Physiological Response and Blood Profile of Sheep Given Forage and Cassava Leaf Silage (*Manihot esculenta* sp.) in Petir Village, Bogor

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ABSTRACT

The study aimed to evaluate the effect of forage chopping and supplementation of cassava leaves silage or concentrate on physiological response and blood profile of sheep. Sixteen male sheep of 12 months old with average body weight of 21.55 ± 2.02 kg were placed in individual cage. Feed was offered at the level of 3.5% of body weight on dry matter basis and given three times at 0730, 1230 and 1730. Drinking water were provided ad libitum. Completely randomized block design applying four treatments and four groups were used in this experiment. The treatments were T0 (100% forage), T1 (100% chopped forage), T2 (80% chopped forage + 20% concentrate), and T3 (80% chopped forage + 20% silage cassava leaves). The variables observed were pshyiological responses (respiration rate, heart rate, and rectal temperature) and blood profile (haemoglobin, haematocrite, erythrocytes, and leucocyte). Physiological responses were measured once a week in the morning, at noon and afternoon. Data obtained were analyzed using analysis of variance (ANOVA) and any significant differences were further tested using Duncan's multiple range test. The results showed that treatment had no effects on rectal temperature of sheep. Supplementation of cassava leaves silage or concentrate increased ($P<0.05$) morning and noon respiration rate. Supplementation of cassava leaves silage increased ($P<0.05$) heart rate at noon. Suplementation of cassava leaves silage or concentrate did not affect erythrocyte, haemoglobin and haematocrite of sheep. Chopping of forage increased the number of leukosit, but supplementation of cassava leaf silage and concentrate recovered the effect of chopping on leucocite. Chopping of forage tended to give better effects on physiological responses. While, supplementation increased heat load onto sheep, even though this can still be handled by sheep thus do not cause heat stress.

Keywords: Blood profile, Cassava leaves silage, Concentrate, Physiological response, Sheep

INTRODUCTION

Constraints often faced by sheep farmers is the low quality of forage and limited availability of forage in the dry season causing low productivity of sheep. Therefore, it is necessary to provide feed supplementation which one of them is cassava leaves (Manihot esculenta sp.). Central Bureau of Statistics (2014) reported that the cassava harvested area in Indonesia in 2013 reached 1,061,254 ha with cassava leaf production reaching 0.92 ton/ha/year of dry matter (Lebdosukoyo, 1983). The high production of cassava leaves has not been optimally utilized as animal feed. To maintain the availability of feed continuously and maintain the quality of nutrient content can be done through silage-making technology. Noveanto (2013) reported that ensilaging process can decrease HCN (Hydrocyanic acid) content in cassava leaves by 78.67%, making it safer for animal feed. He also reported that the protein content of cassava leaves silage was 25.5%.

Farmers in Petir Village, Bogor, usually give forage to sheep without being cut first. Whereas, cutting can increase the amount of forage consumed by animal and can reduce heat stress by decreasing heat increment due to reduced ruminations (Utomo and Soejono, 1987). Feeding by supplementation of cassava leaf silage or concentrate and by cutting first is expected to improve the physiological response of livestock kept in hot areas. Thus, it does not cause disruption to health and livestock production.

The purpose of this study was to analyze the effect of forage cutting and supplementation with cassava leaf silage or concentrate on physiological responses (rectal temperature, respiration rate, and heart rate) and blood profile (hematocrit, hemoglobin, erythrocyte count, leukocyte count) of sheep reared by the farmer in Petir village, Bogor.

MATERIALS AND METHODS

The experiment was conducted at a smallholder farm located at Petir village, Bogor, Indonesia. Sixteen male local sheep with an initial body weight of 21.55 ± 2.02 kg were allocated into completely randomized block design incorporating four treatments and four replicates. They were placed in individual cage provided with buckets for feed and drinking water. Sheep were reared for 12 weeks with a 2-week adaptation period. Body weight sheep weighed once a week. Wet and dry bulb thermometers were installed in animal cage to measure air temperature and humidity.

The four treatment diets were formulated based on concentrate, cassava leaf silage and forage (with the ratio of corn leaves : local grass : sweet potato leaves = 4.20 : 19.05 : 76.76) as follow: T0: 100% forage, T1: 100% chopped forage, T2: 100% chopped forage + 20% concentrate, T3: 100% chopped forage + 20% cassava leaf silage. Feeding level was 3.5% of their body weight on dry matter basis and given at 07.30, 12.30 and 17.30. Drinking water was provided *ad libitum*. The nutrient content of experimental diets was shown in Table 1.

Cassava leaf silage was prepared as follow fresh cassava leaves (including top stalks and top trunks) were manually chopped (approximately 2-3 cm) and wilted for 6 h at ambient temperature. Molasses (5%) was added to the wilted cassava leaves and thoroughly mixed before storage at ambient temperature in 30 kg sealed airtight plastic bags for at least 3 weeks before being fed to the sheep. The cassava silage was fed to sheep for less than 6 days after opening of a bag. The average pH of cassava leaf silage in this study was 4.

