Relationship of Gonadotropin-Releasing Hormones (GnRH) Induction to Reproductive Performance in Batur Sheep

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Relationship of Gonadotropin-Releasing Hormones (GnRH) Induction to Reproductive Performance in Batur Sheep

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Abstract. Experiments were performed to determine the relationship of Gonadotropin-Releasing Hormone (GnRH) induction to estrus activity and pregnancy rate of Batur sheep. Twenty Batur sheep were synchronized to estrus using intramuscularly injection of 2 ml PGF2α that repeated in 11-day intervals. GnRH was given intramuscularly on the 9th day for 10 Batur sheep, and 10 others were not injected as a control. Reproductive performance included estrus intensity, estrus onset, mating time period, and pregnancy rate. The data were analyzed by regression correlation tests, and chi-square test were used for pregnancy rate. The statistical analysis results showed that the induction of GnRH has a very significant relationship ($P<0.01$) to the intensity and onset of estrus as well as the time-mating period it has a significant relationship ($P<0.05$). The pregnancy rate was significantly different ($P<0.05$) between control and GnRH-induced in Batur sheep. The results showed that GnRH induction contributed to the intensity of estrus, the onset of estrus, and the time-mating period of 37.88, 42.79, and 22.16%, respectively. The pregnancy rate in Batur sheep induced by GnRH compared to controls has 25.0% increased. It can conclude that GnRH induction was able to improve reproductive performance in Batur sheep.

Keywords: reproduction performance, Batur sheep, GnRH induction

1. Introduction

The genetic potential of sheep in Indonesia generally has prolific traits with a variety of specific reproductive characteristics, especially related to the ability of the mother to produce the number of offspring at one birth (litter-size). The results of previous studies have reported that the prolific trait of sheep is generally able to produce one or even four offspring at one birth (Sumaryadi, 2003). Fertility and high litter-size in sheep is an important component that has high economic value in accelerating the increase in productivity and livestock population.

Batur sheep are local sheep strains that historically have the elders of Merino sheep which developed from generation to generation in the Batur District, Banjarnegara Regency. This means that Batur sheep have ability to reproduce as prolific sheep. The results of previous studies reported that this prolific trait was brought by a single gene segregation that acts additively from the local sheep's Java (FecJ) fecundity gene which has similarities with the Booroola (FecB) fecundity gene of Merino sheep (Sumaryadi et al., 2007). The presence of these genes can cause variations in the number of lamb that born per sheep.
Differences in the number of lambs, physiologically affected by the number of follicles ovulate in the ovaries. Follicular growth and development affected by concentration of Follicle Stimulating Hormone (FSH) synergistically with Luteinizing Hormone (LH) causing deGraaf follicles to ovulate. The release of both pituitary hormones stimulated by Gonadotropin releasing hormone (GnRH) from the hypothalamus. Sumaryadi and Manalu (1996) stated that the large number of follicles that ovulate during estrus will increase the number of lambs born. Previous researchers concluded that the number of kids/lambs born is closely related to the number of ovulations (Bradford, 1985; Bradford et al., 1986;

Manalu et al., 1994). The higher number of follicles, the higher estrogen hormone produces. High estrogen hormone causes the secretion of LH which will break deGraff follicles in the ovary, so that ovulation occurs and sheep will show signs of estrus (Dianti et al., 2011). Furthermore, it was also reported that the modulation of the FSH-LH hormone induced by GnRH was able to increase the number of ovulating follicle waves (Sumaryadi et al., 2000; Putra and Kusumawati, 2014). According to Hastono (2003), after estrus synchronization, the signs of estrus in female cattle were visually perform and achieved high conception rate. Based on the research by Hafizuddin et al., (2012), increasing in the concentration of Gonadotropin-Releasing Hormone causing the production of FSH and LH to release therefore can stimulate the growth of follicles and de Graaf follicles which produce estrogen hormones.

The induction of Gonadotropin-Releasing Hormone to Batur sheep is expect to increase the amount of FSH which able to increase the number of follicles and estrogen hormone, therefore increasing estrus activity and livestock can be bred on time, so that there is an increase in the rate of pregnancy. Therefore, it is necessary to conduct research related to the relationship between induction of gonadotropin releasing hormone and reproductive performance in Batur sheep.

