



Effectiveness of Forage and Tofu Dregs Mixture on Rectal Temperature, Heart Rate and Respiratory Frequency of Sheep

Wenny N. Sari^{1*}, Ahmad Syakir¹, Mustafa Kamal¹, Reza Wahyudi¹, Mustaqim Mustaqim²

¹Department of Animal Husbandry, Universitas Islam Kebangsaan Indonesia, Indonesia.

²Department of Biology, Universitas Negeri Medan, Indonesia.

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ABSTRACT

Sheep feed sources can be provided in the form of forage and tofu dregs, and the most important thing is feed that meets the needs of protein, carbohydrates, fat, and vitamins and minerals. This study aims to determine the effect of feeding between forage and tofu dregs on rectal temperature, respiratory rate and heart rate. This study was conducted from October to November 2024. The design used in this study was a Randomized Block Design (RAK) with 4 treatments and 3 replications. The results of the study can be concluded that the effect of providing different forage and tofu dregs showed no significant difference ($P > 0.05$) on rectal temperature, heart rate and respiratory rate of sheep. The highest average rectal temperature was seen in treatment D, which was 37.740C and the lowest average was in treatment B, which was 37.640C. The highest average heart rate was seen in treatment D, which was 64.84 times/minute and the lowest average was in treatment B, which was 58.04 times/minute. The highest average respiratory frequency was seen in treatment D, namely 71.93 times/minute and the lowest average was seen in treatment A, namely 66.49 times/minute.

Introduction

Sheep are small ruminant livestock that are used as one of the sources of protein. Sheep often known as small ruminant livestock, are herbivorous livestock that are very popular among Indonesian farmers. This livestock is easier to raise, can utilize agricultural and industrial waste and by-products, is easy to breed and the market is always available at any time and requires relatively little capital compared to large ruminants (Wibowo *et al.*, 2023). The advantages of raising sheep compared to large ruminants are that sheep have a fast reproductive cycle because they can give birth three times in two years, are prolific (give more than one birth) and are seasonal polyestrus (can mate throughout the year) (Najmuddin and Nasich, 2019).

Greens containing high crude fiber can be used as animal feed (Mustaqim and Zulkifli, 2023). The availability of greens in the form of grass, legumes and agricultural waste is influenced by climate, so that

in the dry season there is a shortage of forage and the opposite condition in the rainy season. The greens commonly used by farmers are field grasses. The greens given are usually greens that are easy and cheap to cultivate, one of which is elephant grass. Elephant grass (*Pennisetum purpureum*) is a family of grasses (graminae) which has been known for its benefits as natural ruminant livestock feed in Southeast Asia. This grass is usually harvested by cutting down the entire tree and then given directly (cut and carry) as forage for buffalo and cattle, or it can also be used as a feed supply through the process of preserving forage by silage and hay. In addition, elephant grass can also be used as good soil mulch. In Indonesia itself, elephant grass is the main forage plant for livestock (Pazla *et al.*, 2023).

Indrarosa and Agustin, (2022), (Jihadul *et al.*, 2024), (Mustaqim *et al.*, 2024), (Isramuddin *et al.*, 2024) stated that there are several requirements that must be met by a feed that will be given to livestock, namely

* Corresponding author.

Email address: wenny_zm@yahoo.com

cheap, liked by livestock (palatability) and easy to obtain and does not compete with human food needs. Tofu dregs are solid waste obtained from the process of making tofu from soybeans. In terms of chemical composition, tofu dregs can be used as a source of protein. According to the [East Java Provincial Animal Husbandry Service, \(2021\)](#) the nutritional content of tofu dregs is 8.66% protein, 3.79% fat, 51.63% water and 1.21% ash.

Physiology in general is the science that studies the complete function of the body and the function of all parts of the body including the biophysical and biochemical processes that occur in the body. The purpose of the physiological examination process is to determine the overall physiological condition and to determine things that interfere with the physiological condition of livestock ([Mughayatsyah *et al.*, 2023](#)). Sheep livestock physiology is an event of the rise and fall of the physiological condition of livestock which includes breathing frequency, heart rate and rectal temperature. The physiological condition of livestock (breathing frequency, heart rate and rectal temperature) can be used as a guideline to assess whether the organs of the livestock are in good condition and functioning normally ([Fadilah, 2019](#)).