Variables measured were physiological responses include rectal temperature, respiration rate, and heart rate; blood profiles including hematocrit, hemoglobin, red blood cells, and white blood cells. Data were analyzed using analysis of variance (ANOVA) and any significance different results were further tested using Duncan's multiple range test (Steel and Torrie, 1980).

Table 1. Nutrient content (% DM) of experimental diets

Nutrient Content	Treatments			
	T0	T1	T2	T3
Crude protein (%)	18.42	18.42	16.95	19.84
Ether extract (%)	7.59	7.59	6.85	7.43
Crude fibre (%)	15.66	15.66	15.89	16.67
Niitrogen-fre extract (%)	45.50	45.50	47.99	44.20
Ash (%)	12.83	12.83	12.32	11.88
Total Digestible Nutrient (%)*	67.61	67.61	67.44	68.29

*) Calculation results based on Hartadi (1980)

RESULTS AND DISCUSSION

Micro climate in sheep shed

The average daily ambient temperature ranged from 22.40 - 30.40 °C with humidity reaching 84.4 - 91.9%. The highest temperatures occurred during the day, while the highest humidity occurred in the morning. The average temperature in the cage in the morning was quite cool according to the needs of the sheep, but during the day the temperature in the cage was above the normal temperature for sheep. Yousef (1985) reported that the acceptable temperature of sheep ranged from 4 - 24 °C with humidity below 75%. High temperature and humidity can affect physiological condition of sheep. Sudarman and Ito (2000) reported that sheep fed high forage placed at ambient temperature 30 °C had a higher heat load compared to sheep placed at an ambient temperature of 20 °C. While high humidity can inhibit heat dissipation in sheep.

Effect of Treatment on Sheep's Physiological Response

The sheep's physiological response during the study is presented in Table 2. The treatment had no significant effect on sheep rectal temperature, either in the morning, at noon, or afternoon. The rectal temperature of sheep in this study ranged from 38.71 - 39.10 ˚C. It shows that sheep rectal temperature is still in the normal range which according to Sonjaya (2012) normal sheep rectal temperature ranges 37.90 - 39.80 ˚C. Isnaeni (2006) states that the body temperature in most animals is more influenced by the temperature of the environment. However, Sudarman and Ito (2000) reported that sheep fed with different levels of protein showed significant differences in sheep vaginal temperature at 20 °C but did not significantly affect the temperature of 30 °C. At high environmental temperatures (daytime), the body heat dissipation was not proportional to the amount of heat obtained so that body temperature increases (Sunugawa et al., 2002). The highest rectal temperature of the lamb in the afternoon is the result of heat accumulation received by the body of livestock throughout the day.

Table 2. Micro climatic condition and physiological responses of sheep as affected by treatments

Variables	Treatment	Times of measurement		
		Morning (07.00)	Noon (12.00)	Afternoon (17.00)
Ambient Temp. (°C)		22.40 ± 0.42	29.90 ± 0.74	27.30 ± 2.28
Humidity, Rh (%)		91.90 ± 3.00	86.00 ± 2.12	88.20 ± 5.67
Rectal temperature (°C)	T0	38.57 ± 0.48	39.11 ± 0,.32	39.31 ± 0.25
	T1	38.33 ± 0.32	38.77 ± 0.28	39.02 ± 0.84
	T2	38.76 ± 0.52	39.17 ± 0.38	39.37 ± 0.36
	T3	38.60 ± 0.35	39.12 ± 0.24	39.22 ± 0.27
Respiratory frequency (times/min.)	T0	30.38 ± 7.04^{ab}	59.85 ± 11.54^{ab}	62.80 ± 22.64
	T1	28.20 ± 4.05^{a}	56.55 ± 9.84^{a}	54.78 ± 20.68
	T2	36.15 ± 8.39^{b}	77.40 ± 24.99^{bc}	69.23 ± 28.32
	T3	34.88 ± 7.42^{b}	80.70 ± 23.17^{c}	70.10 ± 29.93
Heart rate (times/min.)	T0	75.78 ± 9.97	87.31 ± 11.58^{a}	98.78 ± 13.44
	T1	78.33 ± 12.65	90.78 ± 14.78^{a}	99.43 ± 16.68
	T2	85.69 ± 12.14	98.71 ± 14.43^{ab}	101.8 ± 16.25
	T3	86.39 ± 12.60	104.13 ± 11.07^{b}	102.38 ± 14.42

T0 = 100% forage; T1 = 100% chopped forage; T2 = 80% chopped forage+ 20% concentrate; T3 = 80% chopped forage + 20% cassava leaves silage

Different superscript within the same column differ significantly (P<0.05)

Treatment had significant effect (P <0.05) on heart rate during the day. The sheep heart rate in this study ranged from 87.29 to 97.63 times/min which is still within the normal range. According to Frandson (1992) normal sheep heart rate in the tropics ranged from 60 to 120 times / minute. Sheep given feed supplementation relatively had a higher heart rate. Supplementation of cassava leaves silage has the highest average heart rate (104.13 ± 11.07 times / min). Improving the quality of feed seems to increase the metabolic rate, in line with it also increases the metabolic heat generated in the body of the livestock. In hot environments, such as during the day, this metabolic heat is unfavorable and must be released into the environment by way of being transported by the blood to the surface of the body, so that the heart rate increases. Besides being influenced by feed quality, the increase of pulse rate is also influenced by the increase of feed consumption (Wuryanto 2010).

