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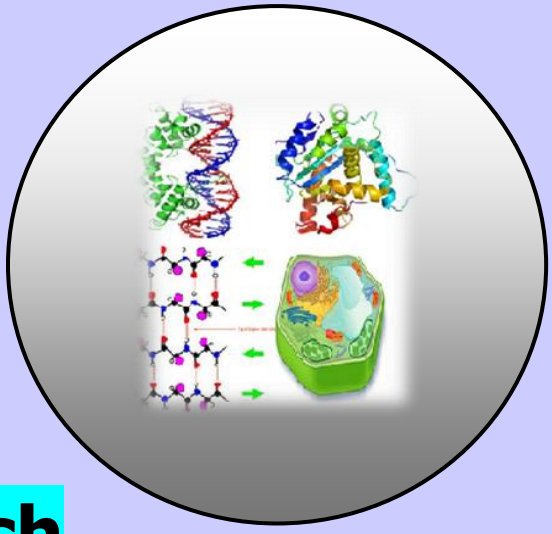

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RESEARCH PAPER

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Micro Climate and Physiological Responses of Local Rabbit Offered Diet Containing Different Levels Coffee Pulp in Tropical Highland Region

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ABSTRACT

The study aims to determine the condition of the microclimate and the physiological response of local rabbits are housed in tropical highlands region. Research conducted in the village of Jelijih, Pupuan District, Tabanan Regency in tropical highland region with altitude of 1350 m above sea level. The experimental design used was a Block Randomized Design (BRD) with 5 treatments and 6 replications. Diets that use different levels coffee pulp as a treatment consisting of: diet without coffee pulp (R0) as a control, diet containing 10% coffee pulp not fermented (R1), diet containing 20% coffee pulp not fermented (R2), diet containing 10% coffee pulp fermented (R3), diet containing 10% coffee pulp fermented (R3). The research results find that the level of coffee pulp fermented and not fermented (R1, R2, R3 and R4) that not significant differences (P> 0.05) compared with control (R0) of the variable cage microclimate which may include: cage air temperature, cage humidity, Temperature humidity Index (THI) and intensity solar radiation. There were no significant differences (P> 0.05) to variable rectal temperature and skin temperature of local rabbit between R0, R1, R2, R3 and R4 treatment. Treatment R3 and R4 cause the pulse rate and respiration rate of the local hare is higher (P<0, 05) compared to the treatment R2, R1 and R0. The results of this study concluded that there is no significant difference (P>0,05) in cage micro-climatic conditions, rectal temperature and skin temperature of a local rabbit between treated using different levels of fermented coffee pulp waste and not fermented coffee pulp waste. Pulse rate and respiration rate of local rabbits fed diet containing 10% and 20% fermented of coffee pulp waste was higher (P<0,05) than local rabbit fed diet containing 10% and 20% coffee pulp waste without fermented and control treatment.

Keywords: Local Rabbit, Coffee Pulp, Microclimate and Physiologic Response.

INTRODUCTION

Rabbit business development is a strategic breakthrough in the field of animal husbandry to accelerate the achievement of food self-sufficiency especially adequacy of animal protein. Ogunjimi *et al*. (2008) reported that the domestic rabbit have been recommended as a good alternative source of dietary protein for the constant increased of the population in developing countries due to their short-cycled production characteristics. McNitt *et al*. (1996) reported that in hot climate regions rabbit production has same problems such as heat stress, low quality food, diseases and parasites and among these, heat stress is the most important factor. Ogunjimi *et al*. (2008) reported that the relationship of environmental temperature, relative humidity, energy intake and heat production in growing animal is fundamental factor that must be considered in designing and managing of an efficient livestock production.

It was suggested that the optimal temperature humidity index for the rabbit husbandry is 27.8 (Marai, 2002). The optimal temperature for rabbit is 9 – 19^{o}C (McNitt *et al*., 1996) and the optimum relative humidity is around 80 -86% (Kamal *et al*., 2010). BMKG (2016) reported that environmental temperature at low land in humid tropics is 21.87 – 31.13^{o}C and relative humidity is 79 - 86%. Biological thermoregulation in rabbits is rather poor as they only have few sweat glands. In heat stressed, both respiration rate and pulse rate are increased in rabbits (Skriivanova *et al*., 2011). Nuriyasa *et al.* (2016) states that rabbit heat stress conditions will be responded by physiological responses. Nuriyasa *et al.* (2014) found that physiological responses of local rabbit such as increased of pulse rate and respiration rate will cause increases the energy for maintenance so less energy that can be used for growth. Diet with different energy and protein level, increase respiration and pulse rates to increase oxygen supply for body cells (Kasa, 1998). This study to investigate micro climate of rabbit cage and physiological responses of local rabbit offered diet containing different coffee pulp waste in tropical highland region.

