

## **The description of the physiological response and milk production of *Etawah* Crossbreed (PE) goats injected with the oxytocin hormone**

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**ABSTRACT:** This study aimed to know the physiological response and milk production of *Etawah* Crossbreed (PE) goat injected with the hormone oxytocin. The mechanism of action of the oxytocin hormone in the body will suppress the production of the cortisol hormone, which causes livestock stress. For now, there are not many publications about the induction of oxytocin hormone in PE goats. In this research, the researchers will provide the latest information. The research material is 18 lactation PE goats divided into 2 groups, namely control and hormone treatment. This research is in the form of an experimental research design with a control group *post-test only design*. The design used is an independent t-test. Hormone injection is carried out intramuscular, as much as 1 ml with a dose of 10 IU. The parameters measured were milk production (ml), heart rate (times/minutes), and respiration frequency (times/minutes). Oxytocin injection had no significant effect ( $P>0.05$ ). Still, it tended to increase the milk production of PE goats in the morning and evening with total milk production of  $1103.65\pm 145.72$ ml compared to without injection of  $884.38\pm 90.49$ ml in 1 day. Similarly, the injection of the hormone oxytocin did not affect the frequency of respiration in the morning and evening. However, it was different from the PE goats heart rate, which had a significant effect ( $P<0.01$ ) in the morning. On the other side, there was no significant effect ( $P>0.05$ ) in the afternoon. The indicators of stress in dairy cattle are respiration frequency and heart rate outside normal limits, affecting milk production. This study concluded that the induction of the oxytocin hormone did not affect milk production, and the cattle did not experience stress because the heart rate and respiration frequency were in the normal range due to the injection of the oxytocin hormone.

**Keywords:** Hormone injection; Oxytocin hormone; Milk production; Heart rate; Respiration frequency

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## **INTRODUCTION**

The increase in population from year to year will lead to high demand for food products. Improving the quality and income of the community also affects the quality of food that the community will consume. Food products from livestock, such as milk, contain good nutrients that are needed by the body. To the consumption of milk, milk production must be maintained well. One of the tropical livestock that can produce milk is the *Etawah* Crossbreed (PE) goats. PE goats are produced by crossing between *Ettawa* goats (India) and local goats (Indonesia). In addition to having good nutrition, goat's milk can also be consumed by people with lactose intolerance to cow's milk.

According to Mukhtar (2006), cited by Febriana et al. (2018), milk production is influenced by 2 main factors, which are genetics and the environment. Environmental factors such as feed and environmental manipulation are the efforts made to increase milk production. Additives such as hormones are given to optimize milk production, which is also related to the physiological response of PE goats. Physiological responses of livestock such as heart rate and respiratory rate become a reference to determine whether the livestock that is stressed or not

The oxytocin hormone has a major function in the milk-ejection process. Tancin and Bruckmaier (2001) stated that if the milk-ejection process occurs perfectly, then 20% of the remaining milk in the alveoli can be milked and increase milk production, plus will maintain the health of the goats. Mechanically, the oxytocin hormone that has bound to its receptor will cause myoepithelial cell contraction to occur. Contraction between the proteins actin and myosin causes the milk in the alveoli to be squeezed into the collecting duct. Oxytocin not only plays a role in stimulating myoepithelial cells, but the concentration of oxytocin in the body can suppress the production of the hormone

cortisol, which causes stress in livestock. Induction of the hormone oxytocin has also been carried out by Bencini (1995), who stated that merino sheep that received oxytocin injections with different dose levels, namely 1 IU, 5 IU, and 10 IU, caused an increase in milk production.

However, Injections in cattle tend to cause discomfort because they can cause shock so that the respiratory rate is unstable and the heart rate will increase. According to Pramono et al. (2014), the physiological response of pre-weaned *boerawa* male goats with a temperature of 30.67°C in the lowlands with an average respiration rate of 42 times per minute. According to Frandson (1996), quoted from Dzarnisa et al. (2017), normally, the average heart rate is 70 to 135 times per minute.

The purpose of this study was to obtain the latest data and information about increasing milk production and see how the hormone oxytocin-induced changes in the physiological response of PE goats.