Respiratory rate is a physical activity where there is a gas exchange process between carbon dioxide (CO²) released from the body with oxygen (O²). Rectal temperature is a good indicator to describe the temperature in the body of livestock and is one of the indicators in knowing the results of livestock balance in releasing heat ([Fadilah, 2019](#)). The heart is a vital organ that pumps blood throughout the body. The heart pumps blood throughout the body to keep the tissue always flowing with blood. [Mughayatsyah *et al.* \(2023\)](#) stated that the heart rate is a mechanism of the Sheep's body to reduce or release heat received from outside the livestock's body. The difference in heart rate is influenced by physical activity and heat stress, where the higher the environmental temperature, the higher the heart rate. This is in accordance with the opinion of [Pramono *et al.* \(2014\)](#) who stated that temperature greatly influences the onset of goats.

Heart rate, respiratory rate and rectal temperature are reflections or indicators of livestock physiology. External factors that affect livestock physiology are temperature, humidity, and solar radiation. According to [Sulistiani \(2014\)](#), the chemical characteristics of tofu dregs in 100 grams contain 5.74% Water, 59.59% Carbohydrate, 10.8% Protein, 14.49% Fat, 9.02% Ash. So that the provision of Tofu Dregs can also cause physiological conditions such as respiratory rate, pulse rate, and body temperature to differ due to differences in

fermentation or metabolism processes that occur in the body, so that it will affect the response and production of the Sheep.

Materials and Methods

Time and Place of Research

The research was conducted from October to November 2024 in livestock groups in Juli Makmur, Juli Mee Teungoh Village, Juli District, Bireuen Regency.

Cattle

The livestock used in this study were local male sheep. The sheep selected were 8-15 months old with a weight of 27-30 kg. Sheep body weight is categorized into 3, namely small body weight (<27 kg), medium body weight (27-29 kg) and large body weight (> 30 kg).

Research methods

This research design used Randomized Block Design (RBD) 4 treatments with 3 replications. The treatments are:

- A : Giving 100% Forage and 0% Tofu Dregs (control)
- B : Giving 90% Forage and 10% Tofu Dregs
- C : Giving 80% Forage and 20% Tofu Dregs
- D : Giving 70% Forage and 30% Tofu Dregs

Data analysis

The mathematical model and design used in this study are [Nurullita \(2020\)](#) is

$$Y_{ij} = \mu + \tau_i + \beta_j + \epsilon_{ij}$$

information:

- Y_{ij} = observation value in the i-th treatment of the j-th group
- μ = general mean (mean of population)
- τ_i = additive effect of the ith treatment
- β_j = additive effect of the jth group
- ϵ_{ij} = experimental error in treatment i of group j
- i = number of treatments
- j = number of groups/repetitions
- i = 1,2,3,4
- j = 1,2,3

The research data were processed using the analysis of diversity of Randomized Block Design (RAK) according to the method described by [Nurullita \(2020\)](#), while the differences in the effects between treatments were tested using Duncan's Multiple Range Test (DMRT). Details of the data analysis can be found in the attached [Table 1](#).

Table 1. Analysis of Variance of Randomized Block Design

Source Diversity	Db	JK	T	Fcount
Group	2	JKK	T	KTK/KTS
Treatment	3	JKP	K	KTP/KTS
Remainder	6	JKS	D c a r d	
Total	11	JKT	T S	

Information:

Fcount > Ftable 0.05 and 0.01 (very significantly different ($P < 0.01$)) Fcount > Ftable 0.05 and < Ftable 0.01 (significantly different ($P < 0.05$)) Fcount < Ftable 0.05 (not significantly different ($P > 0.05$))

Db = Degrees of freedom

SK = Source of Diversity

JK = Sum of Squares

KT = Middle Square

JKS = Sum of Remaining Squares

JKT = Sum of Middle Squares

JKP = Sum of Squares of Treatment

JKK = Sum of Squares of Groups

KTS = Middle Square Remainder

KTK = Middle Square of

KTP Group = Middle Square of Treatment

Observed Parameters**Rectal Temperature**

Rectal temperature was obtained using an automatic thermometer inserted into the rectum to a depth of 5 cm in degrees Celsius and repeated 3 times and then the average value was calculated (Mesa, 2021).