MATERIAL AND METHODS

Rabbits: Thirty domestic rabbits of five week old, with nearly equal live body weight (189.25 g ± 1.54) were used in this experiment. Each cage was provided with feed and water containers. The rabbit battery cage size is 70 × 50 cm wide, with 45 cm height.

Feed and Water. Feed were formulated using a mixture of fermented coffee pulp waste, coffee pulp without fermented, yellow corn, rice bran, palm waste, fish meal, soy flour, cassava, elephant grass, copra meal, mineral mix and bone meal. Rabbit diet made is iso energy and protein containing 2500 kgcal/kg energy metabolizable and 16% crude protein.

Place of Research. The research was conducted in Punggang Village, District Pupuan, Tabanan regency with altitude of 1350 m above sea level. The research lasted 12 weeks district Tabanan

Data Recording: Micro climate and physiological responses were recorded three times a day at 7.30 am, 13.30 pm and 17.30 pm.

Micro Climate

Temperature Humidity Index (THI): THI were calculated following Marai (2002) formulation:

THI = T - [(0.31 - 0.31 × Rh) (T - 14.4)], Where THI : Temperature Humidity Index, T : Temperature (^{o}C) and Rh : Relative humidity/100. Temperature and humidity inside the enclosure measured using digital Thermo hygrometer type CE 11/08.

Intensity of solar radiation: Intensity of solar radiation is measured by using a digital light meter tife brand Lutron LX-103.

Physiology Variable

Rectal Temperature: Rectal temperature is measured with a digital thermometer inserted into the anus se in 6 cm for one minute (Kasa et al., 1993.

Skin Temperature: Skin temperature was measured using digital Thermo hygrometer type CE 11/08 by attaching sensors to the skin of rabbits. Measurements were taken at four points of the head, neck, back and butt (Kasa *et al*., 1993).

Respiration Rate: Respiration rate obtained by calculating the movement of rise and fall of the surface-belly ribs for one minute (Purnomoadi, 2003). Observations were made three times a day, namely at 7:30, 13:30 and 17:30 pm.

Pulse Rate: Before taking pulse rate data do habituation in rabbit (pre-treatment) for one week. The first step taken was palpating rabbit body that most felt his pulse. Pulse rate measurement is done by placing a stethoscope over a minute (Purnomoadi, 2003).

Design of the experiment and statistical analyses: Randomized block design with five treatments and six blocks. All data were recorded, tabulated, and analyzed using analysis of variance. Whenever significantly differences were found, analyses will be continued using Duncan's Multiple Range Test (Steel and Torrie, 1980).

RESULT AND DISCUSSION

Micro Climate

The air temperature in rabbit cage with rabbits offered diet containing diet without using coffee pulp waste (R0), using 10% coffee pulp waste without fermentation (R1), using 20% coffee pulp waste without fermentation (R2), using 10% fermented coffee pulp waste (R3) and using 20% fermented coffee pulp waste (R4) respectively 26.29 ° C, 26.17 ° C, 26.61 ° C, 26.49 ° C and 26.45 ° C which was not statistically significantly different (P> 0.05). Air humidity in rabbit cages that were treated R3 highest (64.98%), while treated R2, R4, R0 and R1 respectively 64.95%, 64.79%, 64.76% and 64.74%, which is not statistically significantly different (P> 0.05). Rabbit cage were treated R0 causes the Temperature Humidity Index (THI) the highest (25.62), while the treatment of R3, R2, R1 and R4 respectively 0.27%, 0.58%, 1.67% and 1.95 % lower but not significantly different (P <0.05). The intensity of solar radiation entrance into the rabbit cage treated R1 was lowest (4, 72 fc) is, while treatment R4, R0, R3 and R2 respectively 12.08%, 25.63, 28.81% and 36, 65% higher but not significantly different (P> 0.05), as shown in Table 1.

Different diet of treatment does not affect cage temperature. This is indicated that differences energy produce in metabolic processed by the difference in energy and protein consumption at different diet treatment, not affect the rabbit cage temperature. McNitt *et al*. (1996) stated that higher energy and protein consumption causes increased metabolic heat production. Cage ventilation causes air circulation is better that metabolic heat does not accumulate in the cage rabbit.

Table 1. Micro Climate of Local Rabbit Cage Offered Diet Containing Different Levels Coffee Pulp Waste.

