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THE EFFECT OF DIFFERENCES IN LAND TRANSPORTATION TIME FROM BANJARNEGARA TO SEMARANG ON THE PHYSIOLOGICAL RESPONSE OF LOCAL RAM

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Abstract
This study aimed to determine local rams' body condition and weight loss after being transported from Banjarnegara to Semarang at different times. The research materials used in this study were 22 local ram lambs aged ten months weighing 17.14 + 1.68 kg (CV = 9.8%). This research used a completely randomized design method with two treatments and 11 replications. The treatment was a transportation time of 4 hours (T1) and 6 hours (T2). The research parameters were pulse rate, respiratory rate, and rectal temperature of rams in Banjarnegara (before transport), Temanggung (during transport), and Semarang (after transportation), as well as loss of body weight in rams. The data collected were analyzed using the t-test. The results showed that the pulse and respiratory rate of T2 before transportation were higher (P<0.05) than T1, but the body temperature was similar, with an average value of 35.86 ºC. During transport, pulse rate, respiratory rate, and body temperature T1 and T2 were relatively the same, with an average value of 97 beats/minute, 57 beats/minute, and 35.85 ºC. After transportation, T1's pulse rate was higher (P<0.05) than T2. T1's respiratory rate and body temperature were lower (P<0.05) than T2's. The body weight of rams before and after transportation between T1 and T2 was not significantly different (P>0.05), with an average of 18.33 kg before transportation. The body weight of rams after transport was 16.80 kilograms. The body weight loss during transportation was not significantly different (P> 0.05), amounting to 1.53 kg. This study concluded that the transport time of 4 and 6 hours affects the (physiological) condition of the sheep's body, but the body weight loss is relatively the same.
Keywords: ram, transportation time, physiological conditions, body weight loss.

PENGARUH PERBEDAAN WAKTU TRANSPORTASI DARAT BANJARNEGARA KE SEMARANG TERHADAP RESPON FISIOLOGIS DOMBA LOKAL

Abstrak
Penelitian ini bertujuan untuk mengetahui kondisi tubuh dan kehilangan bobot domba jantan lokal setelah diangkut dari Banjarnegara ke Semarang pada waktu yang berbeda. Bahan penelitian yang digunakan dalam penelitian ini adalah 22 ekor domba jantan lokal berumur sepuluh bulan dengan berat badan 17,14 + 1,68 kg (CV = 9,8%). Metode penelitian menggunakan rancangan acak lengkap dengan dua perlakuan dan 11 ulangan. Perlakuannya adalah waktu pengangkutan 4 jam (T1) dan 6 jam (T2). Parameter penelitian adalah denyut nadi, laju pernafasan, dan suhu rektal domba jantan di wilayah Banjarnegara (sebelum pengangkutan), Temanggung (selama pengangkutan), dan Semarang (setelah pengangkutan), serta kehilangan bobot badan pada domba jantan. Data yang terkumpul dianalisis menggunakan uji-t. Hasil penelitian menunjukkan denyut nadi dan laju pernafasan T2 sebelum transportasi lebih tinggi (P<0,05) dibandingkan T1, namun suhu tubuh sama yaitu dengan nilai rata-rata 35,86oC. Selama transportasi, denyut nadi, laju pernapasan, dan suhu tubuh T1 dan T2 relatif sama, dengan nilai rata-rata 97 kali/menit, 57 kali/menit, dan 35,85oC. Setelah transportasi, denyut nadi T1 lebih tinggi (P<0,05) dibandingkan T2, sedangkan laju pernapasan dan suhu tubuh T1 lebih rendah (P<0,05) dibandingkan T2. Bobot badan domba jantan sebelum dan sesudah pengangkutan antara T1 dan T2 tidak berbeda nyata (P>0,05), dengan rata-rata sebelum pengangkutan sebesar 18,33 kg. Berat badan domba jantan setelah diangkut adalah 16,80 kilogram. Penurunan berat badan selama transportasi tidak berbeda nyata (P>0,05), yaitu sebesar 1,53 kg. Penelitian ini menyimpulkan bahwa waktu pengangkutan 4 dan 6 jam berpengaruh terhadap kondisi (fisiologis) tubuh domba, namun penurunan bobot badan relatif sama.
Kata kunci: domba, waktu pengangkutan, kondisi fisiologis, penurunan berat badan

