Conception Rate of 11 Months Old Dairy Heifer Following Artificial Insemination with Natural Estrus and PGF2α Treatment

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Abstract. The aim of this study was to evaluate the conception rate of 11-months old dairy heifer following artificial insemination with natural estrus or treated with PGF2α at PT. Ultra Peternakan Bandung Selatan. A case study was applied in this study involving all data of 700 records for date of birth, body weight and reproduction status. Sample was selected according the complete records with criteria of age was 11±3 months, body weight >300kg, having normal reproduction organs detected by rectal palpation. The results showed that from observation of selected 300 samples out of 700 heifers, 25 heifers of them were natural estrus (Control), 50 estrus after single PGF2α injection (PG), 95 following single PGF2α and left to normal estrus after 21 days (PG-N), 50 after double PGF2α (2PG), and the rest of 80 heifers showed estrus following double PGF2α – Natural estrus (2PG-N) with the conception rate (CR) of 17/25(68%), 44/50(88%), 42/50(84%), for the respective groups. None of heifers in PG-N and 2PG-N groups became pregnant after first insemination. The body weight (BW) was classified into Low (336-347kg), Medium (348-359kg) and High (360-372kg). The total conception rate was 34%. The CR for Low, Medium and High BW were 41%, 32% and 31%, respectively. The conclusion, the 11-months old heifer was possible to become normal pregnant following insemination without and with PGF2α injection when reached body weight over 300 kg. To ensure the higher number animal exhibiting estrus, double PGF2α injections should be applied.

Keywords: 11-months old heifers, natural estrus, PGF2α induced estrus, conception rate.

1. Introduction

In commercial dairy farm, the first calving at younger age is important factor for improving economically benefit of farming, due to the revenue from calf and milk production compare to the later mating and calving. Sexual maturity and body maturity are other factors should be considered when the farmer should apply the program of first mating for heifer. The young heifer which not yet reach sexual or body maturity might be has not optimum reproductive organ milieu for supporting fertilization and embryo development, and the capacity of mammary gland cannot facilitate maximum milk production
[1]. During this age phase, the high growth rate of body muscle, reproductive organ and mammary gland structure are occurred, and the stable and optimum functional of reproduction organ should be at the end of fast growth phase. In dairy cows maintained by local farmers in Indonesia, the first breeding begins normally at least 18 months old, and the first calving will be considered around 30 months old. From 3 years old to 6 years old, it was reported no significant differences of service per conception, days open and calving interval in dairy cows maintained by small dairy company [2]. However, some farmers begin to breed heifer at the first time not only base on the age, but also according to the body weight that can be reached of animal at the puberty and sexual maturation.

High efficiency of production process is strictly demanded in modern dairy industry, and therefore earlier calving program of heifer is beneficial strategy for improving income and revenue from the calf and milk production. The 11-months old heifer is physiologically over puberty age, however, had reached not enough sexual maturity yet. Normally, the heifer is considered to be sexual maturity for breeding when reached 15 months old. Heifers represent the best genetics within the herd, and ensuring they are bred and calve in a timely manner is crucial to future production. Research has shown long-term financial benefits to calving heifers for the first time at younger than 24 months of age [3]. The effect of age at breeding on reproductive performance in cows has been reported [4]. Pregnancy rate increased from age 2 to 6 and decreased from age 7 to 11 years and this effect was independent of the culling strategy. Spontaneous estrus and induced estrus are important program to be considered to meet high efficiency cost for industry. In subtropical dairy company, the conception rate of synchronized heifers to the fixed-time AI (53.2%) and to AI after resynchronization(53.1%) was lower than that of control heifers (63.7%). However, pregnancy rate in the first 24 d was higher for the synchronized group (72.4%) than for the control group (67.8%). More control heifers (5.7%) than synchronized heifers (4.0%) failed to become pregnant [5].

This study was conducted to evaluate the pregnancy rate following artificial insemination with estrus emerging spontaneously and treated with single or multiple injection of PGF2α in 11-months old dairy heifers at PT. Ultra Peternakan Bandung Selatan, Indonesia.

2. Methodology
   
   Animal rearing
   This study was conducted at Dairy Company of PT. Ultra Peternakan Bandung Selatan. A total of 700 heifers in this company was included as source of sampling. The animals were kept intensively in semi open housing, and fed with Total Mixed Ration (TMR) 10% of body weight, while drinking water was served ad libitum.

   Animal treatments and estrus observation
   Data of 300 heifer records were randomly selected with quote sampling method from 700 dairy heifers with the criteria of 11 ± 3 months old, body weight >300 kg, and having normal reproductive organ evaluated by rectal palpation. The breeding program was begun by observation the estrus of heifers ranging in those criteria for 1 – 2 days. The estrus animals were inseminated with standard protocol, and non-estrus others were injected with intra venously 2.0 ml PGF2α containing 0.526 mg Clopostenol to induce and synchronize of estrus. The estrus heifers following PGF2α injection were inseminated, nevertheless were let to show natural estrus in next cycle. The treatment groups for estrus exhibition were spontaneous or natural estrus (Control group, n = 25), PGF2α injection (PG group, n = 50), PGF2α and let to natural estrus (PG-Natural, n = 95), twice PGF2α injection (2PG, n = 50), and twice PGF2α injection and let to show natural estrus (2PG-Natural, n = 80). Pregnant animals were determined with two methods, observation for return to service between day 18 – 21 and by rectal palpation on day 32 to 35.

