

## Economic and Reproductive Performances of Two Estrus Synchronization Protocols in Dairy Cows

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### Abstract

The objective of this study was to compare reproductive and economic efficiency between the estrus synchronization protocols utilizing a controlled internal drug release insert (CIDR-E<sub>2</sub>-PG) and fixed time artificial insemination protocol (Ovsynch) in lactating cows. A total of 120 anestrus cross-breed Holstein Friesian lactating cows from 9 dairy herds were randomly assigned to the CIDR-E<sub>2</sub>-PG (n=60) or the Ovsynch (n=60) protocol. Overall, the cumulative pregnancy rate within 250 d in milk period, cows in the CIDR-E<sub>2</sub>-PG group tended to have a higher (P=0.14) compared with the cows received Ovsynch program. Cows in the CIDR-E<sub>2</sub>-PG group tended to have a greater percentage of pregnancy within the first AI (P=0.11). Irrespective of lactation number and body condition score, estimated median times of day open of cows in the CIDR-E<sub>2</sub>-PG group tended to be (P=0.07) a shorter than the Ovsynch cows. The cost per conception utilizing the CIDR-E<sub>2</sub>-PG protocol was lower than the Ovsynch protocol. Furthermore, the efficient scale of economics for the CIDR-E<sub>2</sub>-PG protocol was significantly higher (P<0.05) when compared with the Ovsynch protocol. It can be concluded that estrus synchronization with the CIDR-E<sub>2</sub>-PG protocol tended to improve reproductive performances, reduced production cost and increase the economic efficiency scale in lactating cows.

**Keywords:** Estrus synchronization, reproductive performances, economic, lactating cow

### 1. Introduction

Poor reproductive performance represents financial losses to dairy farmers due to reduced milk yield per year, reduced availability of female calves born as replacements and increased culling (Plaizier, 1997). Low conception rates and prolong day open (DO) periods are closely associated with poor reproductive efficiency and believed to be one of the most comprehensive measures of reproductive performance (Santos et al., 2010). Numerous productive management strategies are available for dairy farmers to improve reproductive efficiency of dairy herds including hormonal synchronization of estrus and timed artificial insemination (AI). Protocols such as Ovsynch (Pursley et al., 1995) and a controlled internal drug release insert (CIDR) with an injection of estradiol and PGF<sub>2α</sub> were developed to increase the chance of insemination and the fertility of time AI (Rabaglino et al., 2010).

In Thailand, several reports (Somchit et al., 2010, Jatupong et al., 2012) have demonstrated conception rate and time to conception using CIDR-E<sub>2</sub>-PG and

Ovsynch. However, very few have evaluated the economic outcome of using such programs. Thus, the objectives of the current experiment were to compare the economic benefit, scale efficiency and reproductive efficiency of the two estrus synchronization protocols in lactating cows.

## 2. Objective

To compare the economic benefit, scale efficiency and reproductive efficiency of 2 estrus synchronization protocols in lactating cows.

## 3. Materials and Methods

The study was designed as a completely randomized block design with 2 treatments. A total of 120 anestrus cross-breed Holstein Frisian lactating cows that reached  $60 \pm 6.5$  days after calving from 9 dairy herds located in Bueng Kan (n=1), Khon Kaen (n=1), and Udon Thani (n=7) provinces were randomly assigned to a controlled internal drug release insert (CIDR-E<sub>2</sub>-PG) (n=60) or Ovsynch (n=60) synchronization protocol. Within each farm, a lactating cow was enrolled in the CIDR-E<sub>2</sub>-PG synchronization protocol. Each cow then received a CIDR vaginal insert concomitantly with an intramuscular injection of 1 mL of estradiol at enrollment (d 0). The CIDR was removed 7 d later concomitantly with an injection of 25 mg of PGF<sub>2 $\alpha$</sub> , and then received a second injection of estradiol on day 9. The artificial insemination (AI) was performed 24 - 36 h after the injection of estradiol. Lactating cows assigned in the Ovsynch protocol were initially given an injection of GnRH (100  $\mu$ g of gonadorelin, Receptal; Intervet Inc., Millsboro, DE) which was then followed 9 d later by an injection of 25 mg of PGF<sub>2 $\alpha$</sub> , and a second injection of GnRH 48 h after the last dose of PGF<sub>2 $\alpha$</sub> . The AI was performed 24 - 36 h after the second injection of GnRH. Clinical signs of estrus were observed in both synchronization protocols before AI. Pregnancy was diagnosed by transrectal palpation on day 60 after AI.

