The effect of giving a combination of Tabut and ammoniated citronella waste on the physiological and hematological responses of lactating Etawa crossbreed goats

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Abstract. This research used a combination of Tabut and citronella waste in Etawa crossbreed goats (PE). The goats used in the research were divided into 5 treatments and 3 groups. The subjects were 15 female Etawa crossbreed. The grouping was done based on lactation period. The parameters observed were physiological profile (respiratory rate, heart rate, rectal temperature) and hematological profile (hematocrit, hemoglobin, erythrocyte, and leucocyte). Data were processed using SPSS version 16 software based on a randomized block design. ANOVA variance analysis was carried out with the F test at a 95% confidence interval (a = 0.05). The results of testing the physiological response and the hematological response showed that there was no effect (P> 0.05) of the combination of tabut and ammoniated citronella waste on respiratory rate, heart rate, rectal temperature, hematocrit, hemoglobin, erythrocytes, and leukocytes. The average obtained tends to be normal, therefore the combination of tabut and ammoniated citronella waste given to Etawa crossbreed goats can be applied to dairy livestock and it is recommended with a combination ratio of 6% tabut and 2% ammoniated citronella waste.

1. Introduction
The Indonesian's need for milk consumption continues to increase. This is influenced by the population, income levels and healthy lifestyles of the community. In 2019, the production of fresh milk in Indonesia increased by about 3%, which was 996,442.44 tons/year compared to 2018 which was 951,003.95 tons/year. The milk production in Indonesia is related to the number of livestock population and milk production in dairy cattle. The population of dairy cattle in Indonesia in 2019 was 561,061 head/year, decreased by 0.2% compared to 2018 of 581,882 heads/year but did not show any decrease in milk production [1]. To overcome the decrease in milk production, it is necessary to find alternatives for milk-producing livestock other than cows. Dairy livestock that can be used as an alternative to produce milk are goats. One of the dairy goats that can produce milk is the Etawa crossbreed goat, because these goats are easy to adapt so that they are easy to be raised in the community.

Etawa crossbreed goat is a type of goat which is widely cultivated by Indonesian breeders as dairy livestock. To meet the needs of national milk consumption, it is necessary to increase milk production. Nationally, milk production is still low based on the development data for the period of 2014 – 2019. Milk production, especially cow's milk in Java, has decreased by an average of 1% per year. Meanwhile, outside Java in the last 5 years, it also shows a decline of 3.05% per year [2].

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One of the efforts made to increase milk production is by making feed modification. Feed modifications that can be done includes the use of Tabut. Tabut is the development of tape-curcuma paste and Sakura block. Tape-curcuma paste has been applied to Madura cows and lactating Balinese cows by 5% of the dry matter requirement of the ration. The results were reported to increase milk production for 0.42 kg/head or 9.5 times higher than cows which are not given tape-curcuma paste [3].

In lactating Etawa crossbreed goats, the provision of tape paste (7.5%) and curcuma solution (50%) resulted in the highest milk production (0.37 kg/day) with the lowest milk fat (2.09%) [4]. Tape paste (1,000g) and 400 ml of curcuma solution, increased the production of FH dairy cow’s milk by about 0.77-1.09 kg/day [5].

One of the efforts to reduce the cost of feed production is by using raw materials from waste, in this case is using citronella waste. Citronella waste can be used as feed for livestock. Citronella waste has better quality than straw. The crude protein content is 7.21%, far above the straw waste which is only 3.9%. Citronella waste has a better (lower) crude fiber content compared to straw and elephant grass, which is 25.7%. Citronella distillation waste can be used directly or 1-2 days after refining. When the waste is dry, it can be sprinkled with water until it is slightly wet before being given to the livestock. The use of citronella waste as feed can reduce unpleasant odors in manure.

The nutritional content of forage and ammoniated citronella waste is very important for the livestock. If there is a deficiency or excess, it can interfere and hamper the livestock growth. The components of the tabut will work together to create a conducive rumen condition for rumen microbes, increase the efficiency of nutrient metabolism and nutrient absorption to produce higher milk precursors. From the foregoing, it is necessary to carry out research on increasing the productivity of lactating Etawa crossbreed goats by providing a combination of tabut with ammoniated citronella waste. Several studies have been carried out on giving citronella waste to cows and tabut has also been tested on dairy cows and Etawa crossbreed goats. However, there has been no research on the combination of the tabut with the ammoniated citronella waste.

