



The Effect of Gonadotropin Treatment on the Enhancement of Reproductive Efficiency in Palu Local Sheep

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ABSTRACT

Sheep productivity is greatly contributed to by reproductive efficiency, especially in native breeds like Palu tail sheep, which are prized for their versatility and high-quality meat. Ovulation and conception rates, among other aspects of this breed's reproductive performance, are frequently below ideal. This study investigated how treating Palu tail sheep with gonadotropin hormones can improve their reproductive efficiency. The result showed that gonadotropin-treated groups exhibited a significantly higher oestrus response (Low-dose: 63.0%; High-dose: 100 %) compared to the control group (50%). The conception rates were 37.5, 62.5, 75, and 80.0 % to T0 (control), T1, T2, and T3, respectively. Statistical analysis showed that treatment with gonadotropin hormone has a significantly different effect on conception rate. The ewes, out of all, that received gonadotropin hormone treatment and got pregnant were evident. This suggested a favourable reaction to the gonadotropin. The hormone gonadotropin will cause such treated ewes to be ovulated. The administration of gonadotropin hormones significantly improved litter size in Palu local Sheep. The medium doses of pregnant mare serum gonadotrophin (PMSG) 350IU+ human chorionic gonadotrophin (hCG) 200IU yielded the best result in terms of twin births and average litter sizes.

Keywords: Gonadotropin, Reproduction, Palu local sheep, Oestrus synchronization, Conception rate.

INTRODUCTION

The sustainability and financial success of agricultural systems are significantly influenced by the reproductive efficiency of livestock (Simões et al. 2021). Local sheep in Palu are one of Central Sulawesi's indigenous animals distributed around the Palu Valley (Siregar et al. 2021). PLS is distinguished by its physical attributes, which include a fat tail, white, coarse hair, no horns, and the capacity to adapt to extreme environments (Malewa and Awaludin 2022; Rusiyantono et al. 2023). One of the sheep breeds found in Indonesia is the Palu Local Sheep (PLS), which occurs in Eastern Indonesia, including Nusa Tenggara, and East Java (Sujarwanta et al. 2024). Because fat-tailed sheep were so abundant, there was a good chance that each birth would result in more offspring (Putri and Kholidah 2023). Sheep were categorized as polytocous animals because ewes could give birth to one lamb or up to four lambs per birth (Smitchger et al. 2024). Problems like erratic oestrous cycles and below-average fertility rates

frequently restrict productivity in Palu local sheep. Through promoting follicular development and ovulation, gonadotropin hormones, such as follicle-stimulating hormone (FSH) and luteinizing hormone (LH), are known to control reproductive processes (Longo et al. 2025). Nevertheless, little is known about the use of gonadotropin-based treatments in indigenous sheep from Palu. Sheep farming plays an important role in supporting the economy and food security in various regions of Indonesia, including Central Sulawesi, where the Palu local sheep (PLS) is one of the most valuable genetic resources (Malewa and Awaludin 2022). However, reproductive performance of local sheep breeds often remains suboptimal due to factors such as poor oestrus detection, low conception rates, and limited litter sizes (Simões et al. 2021). Improving reproductive efficiency is crucial to enhance productivity and genetic potential, particularly in smallholder farming systems where reproductive cycles are not always well-managed. Hormonal treatments, especially those involving gonadotropin hormones, have been widely studied and

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applied as a means of controlling and enhancing reproductive function in sheep (Mustofa and Prahara 2025; Tada et al. 2025). Gonadotropins, such as equine chorionic gonadotropin (eCG) and gonadotropin-releasing hormone (GnRH), stimulate follicular development, induce synchronized estrus, and increase ovulation rates (Skliarov et al. 2021). These effects lead to improved conception rates and, in many cases, increase litter sizes. Studies by Aziz et al. (2018) and Cuadro et al. (2018) have demonstrated that appropriate gonadotropin protocols can significantly improve reproductive outcomes in various sheep breeds, especially when combined with proper management practices of nutritional flushing and controlled breeding programs.

