Estrous responses synchronized by a combination of PGF2α and GnRH hormones in Sapera goat

A Hafid A1, A Anggraeni1, F A Pamungkas1, R G Sianturi1, D A Kusumaningrum1, A B L Ishak1 and A N Mukhlisah2

1Indonesian Research Institute for Animal Production, PO BOX 221 Bogor 16720
2Faculty of Animal Science and Fisheries, Sulawesi Barat University, Majene, Indonesia

E-mail: anitahafid1@gmail.com

Abstract. Estrous synchronization can uniformity of mating and kidding to a population of dairy goat females. The objective of this study was to evaluate response, duration and onset of estrous of Sapera does synchronized by PGF2α and PGF2α combined with GnRH hormones. Study used 16 Sapera does at the ages of one year old after reaching sexual maturity at average body weights of 26.52±2.51 kg (22.4–32.5 kg). Synchronization treatments were conducted for two different injections. Group one was injected two times of PGF2α within 11 day interval. While group two was injected by GnRH on the 9th day after the 1st injection PGF2 α and before the 2nd injection of this hormone within 11 day interval. Estrous observation was evaluated every three hours for four days after the 2nd PGF2α injection. Estrous characteristics were based on behaviour and vulva condition of animals. The result revealed that the two groups of PGF2α vs PGF2α + GnRH hormones gave significantly differences (P<0.05) to the responses of estrous (62.50 vs 100%), duration of estrous (18.75 hrs vs 33.75 hrs) and onset of estrous (25.13 hrs vs 3.00 hrs). The conclusion was that PGF2α + GnRH combination presented more effective synchronization results as indicated by better response, duration and onset of estrous in Sapera goat.

1. Introduction
Estrous synchronization is an important effort for management efficiency of livestock production. Estrous synchronization will synchronize the onset of behavioral symptoms of estrous and ovulation in livestock by manipulating reproductive organs using the hormone. The principle of estrous synchronization is to prolong or shorten the life span of the corpus luteum (CL) or the luteal phase. Through the estrous synchronization we will be knowing the onset, duration and response of estrous.

There are many ways to estrous synchronization such as using Controlled Internal Drug Release (CIDR) [1,2], combined progesterone and Equine Chorionic Gonadotropin [3,4], sponge progesterone [5]. The other method of synchronizing estrous by shortening the luteal phase is usually using a prostaglandin hormone (PGF2α) by lysing CL so that estrous occurs. Hormones which often used for synchronization are progesterone, gonadotropin releasing hormone (GnRH) and prostaglandin, or combination of GnRH and prostaglandin [6]. There are two ways to apply the estrous induce by PGF2α. The first is single injection and the second is double injection. The single injection is effectively used when the estrous cycle had been known on the luteal phase with having the functional CL, while double injection can be applied either on the follicular phase or luteal phase [7].
Estrous synchronization using GnRH and PGF2α has been reported in several animals, such as in dairy cows [8–12], beef cows [13–15], jennies [16], beef heifers [17], ongole crossbred [18], and goat [6]. Nevertheless it has not been widely reported the using GnRH and PGF2α for synchronization in dairy goat. Therefore this study was conducted to determine the estrous response of Sapera goats after being injected with PGF2α and GnRH.

2. Material and methods

2.1. Animal

The research was conducted in the small ruminant pen, Indonesian Research Institute for Animal Production, Ciawi. The materials used in this study were 16 Sapera goat. All goat aged 1 year after reaching sexual maturity, with an average body weight of 26.52±2.51 kg (22.4–32.5 kg).

2.2. Synchronization treatments

Synchronization treatments were conducted for two different injections. The goats divided into two groups of treatment. Group one was injected two times of PGF2α within 11 days interval. While group two was injected by GnRH on the 9th days after the 1st injection PGF2α and before the 2nd injection of this hormone within 11 days interval (figure 1). The dosage of PGF2α used was 1 mL (Lutalyse®), while GnRH used was 0.25 mL.

![Figure 1. Timeline of hormone injection](image)

2.3. Estrous and physiological observation

The estrous observation was evaluated every three hours for four days after the 2nd PGF2α injection. Estrous characteristics were based on the behavior and vulva condition of animals. The pulse frequency and the body temperature were evaluated once a day at 3 pm. The pulse frequency was calculated using stethoscope for a minute. While the measurement of body temperature consisted of rectal and vulva using thermometer digital.