Variable	Treatment					
	R0	R1	R2	R3	R4	SEM
Cage Temperature (^{o}C)	26,29^{a}	26,17^{a}	26,61^{a}	26,49^{a}	26,45 ^{a}	0,08
Cage Humidity (%)	64,76^{a}	64,74^{a}	64,95^{a}	64,98^{a}	64.79 ^{a}	0,14
Temperature Humidity Index (THI)	25,62^{a}	25,19^{a}	25,55^{a}	25,47^{a}	25,12	0,12
Intensity of solar radiation (fc)	5,93^{a}	4,72^{a}	6,45^{a}	6,08^{a}	5,29 ^{a}	1,76

R0: Diet without coffee pulp (control feed)
R1 : Diet containing 10% non fermented coffee pulp
R2 : Diet containing 20% non fermented coffee pulp
R3 : Diet containing 10% fermented coffee pulp
R4 : Diet containing 20% fermented coffee pulp
Value with same superscripts in same row indicate no significant different (P>0,005).
SEM: Standard error of treatment mean.

Lean and Rind (1996) stated interaction of climate elements such as solar radiation, humidity and wind speed in the cage will affect the air temperature in a rabbit cage. Rabbits will balance the heat of his body by removing excess body heat by conduction, convection and radiation. The amount of heat that is released into the cage environment affects the measured temperature in rabbit cage (Esmay, 1978). Table 1 shows that diet treatment ration with the different levels containing of coffee pulp, does not affect the air humidity and the intensity of solar radiation. Air humidity and the intensity of solar radiation is not significantly different because the temperature of rabbit cage was not significantly different among treatments.

The results of a study reported an average relative humidity (Rh) in a rabbit cage ranges from 64.74% - 64.98%. The range of air humidity is still within the normal range for rabbits. Lick and Hung (2008) states rabbits are not tolerant of humidity below 60%, and the rabbit is still able to adapt to the humidity in the range of 90-100%. Ability rabbits can live in areas of high humidity premises, reflected by the living habits of rabbits in their natural habitat in the cave deep enough. The results of the study (Table 1) shows that the air temperature of rabbit cage treated R0, R1, R2, R3 and R4 was not significant difference caused rabbit skin temperature not significant different among treatment (Table 2). Respiration rate of rabbits were treated rations R3 and R4 is higher than the R2 and R1 and R0. Higher respiration rate could potentially increase the moisture in the cage. Side of the cage made of wire cages cause very effective ventilation so that the exchange of water vapor between the rabbit cage with the environment goes well and does not cause the accumulation of water vapor in the rabbit cage. This situation causes not significant different (P>0,05) variable of air humidity inside rabbit cage.

Ogunjimi *et al.* (2008) states that the temperature and humidity affect the thermal environment interacting as indicated by the temperature humidity index (THI). According Esmay (1978) the value of THI is an indicator of the comfortable animals in cages. The higher the value of THI on the optimum range indicated the higher level of heat stress experienced by animals, and vice versa. Results of research on tropical highlands region found that THI ranges from 25.12 to 25.62. Marai et al. (2002) states values of THI below 27.8 indicates the rabbits are in comfortable circumstances (not experiencing heat stress). THI value in the range of 27.8 to 28.9 indicating rabbits are at moderate heat stress conditions. THI in the range of 28.9 to 30 indicated a high level of heat stress and THI values above 30 very high level heat stress. Based on these data, the value of THI on the rabbit cage in the tropical highlands are comfortable.

The intensity of solar radiation that goes into the cage ranged from 4.72 to 6.45 fc (foot candles). There were no significant difference (P>0,05) to the variable of solar intensity of treatment R0, R1, R2, R3 and R4. Diet treatment did not affect the intensity of solar radiation that goes into the cage plot. Incoming solar radiation into the cage is a reflection of radiation from the soil surface near the cage and diffuse radiation from the atmosphere. All plots of rabbit cage is made inside the same, with one side of the building is open so that the intensity of solar radiation received by each rabbit cage is no different. This situation shows all unit rabbit cage receive the same intensity of solar radiation.

Physiological Responses

Diet treatment with the use different levels of fermented coffee pulp not significantly different (P> 0.05) to variable rectal temperature and skin temperature (Table 2). The pulse rate of rabbits that offered diet R4 was highest (114.45 times / min). Rabbit was offered diet R3 was 1.82% lower than R3, but not statistically significantly different (P> 0.05). The pulse rate of rabbits were treated R2, R1 and R0 respectively 8.14%, 9.70% and 11.37% lower (P <0.05) than R3. Treatment diet R4 causes rectal temperature is the highest of 39.38 °C, whereas the treatment R3, R1, R2 and R0 respectively 0.12%, 0.38%, 0.51% and 0.66% lower (P> 0.05) compared with R4.