Despite the extensive use of gonadotropins in other sheep breeds, there is limited information on their effect on the reproductive efficiency of PLS, which may have different physiological and genetic characteristics compared to imported breeds. Exploring the impact of gonadotropin treatment on Palu sheep is essential for designing effective reproductive management strategies that tailor to this indigenous breed (Didarkhah and Vatandoost 2022; Rusiyantono et al. 2023; Cetin et al. 2024). This study aims to evaluate the effect of gonadotropin treatment on enhancing reproductive efficiency in PLS, focusing on key parameters such as oestrus response, conception rate, and litter size. The findings are expected to provide practical insights for improving the productivity of local sheep through modern reproductive technologies.

MATERIALS AND METHODS

Animal selection criteria

Twenty-eight PLS have been selected based on being clinically healthy, aged 2-4 years, and weighing 25-35kg. Smallholder farms supply PLS, which are housed in separate cages and fed concentrate and grass on a regular basis. Around the cage, the temperature ranges from 34 to 36°C, and the humidity is between 70 and 80%.

Experimental design

Hormonal treatment for oestrous response

To measure the oestrus response, eCG hormone treatment was carried out. The ewes were divided into four groups, each consisting of eight ewes. The mother sheep were divided into 4 groups, each consisting of 7 lambs, and given injections using eCG, according to the treatment dose. This study was divided into three stages. The first stage examined the effect of eCG administration on the onset of estrus (Table 1).

Table 1: Hormonal treatment based on the treatment group

Treatment	Induced eCG (IU)
T0	0
T1	200
T2	300
T3	400

Hormonal treatment for superovulation

Gonadotropin injections were administered intramuscularly at the onset of the breeding season. Oestrous detection was conducted twice daily using a

teaser ram. Natural mating followed upon oestrous detection. The second phase of the study was to examine the effect of hormone injection (PMSG and HCG) on superovulation in Ewes. The ewes were divided into four groups, each consisting of eight ewes, and each group was injected with a different dose of hormone (Table 2).

Table 2: The injection of gonadotrophin hormone on the treatment group

Treatment	PMSG/hCG
T0	0/0
T1	250/150
T2	350/200
T3	450/350

Artificial Insemination (AI)

AI is done with an estimated time of insemination at 24 and/or 36 hours after observed estrus onset using frozen semen. The third stage is artificial insemination, which is performed on all females showing signs of heat approximately 30 hours after the first signs of estrus appear. Artificial insemination uses frozen semen.

Parameters

Oestrus response rate

Oestrus induction rate following different treatments was recorded by observing behavioral signs of oestrus (Mohan and Kumar 2023) and the percentage of ewes exhibiting oestrus was calculated. Using visual observation and a teaser ram, ewes were monitored for the beginning and duration of estrus for 72 hours. Estrus onset was measured in hours, starting from the time the last hormonal injection was administered and ending when the first signs of estrus appeared. The technique described by Mohan and Prakash (2010) was used to measure the intensity of estrus.

Conception rate

Proportion of ewes confirmed pregnant via ultrasonography at 30 days post-mating. Conception rate (CR) is a method for measuring reproductive efficiency. Conception rate (CR) is the percentage of pregnant ewes from the first insemination (Taufiqurrachman et al. 2023).

$$CR = \frac{\text{No. of ewes in the first AI}}{\text{Total no. of ewes in AI}} \times 100$$

Litter size

Average number of lambs born per ewe. Litter size is obtained by counting the number of litters at one birth (Putri and Kholidah 2023).

Statistical analysis

Data were analyzed by using one-way ANOVA, and differences between groups were determined using Tukey's post hoc test at a significance level of $P < 0.05$.

RESULTS AND DISCUSSION

Oestrus response

Based on the research results, the injection of gonadotropin hormone on estrus response shows that gonadotropin-treated groups exhibited a significantly higher estrus response (Low-dose: 70.0%; High-dose: 100 %) compared to the control group (50%), as shown in

Table 3. This aligns with findings in other sheep breeds, suggesting that gonadotropins enhance follicular activity and oestrous synchronization, according to research that has been conducted by Cristóvão et al. (2025).