2.4. Statistical analysis

The estrous observation, body temperature, and pulse frequency was analysed using one-way analysis of variance (ANOVA). The model used was as follows:

\[ Y_{ij} = \mu + T_i + \epsilon_i \]

\( Y_{ij} \): Observation
\( \mu \): Population mean
\( T_i \): The effect of administration GnRH
ε_ij : Residual error
Differences were considered significant at $P<0.05$.

3. Results and discussion

3.1. Estrous observation

Based on the results of the study, it was found that the estrous response tended to be higher for injection of the PGF2α hormone with GnRH compared to PGF2α only. The mean response to estrous (%), duration and onset of estrous (hour) following injection PGF2α + GnRH and PGF2α only are presented in table 1.

Table 1. Estrous observation.

| Group            | Response to estrous (%±SD) | Estrous duration (average in hour±SD) | Estrous onset (average in hour±SD) |
|------------------|----------------------------|---------------------------------------|-----------------------------------|
| PGF2α+GnRH       | (100.00±0.00)a              | (33.75±3.11)a                         | (3.00±0.00)a                      |
| PGF2α            | (62.50±51.75)b              | (18.75±16.10)b                        | (25.13±20.90)b                    |

$a,b$ Different letter in the same column shows differ significantly ($P<0.05$).

The working principle of the prostaglandin F2 alpha (PGF2α) hormone is regressing the corpus luteum resulting in levels the progesterone hormone produced will decrease so that it will have an impact on the increase FSH hormone and will stimulate the development of the follicles until they mature and on eventually will cause the estrous. The administration of PGF2α in the middle of the luteal phase caused luteolysis within a few hours so that the progesterone levels decreased and estrogen levels increased which stimulated the anterior pituitary to release Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH), which cause the development and maturation of the follicle, leading to estrous and ovulation.

The goats used in this study were one year old and had just reached the sexual maturity for the first time. So the hormonal regulation will be optimal when administrated the GnRH. The injection of GnRH before the second injection of PGF2α will stimulate to induce maturation of follicle. Elevated GnRH essential for initiating the follicular phase of the estrous cycle. GnRH stimulate release of FSH and LH causing growth and development of ovarian follicles. FSH doesn’t surge with the same magnitude as LH. When estrogen reaches a threshold level (peak), the preovulatory surge of LH occurs, causing estrous response and inducing ovulation [19].

These findings are supported by previous studies, Ataman and Akoz [20] reported that using GnRH and PGF2α are effective for estrous synchronization in sheep. Ruediger et al [21] also reported that the administration of a second dose of GnRH in beef cattle either 24 or 48 hours after PGF2α resulted in 47.7 and 44.9 % pregnancy after TAI.

3.2. Physiological observation

The body temperature every day after the second injection of PGF2α are shown in table 1. There is no significant difference of the goats body temperature neither injection PGF2α nor PGF2α + GnRH (table 2).

Table 2. The body temperature per day after the second injection of PGF2α.

| Group            | Rectal | Vulva |
|------------------|--------|-------|
|                 |        |       |
| PGF2α+GnRH      | 39.05±0.20 | 38.6±0.58 |
| PGF2α           | 38.43±0.45 | 37.56±1.32 |

NS: Not Significant ($P>0.05$)
The estrous cycle can affect the tissue vascularization and blood flow, it will affect the heat of the body [21]. The duration of estrous in this study shows until 33 hours but it doesn’t show the difference of the heat of the body. While the observation of the pulse frequency shows there is a significant difference in day 2 after the second injection of PGF2α (table 3).

**Table 3.** The pulse frequency after the second injection of PGF2α.

| Group               | Pulse frequency |
|---------------------|-----------------|
|                     | Day 1      | Day 2      | Day 3      | Day 4      |
| PGF2α+GnRH          | 57.62±3.29a  | 59.37±5.42a | 53.25±1.58a | 55.75±5.11a |
| PGF2α               | 57.12±6.87a  | 53.00±1.60b | 52.62±2.66a | 55.25±3.80a |

*Different letter in the same column shows significantly different (*P*<0.05)

4. Conclusion
PGF2α+GnRH combination presented more effective synchronization results as indicated by better response, duration and onset of estrous in Sapera goat.

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