Heart rate

The sheep's heart rate was obtained using a stethoscope and what was examined was the base of the sheep's front left leg with a calculation of 1 minute using a stopwatch and repeated 3 times in each taking (Mesa, 2021).

Respiratory Rate

The respiratory rate is obtained by counting the up and down movements of the abdominal rib surface and bringing the palm of the hand close to the livestock's nose, calculated for 1 minute with a stopwatch and repeated 3 times/minute and each

time it is taken and then the average value is calculated (Mesa, 2021).

	Ftable
Results	0.05 0.

The results of the analysis of variance from the provision of different forage and tofu dregs can be seen in Table 2 below.

Table 2. Average results of rectal temperature, heart rate and respiratory rate.

Observation Variables

Treatment	Rectal Temperature (oC)	Heart Rate (beats/minute)	Respiratory Rate (times/minute)
A	37.69 0.29a	+ 61.56 1.20a	+ 66.49 0.52a
B	37.64 0.36a	+ 58.04 1.19a	+ 69.69 0.53a
C	37.67 0.20a	+ 61.04 1.18a	+ 69.84 0.55a
D	37.74 0.11a	+ 64.84 1.20a	+ 71.93 0.57a

Description: The analysis results in the table show no significant effect ($P > 0.05$)

Discussion

In this study, the effect of providing forage and tofu dregs had no significant effect ($P > 0.05$) on rectal temperature, as can be seen in Table 3.

Table 3. Rectal temperature of sheep

Treatment	Rectal Temperature (oC)
A	37.69 + 0.29a
B	37.64 + 0.36a
C	37.67 + 0.20a
D	37.74 + 0.11a

Description: (Ns) the analysis results in the table show no significant effect ($P > 0.05$)

Based on the data in Table 5, the rectal temperature of sheep fed with various proportions of forage and tofu dregs did not show any significant difference. Treatment A (100% forage and 0% tofu dregs) had an average rectal temperature of 37.69°C, while treatments B (90% forage and 10% tofu dregs), C (80% forage and 20% tofu dregs), and D (70% forage and 30% tofu dregs) each showed rectal temperatures of 37.64°C, 37.67°C, and 37.74°C. The results of statistical analysis showed that the differences in feed composition did not significantly affect the rectal temperature of sheep ($P > 0.05$), indicating that variations in the content of forage and

tofu dregs in the feed did not significantly change the body temperature of livestock.

One factor that can explain this finding is the physiological mechanism of sheep in maintaining body temperature. According to research by Hadiyanto *et al.* (2019), herbivorous livestock, including sheep, have the ability to adapt physiologically to maintain body temperature balance. This mechanism includes increasing or decreasing the metabolic rate to adjust to changes in feed. Therefore, even though there are variations in the proportion of greens and tofu dregs, sheep are still able to maintain their body temperature within the normal range.

In addition, the nutritional content of feed also plays a role in regulating the body temperature of livestock. Tofu dregs, which contain high protein, can increase body metabolism, but this increase is not large enough to significantly affect rectal temperature. Research by Sutrisno *et al.* (2020) states that high-fiber feed, such as greens, helps regulate the body temperature of livestock through a more efficient digestion process. The combination of greens and tofu dregs in this study still provides balance in livestock metabolism so that it does not cause significant changes in body temperature.

To further understand the results of this study, it is important to compare them with other studies that have been conducted previously. For example, research by Andriyanto *et al.* (2017) stated that the rectal temperature in local male lambs in Bogor Regency reached 39.46°C, while in females it reached 39.18°C. This temperature is higher than the results of this study, which may be influenced by environmental factors, higher metabolic activity in lambs, or different types of feed. In contrast, research by Mustaghfiri (2021) found that the rectal temperature of Sapudi Sheep observed at the Jember Livestock and Forage Breeding Unit had a lower temperature range. This shows that location factors, environmental conditions, and livestock genetics can affect overall body temperature.