2. Materials and methods

2.1 Time and place of research
This research was conducted at UD Abi Makmur Sentosa, Lamteumen, Banda Aceh, Animal Husbandry Field Laboratory, Dairy Livestock Production Science and Technology Laboratory, Animal Nutrition and Food Science Laboratory, and Physiology Laboratory of the Faculty of Veterinary Medicine of Unsyiah. The implementation time started from February 2020 to July 2020.

2.2 Research methods
The experimental design used was a Randomized Block Design (RBD) with 5 treatments and 3 groups based on the lactation period. Data were analyzed using SPSS version 16 software with ANOVA analysis based on the randomized block design. If the results of the analysis show a significantly different effect, then a further test would be carried out using the Duncan test. ANOVA analysis of variance was carried out with the F test at a 95% confidence interval (a = 0.05) [6].

2.3 Parameter
The parameters measured in this study were physiological conditions including respiratory rate, heart rate, rectal temperature and hematological profile including hematocrit, hemoglobin, erythrocyte, and leukocytes.

3. Result and discussion

3.1. Physiological response
Livestock physiological response is the effort carried out by the livestock in responding the condition of its body from the environment in the form of heat stress or cold stress. Livestock performance is affected by poor environment, feeding, and livestock handling facilities which leads to physiological changes and livestock behavior. It is also stated that high ambient temperature, humidity, type of feed
and solar radiation are associated with the decreased livestock performance. The physiological responses of the cattle observed in this study were respiratory rate, heart rate and rectal temperature.

3.1.1 Respiratory rate. The cause of the increase and decrease in the frequency of breathing is due to environmental temperature and environmental conditions. This study indirectly showed that respiratory rate correlated with pulse. The increased respiratory rate and heart rate will contribute a number of heat energy in the body. This increase in body temperature causes the livestock to shed excess temperature by increasing the respiratory rate.

Based on the research data, a graph of the respiratory frequency of Etawa crossbreed goats during the study described in Figure 1.

![Figure 1. Respiratory frequency of Etawa crossbreed goats measured during the research.](image)

The results of variance analysis showed that there was no difference in the respiratory frequency of Etawa crossbreed goats given the combination treatment of *tabut* and ammoniated citronella waste (P> 0.05). Likewise, the livestock group showed no effect (P> 0.05). The average respiratory rate was 27 times/minute. The average respiratory frequency that tended to be high was 31.46 times/minute in the treatment of 2% of ammoniated citronella waste and 6% of *tabut*. Meanwhile, the average respiratory frequency that tended to be low was 25.25 times/minute with treatment of 8% ammoniated citronella waste and 0% *tabut*. The difference in the mean frequency was relatively normal, in which the respiratory rate in small ruminants was 20-30 times/minute [7]. Normally, the average respiratory rate of Etawa crossbreed goats ranges from 26 to 54 times per minute [8].

Ethyl acetate extract of citronella plant has been shown to have antibacterial activity against *Escherichia coli* and *Staphylococcus aureus* and it is also known that ethyl acetate extract of the citronella plant contains flavonoids, polyphenols, saponins and essential oils [9]. Flavonoid compounds can function as antioxidants, antidiabetic, anticancer, antiseptic, and anti-inflammatory [10]. Flavonoids and saponins in citronella are sedatives. The sedative or calming effect can relax the nerves because of the mineral which are zinc and selenium contained so that the heart works relaxed but blood can still be circulated normally [11].

3.1.2. Heart rate. The results of variance analysis showed that there was no difference in heart rate of Etawa crossbreed goats given the treatment of the combination of *tabut* and ammoniated citronella waste (P> 0.05). Likewise, the livestock group showed no effect (P> 0.05). The average heart rate was 71 beats/minute. The average heart rate that tended to be high was 74.21 times/minute in the treatment of 4% ammoniated citronella waste and 4% of the *tabut*, while the average respiratory frequency tended to be low was 68.38 ± 2.05 times/minute with 6% ammoniated citronella waste and 2% *tabut* treatment. The Etawa crossbreed goat's heart rate was 87 beats per minute [12]. The heart rate of goats in tropical areas was 67–95 beats/minute [13]. Normally, the average Etawa crossbreed goat's heart rate was 70 to 135 beats per minute [8].
Based on the research data, it can describe the heart rate graph of Etawa crossbreed goats during the study as presented in Figure 2.