## **MATERIALS AND METHODS**

This research was conducted on smallholder farms on the Ring Road of Syiah Kuala University Campus, Syiah Kuala District, Banda Aceh City, Indonesia. The number of goats used was 18 adult female *Etawah* Crossbreed (PE) goats in the lactation period. The research sample was taken randomly by ignoring the factors of age, lactation period, udder volume, and body weight.

This research is in the form of an experimental study with a control group *post-test only design*. The research design used was an unpaired t-test. Before the t-test, the data normality test was carried out using the *Shapiro-Wilk* design model. If the data is not normally distributed, then a non-parametric test with the Mann-Whitney design model will be used. The research sample will be divided into 2 groups: the control group and the oxytocin hormone treatment group. The data that will be collected and research parameters are milk

production, respiratory rate (times/minute), and heart rate (times/minute).

This study used hormone injection with the intramuscular method— injection right into the *semimembranosus* muscle. Oxytocin injection was given as much as 1 ml at a dose of 10 IU. Milk injection was carried out 1 hour before the morning milking. Calculation of the amount of milk, calculation of respiratory rate, and heart rate were carried out in the morning and evening.

The measurement of the physiological response of goats includes measuring heart rate (times/minute) and respiration frequency (times/minute). Measurements were made before milking was done. The following is a method of calculating the physiological response: Respiration frequency is done by bringing the back of the hand closer to the goat’s nose to feel

exhalation and then counting for 1 minute. Heart rate is done by counting the heart rate for one minute using a counter, initially with the stethoscope held in the left costal (chest) area, behind the distal scapula (bottom), and ensuring that the area beeps or beats the loudest.

## RESULT AND DISCUSSION

### Milk production

The milk ejection process is an important step in milk production because the milk in the alveoli cells will be transferred to the udder tract, where it will be milked. The ejection of milk takes place with the help of the oxytocin hormone, which will stimulate the myoepithelial cells surrounding the alveoli cells. Below are the results of PE goat’s milk which was given oxytocin and which was not given oxytocin.

**Table 1.** Average Milk Production.

| Parameter            | Average      |                |
|----------------------|--------------|----------------|
|                      | Control      | Hormon         |
| Milk Production (ml) |              |                |
| Morning              | 631,00±61,78 | 795,38±110,37  |
| Evening              | 253,38±29,82 | 308,27±40,39   |
| Total                | 884,38±90,49 | 1103,65±145,72 |

In Table 1, the average daily milk production ratio between each control and treatment is 884.38 ml and 1103.65 ml, respectively. Statistically, there was no effect ( $P > 0.05$ ) of the oxytocin hormone on milk production. In contrast to research Sumaryadi et al. (2002), the milk production of Fries Holstein dairy cows increased by 18.64% due to the injection of the hormone oxytocin compared to those who did not. According to Mukhtar (2006), cited by Febriana et al. (2018), the differences in milk production are caused by genetic factors, including individual variations, heredity, lactation duration, persistence, hormones, and pregnancy, and body size. The second factor is the environment which includes feed, milking, care, disease, and medicine. The effect of the oxytocin hormone was not statistically significant. Still, according to Table 1, milk production

in the control group was less than in the hormone group, indicating that the effect of oxytocin was still there, although it was very small. Jones (1975) states that oxytocin stimulates prolactin secretion in the adenohypophysis and inhibits prolactin release. These inhibiting factors by the hypothalamus can maintain milk production. Nostrand et al. (1991), cited by Lollivier et al. (2002), also states that daily injection of oxytocin in the long term in dairy cows results in increased milk production and allows more persistent milk production, especially during decreased lactation time.

Table. 1 also shows a difference in the amount of production in the morning and evening. In the morning, milk production tends to be higher than in the afternoon in both groups of PE goats. Although the average milk production does not have a

statistical effect, there tends to be an increase or decrease in milk production every day during the research period. The result shows that other external influences affect milk production apart from hormonal factors.