INTRODUCTION

The population of sheep in Indonesia has increased from year to year. Currently, Java Island houses approximately 70% of the national sheep population (Central Bureau of Animal Husbandry Statistics, 2018). The increasing sheep population in Indonesia is due to suitable natural conditions and farmers preference for livestock that is easy to raise and has economic value (Rusdiana and Adiati, 2020). Local ram lamb has several advantages, namely being able to survive with low-quality feed, adapt well to the surrounding environment, resist disease, and be a good

carcass producer (Lutfhi et al., 2021). In addition, sheep can also survive during transportation.

Transportation is essential in the livestock industry, particularly in marketing/shipping livestock intercity between provinces, islands, and countries (Nelvita et al., 2018). Among the various mode of transportation, land transportation is commonly used, besides maritime and aerial transport. Several studies highlighted the effect of transportation on animal's conditions. Previous studies reported that sheep transported for more than 6-24 hours on the road discomfort, heat stress and fatigue during the trip. The discomfort for livestock during the transportation process is often caused by environmental factors such as uncomfortable temperatures, mixing of animals from different herd, food and water restrictions during the trip, road conditions and the driver's driving technique, land the risk of respiratory issues caused by dust (Maulana et al., 2022). The stress animal suffered tend to worsen with longer transportation time.

Maulana et al, (2022) stated that land transportation affects physiological pressure, thermal stress, and animal's physical condition. Stressed livestock will do a thermoregulation process to stabilize their body condition by increasing their physiological activity, as indicated by increasing pulse rate, respiratory frequency, and rectal temperature. Typically, the normal respiratory frequency for sheep ranges between 26-54 beats/minute (Septiadi et al., 2015), the norma pulse rate ranges between 70-135 beats/minute (Lendrawati et al., 2019), and normal rectal temperature ranges between 37.5 – 40.0 ºC (Atik et al., 2020). However, in animals unders stressful conditions, their pulse rate, respiratory rate, and rectal temperature may deviate from these normal ranges. Livestock require substantial times to recover theirthe adverse effects of transportation (Wilasari et al., 2019, Adriani et al., 2020). Prolonged recovery periods, results in extended production cycles and delayed readiness for sale, which slows down capital turnover and poses a significant challenge for breeders.

Most of the previous studies observed the transportation impact on livestock in a longer than 6 hours transport duration. In reality, livestock transportation occurs not only over long distances that demand longer time but also over shorter distances with a relatively shorter time. However, data regarding the effect of short-distance transport on livestock remains limited. One common short distances sheep shipping route is the transportation of sheep from Banjarnegara to Semarang. Therefore, it is imperative to study the effect of short distance sheep transportation (from Banjarnegara to Semarang) on the condition of the sheep.

MATERIALS AND METHODS

This study utilized 22 local ram lambs, each aged ten months with an average body weight of 17.14 + 1.68 kg (CV= 9.8%). The materials used in this study was a pick-up truck, notebooks, hanging scales for weighing sheep, a stopwatch/clock, thermometer, stethoscope, hygrometer, diapers, and writing utensils. This experiment comprised two treatments, each with 11 replications. The treatments were durations of transportation as follows:

T1 = Sheep transportation time of 4 hours
T2 = Sheep transportation time of 6 hours

Research Parameters

The parameters observed in this study were body weight, the physiological condition of the sheep (body temperature, pulse, and respiratory rate) and ambient temperature and humidity were collected at different locations, namely: (1) at the place of origin/Banjarnegara (before departure); (2) in the middle of the trip/Temanggung (during breaks); and (3) upon arrival at the destination (Semarang). The faeces and urine were collected during transportation and weighed upon arrival.