Overall, the differences in results between this study and other studies can be caused by various factors, such as environmental conditions, types of feed given, time of temperature measurement, and physiological adaptation of each livestock to its environment. However, what can be concluded from this study is that feeding with various combinations of greens and tofu dregs does not have a significant impact on the body temperature of sheep, which indicates that livestock are able to adapt well to changes in feed composition without experiencing metabolic disorders.

Effect on Heart Rate

In this study, the effect of providing forage and tofu dregs had no significant effect ($P>0.05$) on heart rate, as can be seen in Table 4.

Table 4. Heart rate of sheep

Treatment	Heart Rate (beats/minute)
A	61.56 + 1.20a
B	58.04 + 1.19a
C	61.04 + 1.18a
D	64.84 + 1.20a

Description: (Ns) the analysis results in the table show no significant difference ($P>0.05$)

Based on the data obtained in this study, feeding with a composition of forage and tofu dregs in various proportions did not show a significant effect on the heart rate of sheep ($P>0.05$). Based on the data obtained, there was a variation in heart rate between treatment A (100% forage and 0% tofu dregs) which showed a value of 61.56 beats per minute, while treatment B (90% forage and 10% tofu dregs), C (80% forage and 20% tofu dregs), and D (70% forage and 30% tofu dregs) each showed values of 58.04, 61.04 and 64.84 beats per minute. However, although there were differences between treatments, the results of statistical analysis showed that these differences did not affect the heart rate of sheep ($P>0.05$).

These results indicate that the sheep's body has a good homeostatic mechanism in regulating its physiological functions despite changes in feed composition. Heart rate regulation in ruminants is highly dependent on the autonomic nervous system and metabolic response to nutrient intake. Although tofu dregs have a higher energy content than forage, the difference in the amount of tofu dregs given in this study did not seem large enough to cause significant changes in sheep heart rate.

Previous research by Wibowo *et al.* (2020) showed that factors such as environment, stress levels, and physical activity have a greater influence on heart rate than variations in feed composition. Under normal conditions, sheep's heart rate tends to be stable and only experiences significant changes when animals experience stress, increased physical activity, or extreme environmental changes. This is also supported by research by Yuliana *et al.* (2020), which states that high-fiber feed such as greens has a greater influence on the digestive system and metabolism than the cardiovascular system.

In comparison, research by Rahman *et al.* (2018) found that sheep fed high energy feed showed an increase in heart rate of up to 75–85 beats per minute.

This is due to higher body metabolism due to the high energy content in the feed, so the cardiovascular system has to work harder to distribute nutrients throughout the body. In contrast, research by [Silva et al. \(2019\)](#) stated that sheep fed low energy feed in optimal environmental conditions had a lower heart rate, which was around 50–55 beats per minute. This shows that consuming feed with very low energy content can cause a decrease in body metabolism, which has an impact on decreasing physiological activity including heart rate.

In addition to feed factors, environmental temperature can also affect the heart rate of livestock. Sheep in high-temperature environments tend to experience increased heart rates as a body mechanism to regulate temperature and maintain thermal balance. Conversely, in colder environments, heart rates can decrease to conserve energy. In this study, because environmental conditions tended to be stable, temperature factors were unlikely to be the main cause of the observed heart rate variations.

Overall, the results of this study indicate that despite variations in the provision of forage and tofu dregs, the sheep's body is able to adapt well to the composition of the feed given. Good physiological regulation allows sheep to maintain heart rate within the normal range without experiencing significant changes. Therefore, in livestock practices, the use of feed with a combination of forage and tofu dregs in proportional amounts can be a good alternative without causing negative impacts on livestock cardiovascular health.

Effect on Respiratory Rate

In this study, the effect of providing forage and tofu dregs had no significant effect ($P>0.05$) on respiratory frequency, as can be seen in [Table 5](#).

