002;

Romano, 2004). However, costs of CIDR are relatively greater than use of sponge and may hinder widespread use of the CIDR. As a consequence, the development or refinement of efficient techniques that brings about cost reduction could be deemed appropriate in the case of estrus synchronization (Souza et al., 2011).

The same CIDR devices, which contain P4, may be used for more than one treatment (Ungerfeld, 2009). In cattle, CIDR-B (1.9 g of P4) still contained P4 after its use (Van Cleeff et al., 1992), with the amount dependent on the duration of insertion. Although not recommended by the manufacturer, device re-use is a common practice in dairy herds. Re-use of progesterone intravaginal devices have been reported in cows (Colazo et al., 2004), ewes (Ungerfeld, 2009) and goats (Oliveira et al., 2001; Vilariño et al., 2011) usually without decreasing fertility rate. Goats that are expressing estrous cycles in typical patterns receiving new or re-use CIDR devices showed similar estrous response and pregnancy rates with second (Oliveira et al., 2001) or third uses (Nogueira et al., 2011). Thus, the re-use of intravaginal devices as a cost-saver, is a possibility to be explored (Vilaiño et al., 2010).

Additionally, gonadotropins such as pregnant mare's serum gonadotropin (PMSG), human chorionic gonadotropin (hCG), and follicle-stimulating hormone (FSH) have been also used as a means of inducing ovulation and superovulation in farm animals (Stenbak et al., 2003). Therefore, the objective of the present study was to compare the efficiency of first use and second use (re-use) controlled internal drug release (CIDR) device on estrus synchronization and conception rate in Thai-native goats.

3.2.2 Materials and Methods

1) Animals and welfare

This experiment was carried out at the small ruminant unit, Department of Animal Science, Faculty of Agriculture, Khon Kaen University, located at 16° 26' N latitude and 102° 50' E longitude, Thailand. The experiment was approved by the Animal Ethics Committee of Khon Kaen University (Reference No. 0514.1.12.2/67). Fifty-six Thai-native goats, 8-10 months of age with body condition score of 2.5-3.0 and body weight of 17.5 kg, and were fed a maintenance diet (NRC, 1981) with ad libitum feeding of fresh ruzi grass. Clean water and mineral block were

provided throughout the experiment. Animals were vaccinated against foot and mouth disease (FMD), hemorrhagic septicemia (HS) and brucellosis according to the standard farm requirement of the Department of Livestock Development, Ministry of Agriculture and Cooperatives, Thailand.

2) Estrus synchronization treatments

All female goats were treated with a long-term protocol using an intravaginal CIDR containing 0.3 g progesterone (Eazi-Breed™ CIDR®, Pfizer, NY, USA) in place for 14 days. Day 0 was defined as the day of CIDR insertion. Goats were given (IM) 300 IU injection of hCG (Chorulon®, Intervet International B.V., New Zealand) at the time of CIDR removal. Two treatment groups were designed using CIDR devices of first use (new devices, n = 28) and re-used CIDR (previously used for 14 days, n = 28). The CIDR had been previously used in goats for 14 days in another trial performed on the same farm a month previously. After removal devices were washed with warm water and solution disinfectant, subsequently devices were stored in a dry at room temperature until use.

3) Ovarian ultrasonography

Ovarian follicular dynamics were monitored by transrectal ultrasonography using a 7.5 MHz transducer (HS-2000, HONDA ELECTRONICS, Japan) stiffened with a hollow plastic rod. Ovarian ultrasonography was performed by the same operator 1 day before device insertion and ovulation time was determined every 8 h or until 96 h after device removal (if ovulation was not detected). Ovulation was defined as the collapse or disappearance of a large follicle as described (Martemucci and Alessandro, 2011).

4) Estrus detection

Estrus detection was recorded using a vasectomized buck dairy, at 6.00 A.M. and 5.00 P.M. after device withdrawal. The onset of the estrus was recorded when the female exhibited standing heat by the vasectomized buck with the aid of mounting activity accompanied by other symptoms such as vaginal mucous discharge and swelling of the vulva were considered to be in estrus as described before (Stenbak et al., 2003).