Experiment Procedure

The research procedure involved 3 stages:

(1) The preparation stage before transportation took place in Banjarnegara. It includes weighing sheep to determine their initial body weight, weighing diapers, measuring the physiological condition of the sheep, including body temperature, pulse, and respiratory rate;
(2) The transportation stage, where sheep are being prepared to be transported to Semarang. Prior to loading onto the trucks, sheeps were fitted with diapers to manage feces and urine during the trip. They were then randomly divided into 2 groups for each specific treatment of transportation. There were 11 local ram lamb in each group. The first pickup truck covered 114.131 km in 4 hours, while the second truck travelled

247.599 km over 6 hours. Both trucks departed at 12.54 WIB with a 40 – 80 km/hour speed. The second pickup truck spent an additional 2 hours travelling around Banjarnegara before heading for Semarang. After halfway to Semarang, the first truck (after a 2-hour drive) and second truck (after 3 hours of travel) were given 1 hour of rest in Temanggung, where the physiological conditions of the male local sheep were monitored;

(3) The final stage of the study involved observations upon the cattle's arrival at the pens of the Faculty of Animal Husbandry and Agriculture, Diponegoro University. These observations includedweighing body weight and assessing their physiological conditions. Additionally, feces and urine collected in the diapers were weighed. The weighing occurred after the sheep were unloaded from the car. Their diapers were removed, weighed, and substracted by the initial diaper's weight, resulting in the number of feces and urine excreted by local rams during the trip. Environmental and physiological conditions, including macro and micro humidity and temperature, were observed in Banjarnegara, during the rest stop in Temanggung, and in Semarang.

Data Analysis

The research data were analyzed using paired t-test and unpaired t-test. The t-test in pairs was used to compare the initial and final conditions in the same individual. An unpaired t-test was used to compare the initial and final conditions for the two treatments (Sugiyono, 2011):

t-test in pairs:

$$t = \frac{x1-x2}{\frac{s1^2}{n1}+\frac{s2^2}{n2}-2r\left[\frac{s1}{n1}\right].\left[\frac{s1}{n2}\right]}$$

Information:

t	=	t value;
x_1	=	average sample 1;
x_2	=	sample mean 2;
S_1^2	=	variance of sample 1;
S_2^2	=	variance of sample 2;
S_1	=	standard deviation 1;
S_2	=	standard deviation 2;
n_1	=	number of samples 1; and
n_2	=	sum up to 2.

Unpaired *t-test*:

$$t = \frac{Xa - Xb}{Sp\left[\left(\frac{1}{na}\right)+\left(\frac{1}{nb}\right)\right]\frac{1}{2}}$$

Information:

t	=	t value;
Xa	=	Average treatment a;
Xb	=	Average treatment b;
Sp	=	Combined standard deviation;
na	=	Number of samples in treatment a; and
nb	=	Number of samples in treatment b.

RESULTS AND DISCUSSION

Physiological Conditions of Sheep Before, During Rest, and After Transportation

Table 1 presents the data on the physiological conditions of the sheep before, during rest, and after transportation. Data analysis results indicate significant differences in the pulse rates of T1 group sheep (P<0.05) before, during rest, and after transportation. The pulse rate of the T1 sheep was lowest before transportation (73 beats/minute), increased during rest (92 beats/minute), and decreased when they arrived at their destination (82 beats/minute). The similar pattern occurred in the respiratory frequency of T1 sheep. Before transportation, it was 34 beats/minute increased to 49 beats/minute at rest, and decreased to 33 beats /minute upon arrival at Semarang. The difference in, breathing frequency before and after transportation was not significant (P>0.05). The body temperature of T1 sheep were relatively constant (P>0.05) before, during rest, and after transportation, with an average of 35.81 ^{o}C.