   Grouping body weight
   For evaluation the effect of body weight on the conception rate, the body weight of heifers was classified into three groups, low body weight (336 – 347 kg, n = 87), medium body weight (348 – 359 kg, n = 128), and high body weight (360 – 372 kg, n = 85)
Data analysis
Data of service per conception (S/C) were analyzed by variance analysis to determine different values between groups (P<0.05), and when observed any difference was then continued by Duncan’s multiple range test at level 0.05 to determine which groups are different. The other data were analyzed descriptively. This analysis was conducted with assisting of SPSS Microsoft Version 21.0.

3. Result and Discussion
The number of heifers showing spontaneous or natural estrus without any treatment during direct estrus observation (Control group) was 25 animals out of 300 animal sample (8.33%), while the remain of 275 heifers were synchronized with PGF2α (PG group) resulting 50 heifers in estrus (18.18%). For improving efficient management cost, the non-estrus animals (225/275 or 81.81%) were not directly synchronized by PGF2α injection but let to observe next natural estrus in 21 days (PG-Natural group), resulting 95/225 (42.22%) exhibiting estrus. The others 130 animals were injected with PGF2α (2PG group) resulting 50 (38.46%) showing estrus, and the resting 80 non-estrus animals (80/80 or 100%) were coming to estrus after next 21 days without any additional estrus-induction treatment (2PG-Natural group). In this study, heifers aging 11 months have already showed estrus spontaneously or naturally (8.33%) as shown in Table 1. This was more earlier compared to dairy cattle in India that do more 30 months [6]. The onset of puberty and sexual maturity are the result of a series of complex events that occur within the reproductive endocrine system [7]. A cow maturing at early age will produce more milk in her whole life time. Delayed puberty in cattle and buffalo is a major problem in the dairy industry. The first age of puberty and sexual maturity in dairy heifer are influenced by growth, body weight and body condition score with positive correlation, although Meier et al [7] showed non-significant effect of body condition score on the age of puberty.

Table 1. Estrus exhibition of heifers according to treatment groups and days of observation

| Day of estrus post treatment | N  | Treatment group | Estrus, N (%) | Remarks                                |
|-----------------------------|----|-----------------|---------------|----------------------------------------|
| 0                           | 300| None            | 25/300 (8.33)*| spontaneous or natural estrus as       |
|                             |    |                 |               | Control group                          |
| 0-10                        | 275| PG              | 50/275 (18.18)| Estrus observation day 0 - 10          |
| 14-31                       | 225| PG-Natural      | 95/225 (42.22)| Estrus observation in next 14 - 31     |
|                             |    |                 |               | days after PGF2α injection             |
| 0-10                        | 130| 2PG             | 50/130 (38.46)| Estrus observation day 0 - 10          |
| 14-46                       | 80 | 2PG-Natural     | 80/80 (100)   | Estrus observation Days 14 – 46.      |

Table 1 showed that PGF2α injection had important role to induce estrus of 11-months old heifers that did not exhibit estrus during spontaneous estrus observation in the herd either for single or double PGF2α injections group (18.18% and 38.46%, for PG and 2PG groups, respectively). Likewise, when the heifers did not show estrus following PGF2α injection were left for 21 days to exhibit natural estrus, the double PGF2α injections improved the number of animals showing estrus (42.22% and 100%, for PG-Natural and 2PG-Natural respectively). The similar results [5] reported that in large scale herd of dairy heifers, the combination treatment with progesterone, estradiol benzoate and PGF2α increased the number of animals showing estrus and reduced the interval days between calving and first insemination.
Table 2. Effect of PGF2α treatment on the S/C, CR and the number of heifers become pregnant

| Treatment Group | No of treatments | No of Estrus and inseminated | Service per conception, S/C* | No of pregnant animals | Conception Rate, CR (%) | No of inseminations to get pregnant |
|-----------------|------------------|-------------------------------|-----------------------------|------------------------|-------------------------|-----------------------------------|
| Control         | 300              | 25                            | 1.44±0.712^a                | 17                     | 68                      | 36                               |
| PG              | 275              | 50                            | 1.14±0.405^a                | 44                     | 88                      | 57                               |
| PG-Natural      | 225              | 95                            | 2.68±0.902^b                | 0                      | 0                       | 253                              |
| 2PG             | 130              | 50                            | 1.20±0.495^a                | 42                     | 84                      | 60                               |
| 2PG-Natural     | 80               | 80                            | 2.98±1.031^b                | 0                      | 0                       | 238                              |
| Total           | N=300            |                               |                             |                        |                         | 644                              |