![Heart rate graph of Etawa crossbreed goats](image)

**Figure 2.** Etawa crossbreed goat heart rate measured during the research.

The high and low heart rate may be caused by heat loads from inside and outside of the body. Low quality feed causes the fermentation process in the rumen to be slower, so that the heat generated from energy for the body's metabolic processes is smaller and has an effect on increasing the pulse rate, because one of the functions of protein is to provide energy for the body's metabolic processes [14].

3.1.3. Rectal Temperature. The results of variance analysis showed that there was no difference in the mean rectal temperature of Etawa crossbreed goats given the treatment of the combination of tabut and ammoniated citronella waste (P> 0.05). Likewise, the livestock group showed no effect (P> 0.05). The average rectal temperature was 38.42 °C. The average rectal temperature which tended to be high was 38.57 times/minute in the treatment of 2% ammoniated citronella waste and 6% of tabut, while the average respiratory frequency which tended to be low was 38.33 times/minute with the treatment of 0% ammoniated citronella waste and 80% tabut. Based on the research data, a graph of the rectal temperature of Etawa crossbreed goats during the study is described in Figure 3.

![Rectal temperature graph of Etawa crossbreed goats](image)

**Figure 3.** Etawa crossbreed goat rectal temperature measured during the research.

The body temperature tended to be high with a value of about 38.57°C but it is still under normal conditions. The normal body temperature of goats in tropical goats is between 37.12°C - 38.50°C [15], the body temperature in goats is 38.3°C - 40.0°C [16]. The difference in temperature is influenced by several factors including age, gender, feed consumption, drinking, environment and activity. Age factor in goats also influences rumen temperature [17].
3.2. Hematology frequency
Blood has a very complex role in order to make the physiological processes to run well, so that livestock productivity can be optimal [18]. There are several factors that influence the erythrocyte concentration, hematocrit, and the concentration of blood constituents. Blood is a body fluid composed of intercellular fluid cells called plasma. Blood has cellular elements consisting of erythrocytes (red blood cells), leukocytes (white blood cells) and platelets (platelets). Erythrocyte examination was performed to determine the state of anemia and polycythemia. Ration is an essential ingredient for blood metabolism because it takes protein, vitamins and minerals for the formation of red blood cells.

3.2.1 Hematocrit. Hematocrit calculation was performed to determine the degree of anemia in livestock. Hematocrit levels that are below the minimum limit indicate anemic cattle [19]. The decrease in hematocrit is caused by the dilution of blood by water and nutrients entering the blood vessels. Increased levels of hematocrit occur when livestock are dehydrated, while decreased hematocrit and less blood formation are caused by feed with insufficient nutritional content [20]. Based on the research data, Figure 4 shows the hematocrit levels of the Etawa crossbreed goat during the study.

![Figure 4](image)

Based on the measurement results, the mean levels of hematocrit are given a combination of tabut and citronella ammoniated waste which can be seen in Figure 4 above. There is an average level of normal hematocrit along with the combination of tabut and ammoniated citronella waste, from 25.00% to 28.56%. The high tendency of hematocrit in treatment P1 (0% tabut and 8% ammoniated citronella waste) compared to other treatments indicated that the feed given to livestock had high nutrients. Higher levels of hematocrit in the blood can have a positive effect on the health status of livestock. The mean levels of Etawa crossbreed goat hematocrit during the study ranged from 25.00 - 28.56%. Normal hematocrit levels in goats are 23% - 33% [21]. In other studies, normal hematocrit values in goats range from 24 - 48% [22].

3.2.2. Hemoglobin. Hemoglobin (Hb) is a compound that functions to bind oxygen in the blood consisting of porphyrin molecules, Fe, glycine and methyl, propionyl and vinyl side groups [21]. Increased levels of Hb can lead to a better ability of blood to carry oxygen into the tissues and cause more efficient CO₂ excretion so that the state and cell function will be better [22]. The Hb value of the research goat's blood was in the normal range. The Hb content in goats is 8-14g / dl [23]. Based on the research data, Figure 5 describes the hemoglobin levels of the Etawa crossbreed goat during the study.
Figure 5. Etawa crossbreed goat hemoglobin levels were measured during the study.