5) Cervical Artificial insemination (CAI)

All goats displaying signs of estrous behavior were cervically artificial inseminated at 12 h after the onset estrus with frozen semen from a single proven sire. Cervical inseminations were performed on a breeding rack by lifting the hindquarters of the goat over the top rail while the front legs remained standing on the ground. Each-goat was inseminated with one 0.25 ml mini straw containing 200 × 10^6 spermatozoa per dose. The semen was deposited into the external os of the first cervical fold, using speculum fitted with an internal light source as described (Karagiannidis et al., 2001). Conception rate was determined 28 days after insemination by transrectal ultrasonography using a 7.5 MHz transducer (HS-2000, HONDA ELECTRONICS, Japan).

6) Progesterone (P4) concentrations

Blood samples (7 ml) for P4 analysis were collected via jugular venipuncture from day 0 to day 18 with higher frequency at device insertion (day 0, day 0 + 12 h) and after CIDR removal (day 14 + 0 h, day 14 + 12 h, day 15 + 0 h, day 15 + 8 h, day 15 + 16 h, day 16 + 0 h, day 16 + 8 h, day 16 + 16 h) followed by long-term protocol into an EDTA solution, then immediately centrifuged at 1500 × g for 15 min. Blood plasma samples were harvested and frozen stored at -20 $^{\circ}$C until assayed. P4 concentrations were determined in duplicate by Enzyme-linked Immunosorbant Assay or ELISA (Cushwa et al., 1992). Goat anti-mouse IgG (H + L) was made in mouse by using a P4-horse radish peroxidase conjugate. The mean intra- and inter-assay coefficients of variation were 6.5% and 8.6%, respectively.

7) Statistical analysis

Time of ovulation, duration of estrus, onset of estrus and follicular diameter at ovulation were analyzed using general linear model (GLM) procedure of SAS (SAS, 2001). P4 concentrations were compared by a Student *t*-test. In addition, P4 concentrations were analyzed with a nested analysis of variance with treatment, animal (treatment), and day included in the model (Navanukraw et al., 2004). Percentages of goats in estrus, ovulation and conception rate were compared between treatments by the Chi-square test. Data were presented as mean ± SEM, and differences were considered significant when $P<0.05$.

3.2.3 Results

1) Estrus, ovulation and conception rate

Percentage of goat exhibiting estrous behavior and ovulation were not significantly different between groups (100.0 and 89.3%, for the first use and re-used; P>0.05; Table 3.1). However, goats receiving the CIDR device of the re-used exhibited significantly (P<0.05) delayed onset estrus and time of ovulation (47.0 ± 3.6 and 74.9 ± 3.9 h) compared to the first use (36.5 ± 1.9 and 64.5 ± 1.3 h). In addition, duration of estrus in goats received the first used CIDR was last longer (P<0.05) than those received the re-used. Follicular size at ovulation was similar for devices of the first and re-used. There was no significant difference in the conception rate on day 28 after AI (28.6 and 24.0%, for devices of the first and re-used; P>0.05).

Table 3.1 Effect of first and re-used controlled internal drug release (CIDR) on ovarian responses and conception rate following cervical AI (CAI) in goats

Item	First use (T1)	Re-used (T2)
n = 56	28	28
Estrus and ovulation	28/28 (100%) [a]	25/28 (89.3%) [a]
Onset estrus* (h)	36.5 ± 1.9 [b]	47.0 ± 3.6 [a]
Time of ovulation* (h)	64.5 ± 1.3 [b]	74.9 ± 3.9 [a]
Duration of estrus (h)	26.1 ± 1.1 [a]	21.4 ± 1.4 [b]
Follicular diameter (mm) at ovulation	6.6 ±0 .2 [a]	6.2 ± 0.2 [a]
Conception rate (%)	8/28 (28.6%) [a]	6/25 (24.0%) [a]

*Interval after CIDR withdrawal.