Rabbit offered diet R2 causes lowest skin temperature (37. 43 °C) whereas treatment R1, R0, R4 and R3 respectively 0.49%, 0.53%, 2.08% and 2,64% higher but not significant different (P> 0.05) compared with R1. Rabbits offered diet R3 cause highest respiration rate is 63.73 / min, while the R4 1.49% lower (P> 0.05) than R3 and the treatment of R1, R2 and R0 respectively 8.76%, 8.77 % and 9.67% significantly lower (P <0.05) compared with R3. Results of the study found that pulse rate of local rabbit ranges from 102.43 to114.45 times/min (Table 2). The results of this study are still within the normal range because it is still in accordance with the results of Kasa *et al*. (1997) that found the pulse rate New Zealand white rabbits were housed at an air temperature of 21.1 ° C causes the pulse rate 76 time/min, while the air temperature 35 ° C cause the pulse rate 421 times / minute. The results of a study reported that respiration rate of local rabbit ranges from 57.57 time/min to 63.73time / min. Respiration rate obtained is still within the normal range, because it is not much different from the results of research Bivin and king (1995) that is 32 to 60 time/ min.

Table 2. Physiological Responses of Local Rabbit Offered Diet Containing Different Levels Coffee Pulp Waste .

Variable	Treatment					
	R0	R1	R2	R3	R4	SEM
Pulse Rate (times/min)	102,43 b	103,35 b	105,13 b	114,37 a	114,45 a	1,13
Rectal Temperature (^{o}C)	39,12^{a}	39,23^{a}	39,18^{a}	39,33^{a}	39,38^{a}	0,12
Skin Temperature (^{o}C)	38,02 ^{a}	37,98^{a}	37,43 ^{a}	38,24^{a}	38,21^{a}	0,65
Respiration Rate (times/min)	57,57^{b}	58,15^{b}	58,06^{b}	63,73^{a}	62,78^{a}	1,63

R0: Diet without coffee pulp (control feed)
R1 : Diet containing 10% non fermented coffee pulp
R2 : Diet containing 20% non fermented coffee pulp
R3 : Diet containing 10% fermented coffee pulp
R4 : Diet containing 20% fermented coffee pulp

Mahardika (1996) and Nuriyasa et al. (2010) reported an increase in the rate of respiration is a rabbit enterprises to accelerate the release of heat by evaporation from the respiratory tract. Lick and Hung (2008) states that the rabbits have thick skins and furs as a heat insulation so the release body heat through the process of evaporation from the skin is very small. Accelerate the rate of respiration is the most effective effort to balance the body heat. Rectal temperature represents the temperature of the entire body of rabbit as a result of the average measurement of all body tissues (Esmay, 1978). Heat on the body of rabbit as measured by the body temperature of rabbit originating from metabolic heat and heat from the environment. The results of a study reported rectal temperature of rabbits treated R0, R1, R2, R3 and R4 respectively 39.12 ^{o}C, 39,23^{o}C, 39,18^{o}C, 39,33oC and 39,38^{o}C. The same results were obtained by Kasa and Thwaites (1993) ranged 39,4oC up to 40.6 ° C, as well as other studies that Bivin and King (1995) found the average rectal temperature of 39.5 ° C.

Treatment diets containing different coffee pulp does not affect significantly (P> 0.05) on rectal temperature variable. Micro-climatic conditions are almost the same, causing a rectal temperature of rabbits were not significantly different. The same research results obtained by Thwaites *et al.* (1995) which rabbit is housed in cage temperature of 34 ^{o}C causing rectal temperature of 40.2 ° C which is not significantly different than housed in cage temperature 36 ^{o}C ie rectal temperature of 40.7 ° C. Treatment diets with different energy content of coffee pulp does not affect rectal temperature. This indicates that the differences in the metabolic heat of the differences of protein and energy consumption by rabbits do not affect the rectal temperature. Mastika (2011) declared fat content in the diet affects the heat increment or specific dynamic effects that may contribute to lower rectal temperature. Proximate analysis results do not happen to get a great difference to the fat content of coarse ration treatment. Skin Temperature Average of local rabbit local ranged 37, 43 ^{o}C to 38.24 °C. The research results obtained are still within the normal range, according to the results of research Thwaites and Kasa (1993) ranged 34,43^{o}C up to 42.8 °C.

Skin temperature is not affected by the treatment of diets containing different levels of coffee pulp. Treatment of different diets did not significantly affect the temperature of rabbit skin caused by micro-climatic conditions did not differ significantly among treatments; the same opinion says Kasa and Thwaites (1993).

CONCLUSION

1. The treatment diets containing different levels of coffee pulp does not affect micro-climatic conditions in the local rabbit cage.
2. Responses physiology of rabbit offered diets containing 10% and 20% fermented coffee pulp worse than other treatments.

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