The Hb level in the group given P1 treatment tended to be higher than the other treatments, this is considered to be able to improve metabolism, especially protein, so that nutrient utilization can be more efficient. Good nutrition will be seen by the increase of Hb levels in the blood. The results of the research giving a combination of tabut and ammoniated citronella waste to Etawa crossbreed goats showed normal result that was between 7.93 - 9.93 g/dl. The normal Hb value for Etawa crossbreed goats is 8 to 12 g/dl [24].

3.2.3. Erythrocyte. The mean total erythrocyte of Etawa crossbreed goats given a combination of tabut and ammoniated citronella waste ranged from 8.46 to 11.28 million/mm³. Based on the average obtained, it can be interpreted that the total erythrocytes was still within the normal range. Therefore, the health condition of goats was still good/normal. The administration of Urea Saka Multinutrient Blok (USMB) combined with temulawak + areca was able to improve the total erythrocyte value in Etawa crossbreed goats and obtain erythrocyte levels ranging from 7.07 to 13.63 million/mm³ [23]. Based on the research data, the graph of the levels of Etawa crossbreed goat erythrocytes during the study is described in Figure 6.

Figure 6. Etawa crossbreed goat erythrocyte levels measured during the study.

The quality of red blood cells (Erythrocytes) can be influenced by several factors, including the levels of dietary nutrition, levels of Hb, packed cell volume (PCV), and levels of other blood constituents. In addition, factors affecting the quality of red blood cells are age, pregnancy, and lactation [25]. The nutritional value of feed and poor management can affect the number of erythrocytes produced in the body of livestock. Age of livestock can also affect the production of erythrocytes in the body. Meanwhile, statistically, the combination of tabut and ammoniated citronella waste did not significantly (P>0.05) affect the levels of Etawa crossbreed goat erythrocytes. The number of erythrocytes inside can be used as an indicator whether the livestock experiencing stress or not [26]. Not only age, the number of erythrocytes also influenced by sex. In male animals the production of red blood cells is influenced by testosterone, the hormone erythropoeitin produced in the kidneys regulates the formation of erythrocytes [27].
3.2.4. Leukocytes. The mean total leukocytes in the Etawa crossbreed goats ranged between 7.47 to 10.43 thousand/mm$^3$. The value of erythrocyte blood in the research goat was within normal limits in terms of erythrocyte levels since the erythrocyte level in goats was 6-16 thousand/mm$^3$ [23]. An increase or decrease in leukocyte levels in the blood circulation can be indicated as the presence of inflammatory disease agents and allergic reactions, therefore it is necessary to know the normal picture of leukocytes in each individual [28]. Based on the research data, Figure 7 illustrates the levels of Etawa crossbreed goat leukocytes during the study.

![Leukocyte levels](image)

**Figure 7.** Etawa crossbreed goat leukocyte levels measured during the study.

High and low levels of leukocytes are influenced by the hormone cortisol in the blood due to stress [24]. In the treatment of *S. agalactiae* irradiation vaccination in Etawa crossbreed goats after giving birth, the value of leukocytes increased compared to before the animals gave birth. This naturally occurs as a result of the stress that the animal experiences during the birth process. Stress results in cortisol levels increase so that the number of neutrophils increases which causes the number of leukocytes to increase as well [24]. This condition is referred to as corticosteroid leukocytosis [29]. Increased or decreased levels of white blood cells in the blood circulation can be indicated as the presence of inflammatory disease agents and allergic reactions, therefore it is necessary to know the normal picture of white blood cells in each individual [28], [30], [31]. Leukocytes act as body immunity. If there is no trigger for the leukocyte count in normal conditions then if there is a trigger it will result in a decrease in the number of leukocytes in the body [27].

4. Conclusions

Based on the results and discussion, it can be concluded that the combination treatment of tabut and ammoniated citronella waste given to Etawa crossbreed goats has no effect (P> 0.05) or has a positive effect on physiological responses (respiratory rate, heart rate, rectal temperature). Likewise, the hematocrit level, hemoglobin level, erythrocyte value and leukocyte value also had a positive effect. The average obtained tends to be normal, so that is why the combination of tabut and ammoniated citronella waste given to Etawa crossbreed goats can be applied to dairy livestock and it is recommended with a combination ratio of 6% tabut and 2% citronella ammoniated waste. At the percentage of the combination, the results tend to be normal.

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