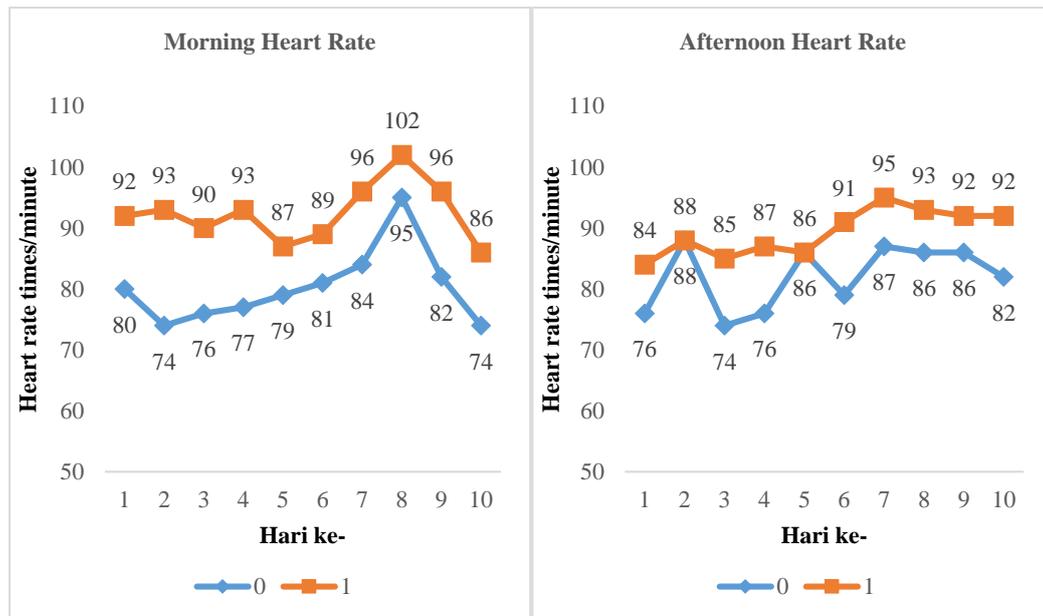
**Physiological Response**

In this research, it can be seen that the heart rate of PE goats in the morning with the treatment group given the oxytocin hormone had a higher effect than the control group ( $P < 0.01$ ). Meanwhile, the afternoon data did not show any effect ( $P > 0.05$ ). Based on research data, the average heart rate of PE goats during the study can be seen in Table 2 below.

According to Frandson (1996) quoted from Dzarnisa et al. (2017), normally, the average heart rate is 70 to 135 times per minute. Meanwhile, in Table 2, the average morning heart rate in the control and hormone groups was 81 and 93 beats/minute, respectively. Meanwhile, in the afternoon, the heart rate of PE goats in the control and treatment groups were 82 and 89 beats/minute, respectively. The hormone cortisol hormonally influences increased heart rate in the blood. High plasma oxytocin levels during stress reduce norepinephrine levels or adrenaline hormones and reduce heart rate (Szyberg et al., 2013).

**Table 2.** Mean Physiological Response of PE Goats

| Parameter                            | Average |         |
|--------------------------------------|---------|---------|
|                                      | Control | Hormone |
| Heart Rate (times/minute)            |         |         |
| Morning                              | 81±2,21 | 93±3,11 |
| Afternoon                            | 82±2,65 | 89±3,40 |
| Respiration Frequency (times/minute) |         |         |
| Morning                              | 46±3,79 | 45±2,06 |
| Afternoon                            | 42±2,77 | 39±2,46 |