The data analysis results indicated significant differences in the pulse rates of T2 group sheep (P<0.05) before, during rest, and after transportation. The pulse of T2 sheep was 86 beats/minute before transportation, increased to 101 beats/minute at rest, and decreased to 75 beats/minute when they arrived in Semarang. Lendrawati et al. (2019) stated that the normal pulse rate in sheep ranges between 70 – 135 beats /minute, indicating that the pulse rate of the researched sheep was within the normal range. The respiration frequency of T2 sheep at rest was the highest (P<0.05) at 66 beats/minute compared to before and after transportation. The respiratory rate of T2 sheep before and after transportation was

not significantly different (P>0.05), with an average of 44 beats/minute.

According to Septiadi et al. (2015), normal sheep breath frequency ranged from 26-54 beats/minute, indicating that the respiratory frequency of the sheep in this study was normal. However, the T2 sheep at rest exhibited a higher respiratory rate of 66 beats/minute, above the normal range. The body temperature of T2 sheep before, during rest, and after transportation showed no significant difference (P>0.05), with an average value of 36.16 ^{o}C.

The normal rectal temperature in sheep ranges from 37.5 – 40.0 ^{o} C (Atik et al., 2020). In this study, the sheep's rectal temperature can be considered lower than normal. The temperature and humidity variations within the pick-up car during the trip from one location to another likely contributed to these differences, affecting the sheep's body, particularly the sheep's rectal temperatures.

Table 1 demonstrates that transportation affects the pulse and respiratory rate but does not affect body temperature in both treatment groups. The pulse and respiratory frequency of T1 and T2 sheep increased after 2 to 3 hours of transportation, and then decreased upon at the destination. Nelvita et al. (2018) stated that the decrease in pulse rate in sheep during transportation may result from ow ambient temperatures. On the other hand, the lamb will increase the respiratory and pulse rate a relatively high ambient temperature and humidity. According to Soeharso et al. (2010) and Mushawwir et al. (2020, 2021), livestock will adjust their pulse and respiratory rate to maintain homeostasis. The increased pulse and respiratory rates illustrate the lamb's efforts to stabilize its body condition under the stress of transportation. A higher respiration rate allows for more efficient heat dissipation, the animal to reach its comfort temperature zone. Qisthon and Madi (2019) mentioned that an increase in the metabolic process produces body heat, which raises body temperature. In response to this, animal will increase their respiratory and pulse rate. Facilitating heat dissipation through breathing.

The measurement of respiratory rate, pulse and rectal temperature was conducted 3 times: before departure at the same time for both T1 and T2 in Banjarnegara (at 12.54 WIB), during the rest stop in Temanggung area at different times for T1 (at 15.45 WIB) and T2 (at 17.15 WIB); and, upon arrival in Semarang at different times for group T1 (at 18.42 WIB) and T2 (at 19.45 WIB). These time differences also significantly affected ambient temperature and humidity, which influenced the sheep's physiological condition measurement result. In addition, there were temperature differences between the inside and outside of the pickup car for T1 (20.6 and 18.3 ^{o}C) and T2 (21.8 and 17 ^{o}C) during rest stop in the Temanggung area. There were also differences in T1 ambient temperatures (24.5 ^{o}C) and T2 (23.3 ^{o}C) as well as the temperature in the T1 pick-up truck (26.4 ^{o}C) and T2 (25.1 ^{o}C) upon arrival in Semarang. These variations can cause differing responses between sheep in the T1 and T2 groups, ultimately influencing the measurement of the sheep's physiological condition results.