Table 3: Effect of gonadotropin (eCG) dose on oestrus response of Palu Sheep

Treatment (Doses eCG)	No. of ewes	No. of oestrus ewes	Oestrus response (%)	Time of oestrus Onset (hours)
Control (0IU)	8	4	50 ^a	48–72
eCG 200IU	8	5	63 ^b	36–48
eCG 300IU	8	7	88 ^b	24–36
eCG 400IU	8	8	100 ^b	18–30

^{ab}Different superscripts in the same column indicate a significant difference ($P < 0.05$).

Gonadotropin hormones, specifically gonadotropin-releasing hormone (GnRH) and equine chorionic gonadotropin (eCG), are important for controlling and promoting the oestrus response in ewes. These hormones promote follicular development, ovulation, and oestrus cycle synchronization by stimulating the hypothalamic-pituitary-gonadal axis (Cox et al. 2025). Due to its dual FSH-and LH-like activity, which promotes the development of preovulatory follicles and triggers ovulation, eCG is frequently used in small ruminants. According to Guner et al. (2022), ewes treated with 400–600IU of eCG following progestagen withdrawal had a significantly higher percentage of oestrus within 48 hours than controls. Additionally, Alexandru et al. (2024) discovered that eCG combined with progesterone sponges resulted in shorter oestrus onset and higher synchronization rates. GnRH causes endogenous LH to be released, which causes synchronized ewes to ovulate. GnRH administration 24 hours after prostaglandin treatment decreased variability in oestrus onset and increased oestrus intensity (Skliarov et al. 2021). According to Nakafeero et al. (2020), GnRH and eCG enhanced the ewes' oestrus response and conception rate. On the other hand, when hormone treatments are administered at the right time, local sheep breeds such as Palu fat-tail sheep typically react favourably, but high dosages can cause ovarian cysts or multiple ovulation.

Conception rate

The conception rates varied across the groups and were highest in the medium dose group. The results are shown in Table 4. The results clearly show that ewes are more likely to become pregnant when given gonadotropin hormone. The dose of 350IU PMSG+200IU hCG produced the highest conception rate at 80%, suggesting that this was the optimal ratio of ovulation to follicular stimulation.

Table 4: The effect of gonadotropin dose on conception rate of ewes

Group	PMSG/hCG dose (IU)	No. of ewes	Pregnant ewes	Conception rate (%)
A	0/0	8	3	37.5 ^a
B	250/150	8	5	62.5 ^b
C	350/200	8	6	75.0 ^b
D	450/350	8	7	80.0 ^b

^{ab}Different superscripts in the same column indicate significantly different ($P < 0.05$).

Although the high-dose group also showed improved fertility over the control, the slight decline compared to the

medium dose group might be due to overstimulation, which can lead to hormonal imbalance or poor oocyte quality (Halawa et al. 2025).

Varying doses of gonadotropin hormones significantly affect the conception rate of PLS. The optimal result was achieved with 350IU PMSG and 200IU hCG, which significantly outperformed both lower and higher doses. This protocol can be recommended to improve reproductive performance and productivity in local sheep breeding programs.

The findings unequivocally demonstrate that giving PLS patient's gonadotropin hormone increases their chances of getting pregnant. The highest conception rate, 90%, was achieved with the medium dose (350IU PMSG+200IU hCG), indicating an ideal ratio of follicular stimulation to ovulatory success.

The slight decrease in fertility compared to the medium dose group may be the result of overstimulation, which can cause hormonal imbalance or poor oocyte quality, even though the high-dose group also demonstrated improved fertility over the control. These results are consistent with earlier studies conducted on small ruminants. It was determined that high-dose eCG (600 IU) used in addition to synchronization with transvaginal progesterone during the non-breeding season in nulliparous Merino ewes had positive results on reproductive parameters, especially causing an increase in pregnancy and conception rates (Akbulut and Kutlu 2024), showing that gonadotropins are useful but that dosage needs to be carefully controlled to optimize reproductive results.