[a, b] Within a row, means with different superscripts differ (P<0.05), Values are mean ± SEM

2) Plasma progesterone (P4) concentrations

On day 0 (before the CIDR insertion), plasma P4 concentrations were similar (P>0.05) between the first (2.9 ± 0.2 ng/ml) and re-used (3.4 ± 0.2 ng/ml) groups (Figure 3.3). But shortly, at day 1 after the device insertion, P4 concentrations

increased to 5.9 ± 0.2 and 4.4 ± 0.4 ng/ml for the first and re-used CIDR. The maximum concentration of plasma P4 was reached on day 4 after device insertion (6.5 ± 0.5 and 5.0 ± 0.3 ng/ml, for the first and re-use respectively; $P<0.05$). Although the concentrations were maintained and thereafter, the re-used CIDR devices significantly induced lower plasma P4 concentrations than the first use during the time of CIDR insertion. On removal of the CIDR, P4 concentrations decreased rapidly to basal level within 12 h for the first use (1.4 ± 0.2 ng/ml) whereas the concentrations gradually decreased to basal level within 40 h (day 15+16 h) for the re-used (1.9 ± 0.2 ng/ml).

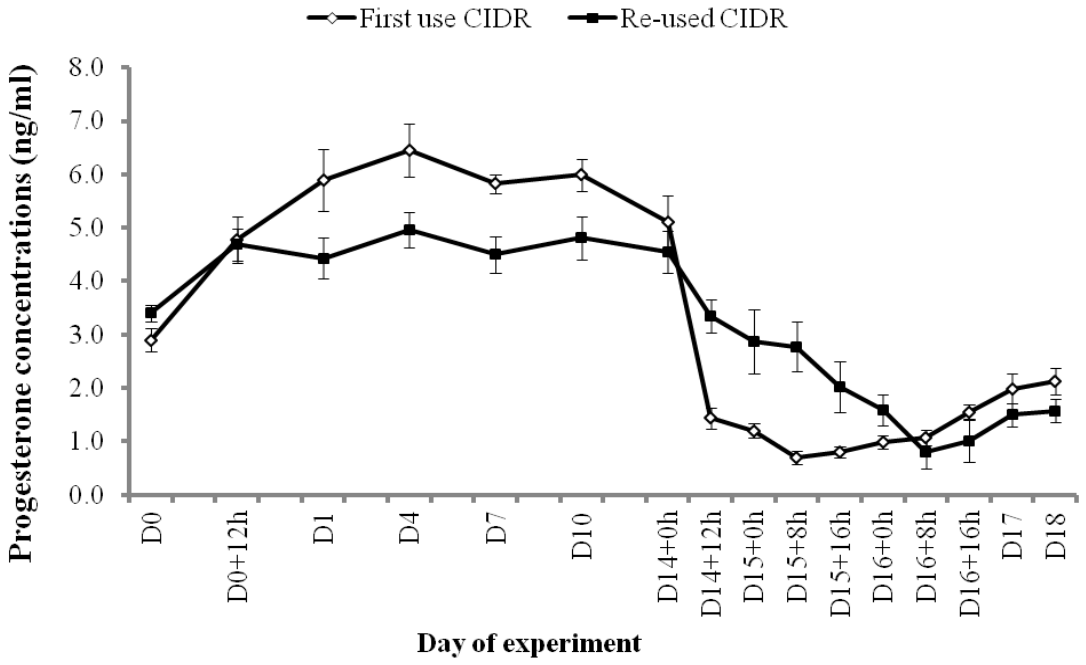


Figure 3.3 Mean (± SEM) plasma progesterone (P4) concentrations induced by the first and re-used CIDR in goats. At the time of CIDR insertion (day 0), P4 concentrations were similar, but were greater ($P<0.05$) in the first use from day 4-14 of the device insertion.

3.2.4 Discussion

In a farm setting, estrus synchronization is normally defined as acceptable when a high percentage, typically 90% or better, of treated animals come into estrus within a 72 h period (Van Cleeff et al., 1998). In our study, percentage of

estrus and ovulation did not differ significantly between the first and re-use CIDR. These results are in agreement with many reports of previous studies that have shown that the re-use CIDR device was successful in controlling estrus and ovulation in goats (Vilariño et al., 2011; Nogueira et al., 2011; Souza et al., 2011; Oliveira et al., 2001). Although duration of estrus for the re-used was significantly shorter (21.4 ± 1.4 h) compared to the first use (26.1 ± 1.1 h), it was still in a normal range time (Baril and Vallet, 1990; Fonseca et al., 2008). Longer duration of estrus in dairy and meat goats was reported in some studies (Greyling and Van der Nest, 2000; Motlomelo et al., 2002; Romano, 2004). These differences can be explained by the frequency of estrus detection in the present study or by individual differences among breeds (Nogueira et al., 2011). Dose of progestagen or synthetic progesterone has been reported that no significant difference in efficiency of estrus synchronization, regardless of the goat breed, was observed (Greyling and van der Nest, 2000).