### 3.1 Data collection

The cows in both synchronization protocols were visually observed twice a day (morning and afternoon) for signs of behavioral estrus and recorded. One technician inseminated the cows in the farms located in Bueng Kan and Khon Kaen. However, two technicians inseminated the cows on the farm located in Udon Thani. Data collected included reproductive performances, cost of the programs, total cost for raising the cows and the projected profit for both protocols were calculated.

### 3.2 Statistical analysis

Pregnancy per AI was calculated by dividing the number of cows diagnosed pregnant by the number of cows receiving AI. Day open (DO) was calculated as the interval from calving to conception and between the date of calving and the date of conception. Survival analysis using the Kaplan Meyer survival analysis (SPSS for window version 20) was used to evaluate the effectiveness of treatment on interval of DO. Cox's proportional hazards regression model included effects of the farm, parity, and BCS categorized were analyzed. The adjusted hazard ratios and the 95% CI were calculated. Effect of synchronization programs on the pregnancy rate was determined using a Chi-square test. Furthermore, the economic efficiency of the 2 programs was calculated for scale efficiency according to the

method described by Banker (1996). Student's t-test was used to compare the cost and economic efficient scale. Differences with  $P < 0.05$  were considered significant, and those with  $0.05 < P < 0.10$  were considered a tendency.

#### 4. Results and Discussion

The interval from enrollment to first AI was significantly ( $P < 0.01$ ) affected by treatment. Lactating cows in the Ovsynch protocol had a longer interval from enrollment to first AI compared with the CIDR-E<sub>2</sub>-PG protocol ( $10.9 \pm 0.36$  and  $11.2 \pm 0.20$  days, respectively). Lactating cows which received the CIDR-E<sub>2</sub>-PG protocol displayed a significantly higher ( $P < 0.05$ ) percentile of mounting behavior, vulva redness and swelling compared with the Ovsynch cows. Overall, the cumulative pregnancy rate within 250 d in milk period showed cows in the CIDR-E<sub>2</sub>-PG group tended to have a higher ( $P = 0.14$ ) compared with the cows which received the Ovsynch program (76.3% and 63.8%, respectively). Cows in the CIDR-E<sub>2</sub>-PG group also tended to have a reduced ( $P = 0.15$ ) number of AI compared with the Ovsynch group (2.1 and 2.4, respectively). Similarly, cows in the CIDR-E<sub>2</sub>-PG group tended to have a greater percentage of pregnancy within the first AI ( $P = 0.11$ , 18.6% vs 13.8%, respectively). Irrespective of lactation number, body condition score and farm conditions, estimated median times of day open for cows in the CIDR-E<sub>2</sub>-PG group tended ( $P = 0.07$ ) to be shorter than the Ovsynch cows (131.0 and 169.0 days, respectively, Table 1).

*Table 1*  
*Reproductive parameters of lactating cows received the CIDR-E<sub>2</sub>-PG and Ovsynch synchronization protocols at 250 days of the voluntary waiting period*

Item	CIDR-E <sub>2</sub> -PG	Ovsynch	P-value
Number of animal	59	58	
Interval (d) from enrollment to first AI ( $\pm$ SD)	$10.1 \pm 0.36$	$12.0 \pm 0.20$	$< 0.01$
Pregnancy per AI (%; no. in parentheses)	76.3	63.8	0.14
Cow pregnancy to first AI (%)	18.6	12.2	0.11
Cow pregnancy to second AI (%)	47.5	41.9	0.23
Cow pregnancy to more than third AI (%)	47.6	44.0	0.81
Number of AI to pregnancy ( $\pm$ SD)	$2.1 \pm 1.02$	$2.4 \pm 1.45$	0.15

For survival model, the censored cases for DO were 32.8%. For the final model of DO, no significant different was observed between the synchronized programs, lactation and BCS (Table 2). Estimated median times of day open for cows in the CIDR-E<sub>2</sub>-PG group trended to ( $P = 0.07$ ) shorter than cows in the Ovsynch group (131.0 and 169.0 days, respectively, Table 2).