The treatment had significant effect (P <0.05) on the rate of respiration of sheep in the morning and afternoon. The highest respiration rate was shown by sheep with the treatment of cassava silage leaf supplementation (T3) of 61.89 ± 29.57 times/min and the lowest was shown by sheep with 100% forage chopped (T1) of 46.51 ± 18.62 times/min. The pattern of increasing respiration rate is in line with the increase in heart rate. Consumption of high nutrients will increase the body's metabolism so that more heat will be produced body (Wuryanto et al. 2010). As the metabolic rate increases, the need for O2 and CO2 formation also increases (Isnaeni, 2006). So the sheep will increase the respiration rate to meet the needs of O2, releasing CO2 and body heat that has been transported by blood. While the reduction in particle size can increase consumption and reduce heat increment due to reduced rumination (Utomo and Soejono, 1987), so the release of heat through the breathing is lower. Respiration rate of sheep in this study ranged from 46 to 61 times/minute. The average rate of respiration is much higher than the normal respiration rate of 26-32 times/min (Frandson 1992). The results show that sheep experience mild stress, which according to Silanikove (2000) is characterized by sheep doing respiration as much as 40-60 times/minute.

Effect of Treatment on Blood Profile of Sheep

The sheep blood profile of the study is presented in Table 3. The treatment did not show any significant effect on the amount of erythrocytes, hemoglobin and hematocrit of sheep. The amount of erythrocytes, hemoglobin and hematocrit of sheep in this study were 8.53 - 8.60 million/mm, 7.05 - 7.85 g/ dL, and 28.25-31.75%, respectively. The blood profile is slightly below the normal range, since normal conditions for sheep for erythrocytes range from 9 to 17 million / mm, hemoglobin ranges from 9 to 15 g / dL (Pugh, 2002) and hematocrit is 32% - 45% (Smith and Mangkoewidjojo, 1998). These low levels of erythrocytes and hematocrit are proportional to the low number of hemoglobin. The low level of hemoglobin in sheep is possibly due to the presence of saponin in forage in the form of sweet potato leaves that can bind to a divalent atom 2, ie Fe2 + forms a complex compound that causes the absorption of Fe to interfere with and interfere with the formation of hemoglobin (Francis, 2002).

Tabel 3. Blood profile of sheep as affected by treatments

Variables	Treatment			
	T0	T1	T2	T3
Eritrosit (juta/mm)	8.53 ± 0.82	8.60 ± 0.92	8.04 ± 1.47	8.47 ± 1.16
Hemoglobin (g/dL)	7.85 ± 1.23	7.08 ± 1.04	7.05 ± 1.34	7.80 ± 0.28
Hematokrit (%)	31.75 ± 1.89	28.25 ± 3.86	29.50 ± 3.11	30.50 ± 1.00
Leukosit (ribu/mm)	5.11 ± 0.36a	6.51 ± 0.42b	5.71 ± 1.03a	5.58 ± 0.53a

T0 = 100% forage; T1 = 100% chopped forage; T2 = 80% chopped forage+ 20% concentrate; T3 = 80% chopped forage + 20% cassava leaves silage
Different superscript within the same column differ significantly (P<0.05)

The treatment had a significant effect (P <0.05) on the number of white blood cells (leukocytes) of sheep. The number of sheep leukocytes in this study ranged from 5.11 to 6.51 thousand/mm. This result shows that the number of sheep leukocytes in this study is still within the normal range, ie 4-12 thousand/mm (Pugh, 2002). These results indicate that the sheep in the study were healthy. The number of sheep leukocytes in T1 treatment was higher than that of other treatments (T0, T2, and T3). Factors that may cause the leukocyte count in T1 is higher because of the saponin content in sweet potato leaves. Saponins can act as immunomodulators that are immunostimulators that can enhance function and activity of immune system (Francis, 2002).

CONCLUSIONS

Cutting forage into smaller sizes tends to lower the frequency of respiration and heart rate of sheep. Feed supplementation (cassava leaf silage or concentrate) increases body heat production released by increasing the frequency of respiration and heart rate to keep the sheep body temperature normal. Forage cutting and feed supplementation do not affect erythrocytes, hemoglobin, and hematocrit but increase the number of leukocytes.

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