Researcher has reported the onset of estrus within 18-96 h following progestagen withdrawal (Alacam et al., 1985). The interval from CIDR withdrawal to the onset of estrus and time of ovulation were significantly shorter for the first use (36.5 ± 1.9 h) compared to the re-use (47.0 ± 3.6 h). In this study was comparable to our previous study with the first use of CIDR by which hCG treated nulliparous goats has been reported in estrus during 42.5 ± 4.9 h (Lertchunhakiat et al., 2012). These may be attributed to the variation of remaining P4 after its use in a long-term protocol (11-14 day of treatment) (Vilariño et al., 2011) and it would not suffice in maintaining the levels of P4 required for precise synchronization regimens. However, studies of Vilariño et al. (2011) and Nogueira et al. (2011) found the onset estrus and time of ovulation was similar for devices of the first and re-use.

Diameters of the ovulatory follicle were similar for devices of the first and re-use (6.6 ± 0.2 and 6.2 ± 0.2 mm). This is in agreement with a previous report, two or more follicles in each wave reach > 5 mm diameter in goats (Ginther and Kot, 1994). de Castro et al. (1999) reported that the size of ovulatory follicle was 7.0 mm, whereas Tenório Filho et al. (2007) found much smaller size (5.5 mm) in Nubian goats. Thus, follicle diameter value seems to vary greatly depending on the breed evaluated (Souza et al., 2011). The administration of hCG using the long-term protocol advanced the onset estrus and the time of ovulation (Stenbak et al., 2003).

Plasma P4 concentrations were significantly greater for the new devices compared with devices of re-use (Souza et al., 2011; Vilariño et al., 2011). The main difference was found on day 4 after insertion due to greater surge of P4 concentrations that is typical using new devices (Wheaton et al., 1993). However, the first and re-use devices ensured that plasma P4 concentrations were maintained higher than 1.0 ng/ml until devices were removal. P4 concentrations induced by both treatments were effective in blocking estrus and ovulation until the devices were removed (Vilariño et al., 2011). According to Goodman and Karsh (1980), plasma P4 concentrations greater 1 ng/ml are enough to block or control LH pulsatility and ovulation. After devices removal, P4 concentrations were less than 1.0 ng/ml in the first use (day 15 + 8 h) and re-use (day 16 + 8 h), this value is desirable because it will allow the occurrence of estrus (Souza et al., 2011).

The conception rate in this study did not differ between treatments but was low compared to previous reports resulting in an acceptable conception rate, consistently > 60% (Menchaca and Rubianes, 2004; Nogueira et al., 2011; Oliveira et al., 2001). It is possible that P4 treatments for 14 days may have detrimental effects on fertility as previous report (Kinder et al., 1996). Long-term progestin treatment exhibited negative effects to the ovulation of older and larger follicles and also induced persistent follicles leading to low fertility in goats (Viñoles et al., 2001; Rubianes and Menchaca, 2003). Another has suggested that the short hormonal treatments did not necessarily induce persistent follicles or result lower fertility (Vilariño et al., 2010). Moreover, the conception rate is generally depressed probably due to the quality of frozen semen and AI technique. This is in agreement with Donovan et al. (2004) who reported that CAI with frozen-thawed semen also gives lower fertility compared to the fresh semen.

Although these data indicated the greater efficiency of first use CIDR in term of onset estrus, duration of estrus and time of ovulation, the ovearall percentages of estrus, ovualtion and conception were similar between treatments. In goats, further reseach is warranted focusing on fixed-timed AI using the re-use CIDR as a precise synchronization protocol due to the delayed onset estrus and time of ovulation to improve conception rate.

3.2.5 Conclusions

The present study contributes to new information regarding the re-use of CIDR device for 14 days in goats. At the time of CIDR withdrawal, the re-use CIDR effectively synchronized the estrus and ovulation thereafter with comparable conception rate. Thus, the re-use of CIDR device could be used in goat to synchronize the estrus and is therefore a new alternative to reduce cost of the synchrony.