2. Materials and Methods

The material used in this research was 20 non-pregnant Batur sheep with criteria: second parity with an age of 2 years in Batur District, Banjarnegara farmer group. For estrus detection method, 9 males were used. The tools and materials used were 3 ml injection syringe for injecting PGF2α hormone (Dinoprost trometamol 5 mg/ml) at a dose of 2 ml per animal and Gonadotropin-Releasing Hormone (GnRH) (Gonadorelin 0.1 mg/ml) at a dose of 1 ml per animal, logbook, stationery, flashlight, watercolor, and ice box. Research variables were observed including estrus activity, time-mating period, and pregnancy rate as the dependent variable (Y), while GnRH induction as the independent variable (X). All samples sheep in this research were synchronized to estrus by two times injection of 2 ml PGF2α intramuscularly with 11-day intervals. For GnRH induction, ten sheep were intramuscularly injected using GnRH on the 9th day, and the remaining ten sheep were not injected as a control. Previously, the experimental sheep were adapted to local feed and environmental conditions, while drinking water was provided ad libitum. Reproductive performance was observed included estrus intensity, estrus onset, time-mating period, and pregnancy rate.

The intensity of estrus was determined based on a score of 1 to 4 on tail movement, vulvar swelling, vulvar color, mucus, vulvar temperature, and behavior. The onset of estrus was determined based on the length of time from the second injection of PGF2α until the first estrus signs occurred (in hours). The time-mating period was determined based on the length of time from the second injection of prostaglandins to the peak of estrus when the cattle were mated in hours. Pregnancy rate is the number of pregnant sheep divided by the number of sheep were mated (in percent)

The data obtained were then tabulated and analyzed by regression and correlation test as X is reproductive performance and as Y is GnRH induction.

3. Results and Discussions

According to the observation, after induction all of the sheep showed the signs of estrus. The results of this study were higher than the previous that the percentage of estrus in thin-tailed lambs injected with PGF2α resulted response around 70% (Hasan et al., 2017; Yasa et al., 2018). The score of estrus intensity, onset of estrus, time-mating period and average pregnancy rate in Batur sheep are shown in Table 1.

Table 1. Estrus Intensity, Estrus Onset, Time Mating Period and Pregnancy rate of Batur Ewes

No	Reproduction Performance of Batur Ewes	score
1.	Estrus intensity score (1 – 4)	3.20±0.83
2.	Estrus Onset (h)	23.10±4.76
3.	Time mating period (h)	24.63±8.37
4.	Pregnancy rate (%)	90

The score of estrus intensity in Batur sheep (presented in table 1) was higher than in Kacang goats which is only 2.47 ± 0.21 (Syafruddin et al., 2016) and 2.08 ± 0.52 hours (Adam et al., 2018). The onset of estrus in Batur sheep showed faster than in Kecobong goats at around 42.00 – 44.57 hours and Garut sheep around 28 – 37 hours (Zulkarnain et al., 2015). This condition causes the period of time-mating period to be faster in Batur sheep. However, a pregnancy rate relatively same as Peranakan Etawah (PE) goat of around 80-90% (Al' A'raaf et al., 2020).
The results of Gonadotropin-Releasing Hormone (GnRH) induction for estrus intensity scores in Batur sheep are shown in Figure 1.

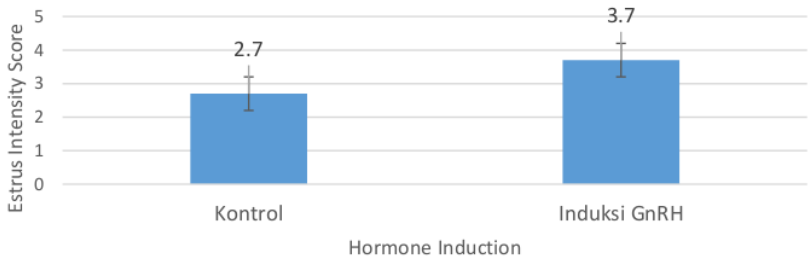

Fig. 1. Estrus Intensity Score

The results in Figure 1 showed that with GnRH induction, there were an increase score of estrus intensity in Batur sheep by 37.04%. it means that the induction of GnRH could elevates the intensity of estrus with higher signs of estrus. The results of the regression analysis showed that the induction of GnRH hormone had a very significant relationship ($P<0.01$) with the intensity of estrus by following the equation of the regression line $Y = 2.7 + 1.0\ X$ and a coefficient of determination of 0.3788. This means that GnRH induction contributed on the estrus intensity by 37.88% and the remain were influenced by other factors. Based on the equation of the line, it shows that GnRH induction is directly proportional to the intensity of estrus, means that the GnRH induction treatment increases the estrus intensity of Batur sheep. This is due to the administration of gonadotropin releasing hormone will cause regression and ovulation of the dominant follicle and the formation of a new follicular wave (Ummaisyah et al., 2020) which will secrete estrogen which plays a role in stimulating the signs of estrus. The results is in agreement with Ismail (2009) who reported that increasing concentration of the hormone estrogen in the bloodstream is affected by LH stimulation in the process of follicular development, causing granulosa cells to produce the hormone estrogen which triggers estrus in cattle.

3.1. Estrus Onset

The observation results of the estrus onset in Batur sheep induced by gonadotropin releasing hormone (GnRH) are shown in Figure 2.