Table 5. Respiratory frequency of sheep

Treatment	Respiratory Rate (times/minute)
A	66.49 + 0.52a
B	69.69 + 0.53a
C	69.84 + 0.55a
D	71.93 + 0.57a

Description: (Ns) the analysis results in the table show no significant effect ($P>0.05$)

[Table 5](#) shows the respiratory frequency values in each treatment, where treatment A (100% forage and 0% tofu dregs) showed 66.49 breaths per minute, treatment B (90% forage and 10% tofu dregs) showed 69.69 breaths per minute, treatment C (80%

forage and 20% tofu dregs) showed 69.84 breaths per minute, and treatment D (70% forage and 30% tofu dregs) showed 71.93 breaths per minute. Although there were variations between treatments, the results of statistical analysis showed that there was no significant difference in the respiratory frequency of livestock ($P>0.05$). This indicates that changes in the proportion of forage and tofu dregs in the feed did not trigger significant changes in the respiratory mechanism of sheep.

Respiratory rate is one of the physiological indicators that can reflect the metabolic condition and stress level of livestock. In this study, the results showed that differences in feed composition did not have a significant impact on the sheep's respiratory system. The physiological adaptability of sheep in adjusting oxygen requirements to changes in feeding patterns is likely to be the main factor in the results obtained. As herbivores, sheep have a stable metabolic system and are able to regulate energy balance and oxygen requirements according to the feed consumed. According to [Santoso et al. \(2023\)](#), the respiratory rate of livestock is more influenced by environmental factors such as temperature and humidity than by variations in feed composition.

Providing tofu dregs in feed can increase the protein content consumed by sheep, but the amount given in this study seems to be within limits that do not cause a large enough increase in metabolism to affect respiratory frequency. This shows that although tofu dregs have a higher nutritional value than forage, its impact on the livestock's respiratory system is not significant. In addition, providing forage rich in fiber can also affect the livestock's digestive system, but is not always directly related to changes in the respiratory system unless there is a significant increase in metabolic load ([Rahayu et al. 2021](#)).

In comparison, research conducted by [Oliveira et al. \(2018\)](#) stated that sheep fed with high energy levels experienced an increase in respiratory rate of up to 80–85 times per minute. This increase occurs because more active metabolism causes an increase in oxygen demand, so that the respiratory system works faster to adjust to metabolic changes. These results indicate that high-energy feed can increase metabolic activity which affects the increase in respiratory rate.

In contrast, a study by [Martínez et al. \(2020\)](#) showed that sheep fed low-energy feed in cooler environmental conditions had an average respiratory rate of 55–60 times per minute. This value is lower compared to this study, which shows that in addition to the type of feed, external factors such as ambient temperature and humidity also have a major influence in regulating the respiratory pattern of

livestock. Thus, the environment where livestock are kept must also be considered in the evaluation of physiological parameters, because high temperature and humidity can increase heat stress which has an impact on increasing respiratory frequency.

The results of this study indicate that variations in the composition of forage and tofu dregs do not cause significant changes in the respiratory rate of sheep. This indicates that the sheep's body has a good adaptation mechanism to the feed given without experiencing disturbances in the respiratory system. Environmental factors and livestock conditions likely play a greater role in determining respiratory rate than variations in feed composition. Therefore, farmers can use a combination of forage and tofu dregs in appropriate amounts without worrying about negative impacts on the livestock's respiratory system. In addition, monitoring environmental conditions such as temperature and humidity remains an important aspect in maintaining the health and comfort of sheep so that they do not experience physiological stress.

Conclusions

Based on the results of research on the effect of providing forage and tofu dregs on rectal temperature, heart rate, and respiratory rate of sheep, it can be concluded that:

- Feeding forage and tofu dregs with different compositions did not have a significant effect ($P>0.05$) on the rectal temperature of sheep. The highest rectal temperature was found in D (37.74°C), while B recorded the lowest rectal temperature (37.64°C).
- Variations in the provision of forage and tofu dregs did not have a significant effect ($P>0.05$) on the sheep's heart rate. The highest heart rate was found in D (64.84 times/minute), while B recorded the lowest rectal temperature (58.04 times/minute).
- Feeding with a combination of forage and tofu dregs also did not have a significant effect ($P>0.05$) on the sheep's respiratory frequency.

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