*Table 2*  
*Effect of CIDR-E<sub>2</sub>-PG and Ovsynch synchronization protocols on the interval calving to conception*

Item	median	95% Confidence interval		P-value
		lower	upper	
CIDR-E <sub>2</sub> -PG	131.0	101.9	160.0	0.07
Ovsynch	169.0	80.9	257.0	

The production cost, and net profit were significantly different ( $P < 0.05$ ) between dairy herds. Cost per conception of the CIDR-E<sub>2</sub>-PG protocol was lower than the Ovsynch protocol (1,510 vs 1,580 baht, respectively). Therefore, revenue for the CIDR-E<sub>2</sub>-PG protocol was 9.75% higher than the Ovsynch protocol. Furthermore, the efficient scale of economics for the CIDR-E<sub>2</sub>-PG protocol was significantly higher ( $P < 0.05$ ) compared with the Ovsynch protocol. Additionally, management and technique efficiency were also higher (Table 3).

Cows which received the CIDR-E<sub>2</sub>-PG protocol showed a greater percentage of economic efficient scale compared with Ovsynch cows (69.64% and 53.45%, respectively). This is in line with the data that total profit of the CIDR-E<sub>2</sub>-PG cows was higher than Ovsynch cows (Table 4).

Table 3

Comparison of the cost of synchronization protocols per pregnancy, total cost production, total income and profit per cow per year of lactating cows received CIDR-E<sub>2</sub>-PG and Ovsynch synchronization of estrus programs

Item	CIDR-E <sub>2</sub> -PG ( $\times 10^3$ Baht)	Ovsynch ( $\times 10^3$ Baht)	P-value	
			Farm	Treatment
Cost of synchronization protocol per pregnancy	1.5 $\pm$ 0.05	1.6 $\pm$ 0.05	0.75	0.35
Total cost production per cow per year	62.9 $\pm$ 0.08	63.0 $\pm$ 0.09	<0.01	0.19
Total income/cow/year	102.5 $\pm$ 3.13	98.6 $\pm$ 3.63	0.57	0.42
Profit/cow/year	39.5 $\pm$ 3.14	35.6 $\pm$ 3.64	0.01	0.41

Table 4

Economic efficient scale of CIDR-E<sub>2</sub>-PG and Ovsynch synchronization of estrus protocols

Farm	Number of animals		Efficiency scale (%)	
	CIDR-E <sub>2</sub> -PG	Ovsynch	CIDR-E <sub>2</sub> -PG	Ovsynch
1	21	19	57.1	36.8
2	4	4	50.0	100.0
3	6	6	83.3	33.3
4	6	3	50.0	0.0
5	3	5	100.0	100.0
6	5	6	80.0	83.3
7	6	6	83.3	33.3
8	3	5	100.0	80.0
9	5	4	80.0	50.0
Total	59	58	69.5	53.5

## 5. Conclusion

It can be concluded that the estrus synchronization with the CIDR-E<sub>2</sub>-PG protocol tended to improve reproductive performances, while reducing production costs and increased the economic efficiency scale in dairy cows.

## 6. Recommendations

Although the CIDR-E<sub>2</sub>-PG protocol tends to improve the economic benefits in dairy herds, the net profit depends on the production cost in each farm. On the other hand, the majority of dairy farmers are still inseminated cows during a natural estrus. The further studies are warranted to compare economic benefits between natural estrus breeding and the estrus synchronization protocol across different managerial and physiological conditions in order to explore which factors have an important impact on economic efficiency.

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