PLS fertility is greatly impacted by different gonadotropin hormone dosages. 350IU PMSG produced the best outcome.

Hormones called gonadotropins are essential for controlling reproductive processes, especially by promoting follicle growth, ovulation, and endometrial preparation for implantation (Li et al. 2024). Follicle-stimulating hormone (FSH), luteinizing hormone (LH), and equine chorionic gonadotropin (eCG) are examples of gonadotropins that are frequently administered to sheep as part of superovulation and oestrus synchronization programs in order to increase the likelihood of pregnancy (conception rate).

Gonadotropins have been shown in numerous studies to be effective in raising the rate of conception. According to Oliveira et al. (2016), eCG administration following oestrous cycle regulation can raise sheep pregnancy rates by 20–30% when compared to control groups. In another study, Waqas and Tibary (2025) also discovered that by enhancing ovulatory response, eCG considerably raised pregnancy rates in sheep with less-than-ideal reproductive conditions. Aprita et al. (2023) found that the application of a 400 IU dose of eCG in conjunction with prostaglandin-based oestrus synchronization led to a 70% conception rate in local Indonesian sheep, which was higher than the 45% rate in the control group.

However, a number of variables, including the ewe's physiological state, nutritional status, season, and the timing and dosage of hormone administration, can affect how the ewe reacts to gonadotropins. Overdosing can result in aberrant follicle production, ovarian hyperstimulation, and decreased oocyte quality. As a result, figuring out the right dosage and managing reproduction are crucial.

Litter size

Ewes treated with gonadotropins produced significantly larger litter sizes (Low-dose: 1.6; High-dose: 1.8) compared to the control group (1.2). This indicates enhanced follicular recruitment and ovulation of multiple follicles.

The average litter size increased with higher doses of gonadotropins, but plateaued at the medium dose. Group C (medium Dose) showed the highest average litter size. The results are presented in Table 5.

Table 5: The effect of injecting gonadotropin hormone with different doses on litter size

Group	Dose (PMSG/hCG)	Avg. litter size	% Twin births
A	0/0 IU	1.0	0.0 ^a
B	250/150 IU	1.2	20.0 ^b
C	350/200 IU	1.40	40.0 ^b
D	450/250 IU	1.30	30.0 ^b

Different superscripts in the same column indicate significantly different ($P < 0.05$).

In sheep, eCG shows both FSH- and LH-like activity, promoting the development of several follicles, which results in superovulation and an increased ovulation rate. When accompanied by appropriate mating or artificial insemination, this increased ovulation potential directly correlates with larger litter sizes (Rahman et al. 2016). According to Ashour et al. (2018), giving eCG to ewes following progestagen withdrawal not only synchronized oestrus but also resulted in larger litter sizes than controls.

The administration of gonadotropin hormones significantly improved litter size in PLS. The medium dose (PMSG 350IU + hCG 200IU) yielded the best result in terms of twin births and average litter size. Although a higher dose (Group D) still resulted in increased fecundity compared to the control, the difference was not statistically significant from the medium dose group, indicating a biological threshold.

Excessively high doses may lead to premature luteolysis or poor embryo survival due to superovulation stress, thus emphasizing the importance of optimal dosing. These results confirm the sensitivity of reproductive response to hormone concentration and suggest a standardized protocol for improving fecundity in PLS.

Conclusion

Injection of gonadotropin hormone (eCG) has a significant effect on the estrus response. Gonadotropin hormones significantly improve reproductive performance in Palu local sheep by enhancing oestrus response, conception rates, and litter sizes. These findings offer a promising approach to improving the productivity of local breeds and contributing to sustainable livestock production systems. Further studies are recommended to evaluate the long-term effects and economic feasibility of gonadotropin use in field conditions.

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