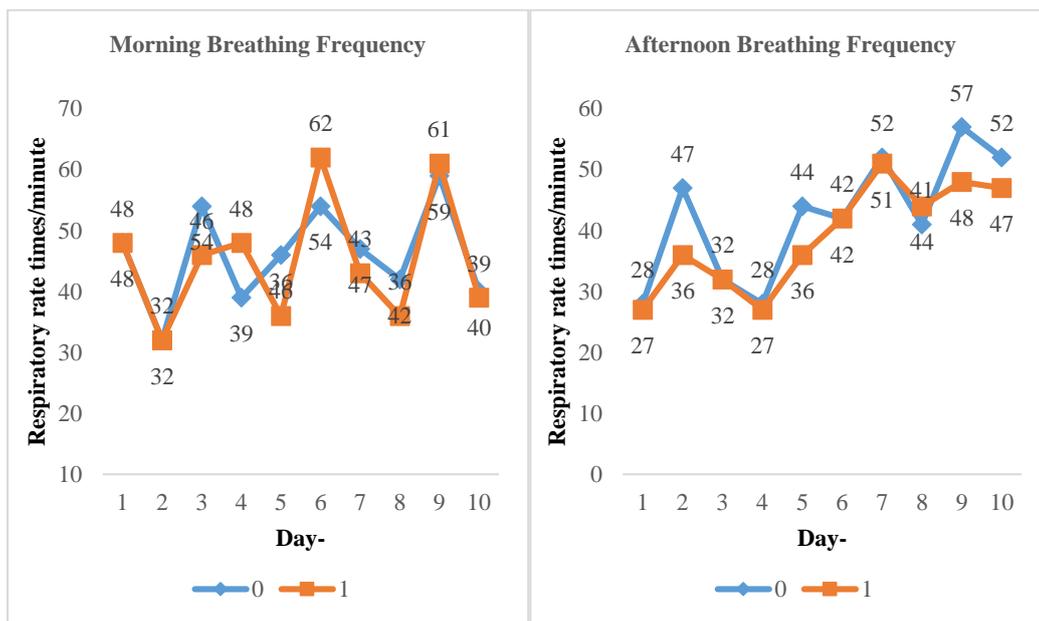


Description: 0; Control Group, 1; Treatment Group.

**Figure 1.** PE Goat's Heart Rate Measured During the Study

Heart increasing rate in the treatment group is not a stressed condition because it does not exceed the normal heart rate limit in goats, as for the increase in heart rate caused by the injection and other effects of the hormone oxytocin, namely contraction of the uterus. This condition causes uncomfortable conditions, increases the hormone cortisol in the blood, and stimulates an increase in heart rate. In the

afternoon, there was no effect on either the control group or the treatment group. It was because the oxytocin hormone was dissolved in the blood by metabolic processes in the body. According to Lollivier et al. (2002), in dairy cows, the first two minutes after receiving stimulation, the concentration of the hormone oxytocin increased and then slowly decreased until it reached a normal concentration.



Description: 0; Control Group, 1; Treatment Group

**Figure 2.** Graph of PE Goat's Breathing Frequency during the Study

The t-test analysis showed no difference in the respiratory rate of PE goats injected with oxytocin hormone ( $P > 0.05$ ) both in the morning and in the evening. The average respiratory rate in the morning was 46 times/minute in control and 45 times/minute in the treatment. According to Frandson (1996), cited by Dzarnisa et al. (2017), the average respiratory rate of goats normally ranges from 26 to 54 times per minute. The average respiratory rate did not exceed the normal limit both in the hormone and control groups. It can be seen in Table 2 that the frequency of morning respiratory in the control group and the hormone group were 46 and 45 times/minute, respectively. While in the afternoon, each group is 42 and 39 times/minute.

According to Szyberg et al. (2013), an increase in heart rate can be caused by injection and other oxytocin hormone effects, namely contraction of the uterus, causing uncomfortable conditions and increasing the hormone cortisol in the blood and spurring an increase in heart rate. According to Pramono et al. (2014), Increased respiratory rate and heart rate will produce heat energy in the body. An increase in body temperature causes livestock to get rid of excess temperature by increasing the respiratory rate. In line with Karstan (2006) opinion, an increase in respiratory frequency is carried out to free the heat trapped in the goat's body. In this study, there is an indirect possibility that respiratory rate correlates with heart rate, an

increase in heart rate causes circulation in the blood to increase.

## CONCLUSIONS

Based on the results and discussion, it can be concluded that the induction of the oxytocin hormone had no effect but tended to increase milk production and did not negatively affect the respiratory rate and heart rate of the *etawah* crossbreed (PE) goats.

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