Different superscript in the same column are differ (P<0.01)

Table 2 showed the effect of treatment on S/C and CR. Service per conception (S/C) of animal failed to show estrus in Control group (1.44±0.712) were better (P<0.01) when the animal treated with PGF2α injection either single (PG: 1.14±0.40) or double injection (2PG: 1.20±0.49) than the animal left to show spontaneous estrus following PGF2α injection (PG-Natural: 1.20±0.49) or double PGF2α injections (2PG-Natural: 2.98±1.03). Non two latest groups resulted value CR because the insemination number of all animals more than two. The injection of PGF2α of non-estrus animal improved dramatically the number of animal exhibiting estrus. PGF2α injection can induce the estrus of most heifers because the most heifers are normally have low level of reproduction hormones, and therefore the this low hormone levels are not enough to stimulate exhibiting natural estrus [5, 6].

Table 3. Service per conception and conception rate according body weight groups in young heifers

| Body weight (kg) | No of animal inseminated | Service per conception, S/C | No of animal pregnant | Conception Rate, CR (%) |
|------------------|--------------------------|-----------------------------|-----------------------|-------------------------|
| Low (336-347)    | 87                       | 1.98±1.034                  | 36                    | 41                      |
| Medium (348-359) | 128                      | 2.32±1.242                  | 41                    | 32                      |
| High (360-372)   | 85                       | 2.09±1.031                  | 26                    | 31                      |

Table 3 showed S/C and CR in low body weight group of 11-months heifer (SC: 1.98±1.034, CR: 41%) were better than heifers with higher medium (S/C: 2.32±1.242, CR: 32) and high body weight (S/C: 2.09±1.031, CR: 31%) although no significant differences were observed. In dairy heifers with superior rearing condition in this study, the body weight should be controlled to ensure constant ranging 336–347 kg. Poor as well as over body condition growth of heifer effect on the reproduction performance of dairy cow. The more intensive rearing of dairy heifer resulted lower pregnancy rate following first and all inseminations/services, and the highest average daily gain (ADG) showed lower conception rate than those lower ADG [8, 9]. Therefore, the intensive dairy heifer rearing should be considered the purpose for breeding or fattening and be considered to ration composition and amount to adjust the body weight during breeding age.

4. Conclusion

The heifers 11 months old were possible to exhibit naturally estrus of 8.33% with conception rate of 66% from estrus – inseminated animals when reared at good condition and reach at least 300 kg body weight. The injection of PGF2α could induce the estrus of heifers more prefer produce hinger conception rate than without any PGF2α injection, and therefore, the non-estrus animals following PGF2α treatment and were left to show estrus resulted higher values S/C of more 2.0.
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References

[1] J. M. Bormann, L. R. Totir, S. D. Kachman, R. L. Fernando, and D. E. Wilson. 2006. Pregnancy rate and first-service conception rate in Angus heifers. J. Anim. Sci. 84:2022–2025.
[2] M. Zainudin, M. N., Ihsan dan Suyadi. 2014. Reproduction performance of Friesian Holstein cows in different parities at CV. Milkindo Berka Abadi, Kepanjen-Malang, Indonesia. Indon. J. Anim. Sci. 24(3): 32-37.
[3] M. Lormore. 2005. The case for a quality dairy replacement program. Proceedings. NRAES Dairy Calves and Heifers. Integr. Biol. Manag. Conf. 155-163.
[4] P. R. Shorten, C. A. Morris, N. G. Cullen. 2015. The effects of age, weight, and sire on pregnancy rate in cattle. J. Anim. Sci. 93(4):1535-1545.
[5] Z. Z. Xu and L. J. Burton, 1999. Reproductive Performance of Dairy Heifers after Estrus Synchronization and Fixed-Time Artificial Insemination. J. Dairy Sci. 82(5): 910-917.
[6] S. K. Gupta, P. S. Dabas, K. P. Shinde, S. A. Lone, N. Kumar, and A. Kumar. 2016. Strategies for attaining early puberty in cattle and buffalo: A review. Agric. Rev. 37(2):160-167.
[7] D. L. Foster. 1994. Puberty in sheep. The Physiology of Reproduction. 2nd Ed. New York: Raven Press. 411
[8] L. Krpálková, V. E. Cabrera, J. Kvapilik, J. Burdych, and P. Crump. 2014. Associations between age at first calving, rearing average daily weight gain, herd milk yield and dairy herd production, reproduction, and profitability. J. Dairy Sci. 97:6573–6582.
[9] S. Meier, B. Fisher, K. Eketone, L. R. McNaughton, P. R. Amer, P. Beatson, J. R. Bryant, K. G. Dodds, R. Spelman, J. R. Roche, and C. R. Burke. 2017. Calf and heifer development and the onset of puberty in dairy cows with divergent genetic merit for fertility. Proceed. New Zealand Soc. Anim. Prod. 77:205-210.