Lendrawati et al. (2019) noted that body temperature and respiratory rate are linked to the body's ability to maintain homeostasis in response to environmental temperature changes during transportation, especially from daytime to nighttime. These changes affect the sheep's body temperature and respiratory rate. The body temperature of local rams in both T1 and T2 before, during rest, and after arriving at the destination was stable, indicating that the sheep's body temperature was not affected by the duration of transportation. It was plausible that the sheep was able to overcome heat stress during transport by adjusting its pulse and breathing frequency. Additionally, though ambient temperature during transportation, especially when travelling at noon, can increase the respiratory rate and rectal temperature, the ambient temperature during transportation remained within the comfort zone for sheep, (18.3-17.0 ^{o}C). Herbut and Angrecka (2012) stated that environmental temperature and humidity are two factors that greatly influence changes in livestock physiological conditions, such as respiratory rate.

Table 1. Physiological Conditions of Sheep Before, During Rest, and After Transportation

Description	Before	Rest	After	Average
Transportation 4 hours (T1)				
Pulse rate (beats/minute)	73 [c]	92 [a]	81 [b]	
Respiration rate (beats/minute)	34 [b]	49 [a]	33 [b]	
Body temperature (°C)	35.96	35.4	36.08	35.81
Sheep body weight (kg)	18.35 [a]	-	16.78 [b]	
Transportation 6 hours (T2)				
Pulse rate (beats/minute)	86 [b]	101 [a]	75 [c]	
Breathing rate (beats/minute)	42 [b]	66 [a]	45 [b]	
Body temperature (°C)	35.75	36.30	36.42	36.16
Sheep body weight (kg)	18.30 [a.]	-	16.82 [b]	

[a,b,c] Different letters in the same line indicate significantly different (P<0.05).

The t-test showed that both T1 and T2 sheep had a higher body weights before transportation (P<0.05) than after transportation, indicating a decrease in sheep body weight during the 4-hour and 6-hour transportation. This weight loss can be attributed to the stress experienced by the sheep during transportation to Semarang due to the varying environmental temperature and humidity. The temperature and humidity of the environment upon arrival in Semarang differed for T1 and T2, with the temperatures of 24.5 °C and 23.3 °C, and humidity of 60 and 72%, respectively. The excretion of feces and urine during transportation also contributed to the weight loss. According to Lendrawati et al. (2019), stress that occurs due to transportation can be detrimental to breeders, including decreased body weight in livestock. Such weight loss occurs due to the evaporation and excretion processes during extended transportation.

Physiological Response and Body Weight of Sheep Groups at Different Transportation Periods

The results of the data analysis on the different lengths of transportation for sheep are presented in Table 2. The pulse before transportation at T1 (73 beats/minute) was lower (P<0.05) than at T2 (86 beats/minute). However, upon arrival in Semarang. T1 displayed a higher pulse (81 beats/minute) (P<0.05) than T2 (75 beats/minute), while at rest in Temanggung, both groups displayed a relatively similar pulse rates, with an average of 97 beats/minute. These variations are caused by the differences in travel duration and ambient temperatures. In both T1 and T2, there was a differing, increase in pulse rate from the pre-departure until rest stop. The increase in pulse rate on T1 was 8 beats/minute, whereas T2 displayed a higher rate of 11 beats/minute, so the pulses during rest stop in Temanggung were not significantly different (P>0.05)

Table 2. Physiological Conditions and Body Weight of Sheep with Different Transport Times

Parameter	Before Transportation (Banjarnegara)		During Rest (Temanggung)		After Transportation (Semarang)	
	T1	T2	T1	T2	T1	T2
Pulse Rate (beats/minute)	73[b]	86[a]	92	101	81[a]	75[b]
Respiratory Rate (beats/minute)	34[b]	42[a]	49	66	33[b]	45[a]
Rectal temperature (°C)	35.96	35.75	35,40	36,30	36.08[b]	36.42[a]
Body Weight (kg)	18.35	18.30	-	-	16.77	16.82
Body Weight Loss (kg)	-	-	-	-	1.57	1.48
Feces and Urine Weight (kg)	-	-	-	-	0.56	0.59

Information: T1 = before transportation (12.54 WIB), during breaks (15.45 WIB), after transportation (18.42 WIB)
T2 = before transportation (12.54 WIB), during breaks (17.15 WIB), after transportation (19.45 WIB)
[a,b,c] Different letters in the same row and column indicate significant difference (P<0.05).