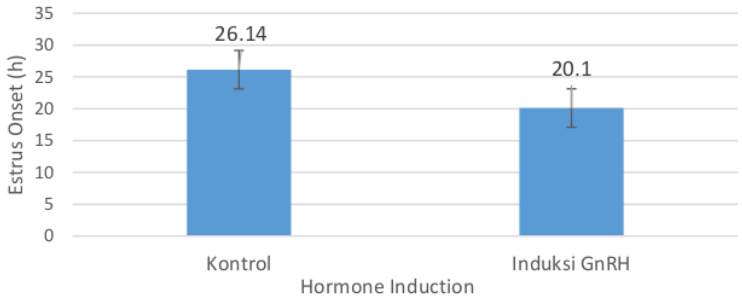

Fig. 2. Estrus Onset Batur Sheep

The results in Figure 2 presented that GnRH induction accelerates the onset of estrus in Batur sheep by 30.05%, it means that gonadotropin releasing hormone (GnRH) induction causes the onset of estrus occur faster than controls. The results of the regression analysis showed that the induction of GnRH hormone had a very significant relationship (P<0.01) with the onset of estrus by following equation of the regression line Y = 26.14 – 6.08 X and the coefficient of determination was 0.4279. This means that the induction of GnRH hormone contributes to the onset of estrus by 42.79% and the rest is influenced by other factors. Based on the equation of the line, it shows that GnRH induction is inversely proportional to the onset of estrus, meaning that the GnRH induction treatment accelerates the onset of estrus in Batur sheep. This is because the administration of gonadotropin releasing hormone will cause regression and ovulation of the dominant follicle and the formation of a new follicular wave (Muti et al., 2019; Ummaisyah et al., 2020) which will secrete estrogen which plays a role in spurring the signs of estrus. This condition causes faster onset of estrus in GnRH-induced Batur sheep.

3.2. Time Mating Period and Pregnancy Rate

The results of the time-mating period and pregnancy rate in Batur sheep induced by gonadotropin releasing hormone (GnRH) were demonstrated in Figure 3.

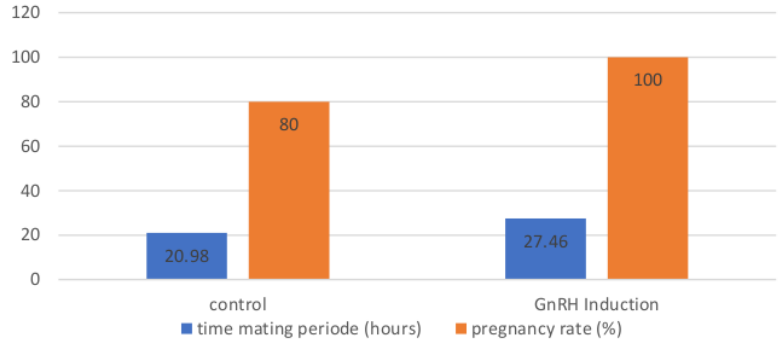

Fig. 3. Time-mating period and Pregnancy rate

The results in Figure 3 showed that GnRH induction prolongs the time-mating period in Batur sheep by 30.89%, it means that induction of gonadotropin releasing hormone (GnRH) causes the time mating to occur longer than the control. The results of the regression analysis showed that the induction of the GnRH hormone had a very significant relationship (P<0.01) with the time-mating time period by following the regression line equation Y = 20.98 + 7.49X and the coefficient of determination was 0.2216. This means that the GnRH induction contributed to the time-mating period by 22.16% and the remains was influenced by other factors. Based on the equation of the line, it shows that the GnRH induction is directly proportional to the time-mating period, therefore it could prolong the time-mating of the Batur sheep. This condition increased the pregnancy rate of Batur sheep to 100% compared to control (80%), moreover high estrus intensity with more obvious signs of estrus could achieved. This is due to the administration of gonadotropin releasing hormone which causing regression and ovulation of the dominant follicle and the formation of a new follicular wave (Ummaisyah et al., 2020) which will secrete estrogen which generate the signs of estrus such as swelling, reddening or changing temperature of the vulva (Sutama, 2011; Irfan et al., 2017; Wijayanti and Ardigurnita, 2020) and mucus secretion (Silaban et al., 2012; Priatin et al., 2019; Verma et al., 2014; Rizki et al., 2019; Setiawati et al., 2020; Brinaldi et al., 2022).

4. Conclusion

Induction of Gonadotropin-Releasing Hormone (GnRH) associate to increasing reproductive performance in Batur sheep. The intensity of estrus increased by 37.04%, the onset of estrus was faster, and the time-mating period was longer when the peak of estrus occurred. It provides better opportunity for the mating process and able to increase the pregnancy rate up to 100%. However, this research needs to be applied to other livestock commodities.

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