The t-test results showed differences in the respiratory rates and body temperatures of sheep under different transportation conditions. Before departure, the respiratory rate of T1 (34 times/minute) was lower (P<0.05) than T2 (42 times/minute). Upon arrival in Semarang, T1 maintained a lower respiratory rate (33 times/minute) (P<0.05) than T2 (45 beats/minute). During rest in Temanggung, both groups exhibited relatively similar respiratory rate, averaging at 57 beats/minute. These result indicate that the respiratory rate of T1 sheep was lower than that of T2 sheep, which was reflected upon their measurement in Semarang. It is worth noting that while resting in Temanggung, the respiratory rate of the T1 and T2 sheep showed a different increase (Table 1), so the respiratory rate was not significantly different (P>0.05). According to Septiadi et al. (2015), the normal respiratory frequency in sheep ranges from 26-54 times per minute, and deviations might, indicate stress in sheep. In our study, both T1 and T2 sheep before and after transportation had normal respiratory rates, with the exception of the T2 sheep after being transported for 3 hours, reaching a higher rate of 66 times/minute. Even though the T1 sheep, experienced an increase in their respiratory rate at Kledung Temanggung rest stop (49 breaths/minute), it remained within the normal range of 26 - 54 breaths/minute. According to Nelvita et al. (2018), an increase in respiratory frequency during high ambient temperature is essential to dissipate excess body heat, aiding animals in overcoming heat stress by accelerating their respiratory rate.

The t-test result also indicates no significant difference in body temperature between T1 and T2 treatments before transportation and during rest stop (P>0.05). The average temperatures were 35.86 ^{o}C before transportation and 35.85 ^{o}C during rest stop. Upon arrival in Semarang, T1 group displayed a lower (P<0.05) body temperature (36.08 ^{o}C) compared to T2 (36.42 ^{o}C). This suggests that sheep treated with both T1 and T2 did not experience stress halfway through transportation, indicated by their stable body temperature. However, the notable (P<0.05) temperature increase in T2 upon arrival could be attributed to the longer transport duration (6 hours compared to 4 hours in T1) which resulted in varying environmental conditions. According to Anwar (2021), rectal temperature and respiratory rate are related to the body's ability to maintain homeostasis in response to changes in ambient temperature during transportation, with high ambient temperatures leading to increased livestock respiratory rates and rectal temperatures.

The t-test on initial body weight (before transportation) and final body weight (after transportation) showed no significant differences (P>0.05) between T1 and T2, with an average of 18.33 kg (weight before transportation) and 16.80 kg (weight after transportation). These results are consistent with the lack of a significant difference in the weight of feces and urine excreted by the local male sheep (P>0.05), with an average weight loss of 1.53 and 0.58 kg. As noted by Lendrawati et al. (2019), transportation-induced stress can have a detrimental effect, including decreasing body weight due to evaporation and excretion process during transportation.

Nelvita et al. (2018) noted that transportation related weight loss in sheep may necessitate farmers to implement post-transportation recovery management. Livestock transportation can induce stress on livestock, so providing appropriate animal care and treatment during transportation to alleviate stress and minimize body weight loss. Wilasari et al. (2019) stated that livestock body weight loss can be affected by perspiration, duration of transportationroad conditions, ambient temperature, the age of animal, and the excretion of feces and urine.

CONCLUSION

The breath and pulse frequency of sheep with a 6-hour transportation duration from Banjarnegara to Semarang was higher than the 4-hour trip. Nevertheless, body temperature remained relatively stable and within the normal range. Stress experienced during transport can led to fluctuation in the physiological condition of sheep, influenced by the ambient. Temperature and humidity at the time of measurement. Transporting sheep with a time of 4-6 hours did not significantly impact body weight, weight loss, or the excretion of feces and urine, but both treatments resulted in a decrease in sheep’s body weight.

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