Energy and Protein Retention of Local Rabbit Housed in Different Cages

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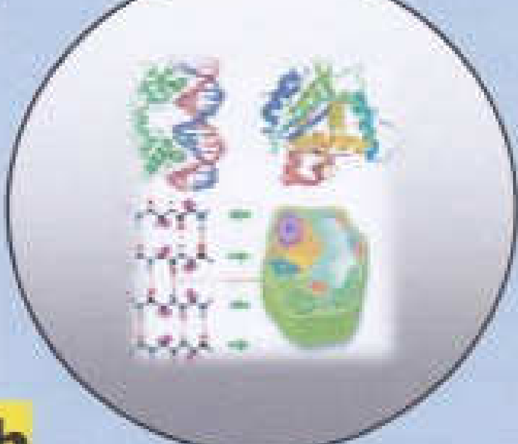

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RESEARCH PAPER

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Energy and Protein Retention of Local Rabbit Housed in Different Cages

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ABSTRACT

An experiment was carried out to study microclimate, energy and protein retention of local rabbit offered diets with different energy and protein level. Sixty four rabbits of five week old were used in this study and housed in battery and underground cages. A split-plot design consisting of two main plots: underground shelter (K0) and battery housing systems (K1), four sub plot: diets with 2200 kcal ME kg^{-1} and 14% CP (R1), 2400 kcal ME kg^{-1} and 15.5% CP (R2), 2600 kcal ME kg^{-1} and 17% CP (R3), 2800 kcal ME kg^{-1} and 18.5% CP (R4) with four replicates used in each of experiment. The results showed that underground shelter cage had lower temperatures and humidity (P<0.05) than the battery cage. Rabbits housed in underground shelter had higher energy retention (P<0.05) than those housed in battery cages. Rabbit housed in underground shelter had lower heat production than those housed in battery cages (85.51 kcal ME W$^{0.75}$d^{-1} vs. 120.68 kcal ME W$^{0.75}$d^{-1}). Diets R3 fed to local male rabbits had higher energy retention (P<0.05) which is 60.05 kcal d^{-1} compared to that was 48.65 kcal d^{-1}, 35.64 kcal d^{-1} and 31.63 kcal d^{-1}, respectively. Rabbit fed R3 diet had the lowest heat production that was 89.12 kkalW$^{0.75}$d^{-1} (P>0,05) compared to R4, R1 and R2 was 104.64 kcalW$^{0.75}$d^{-1}, 106.86 kcalW$^{0.75}$d^{-1}, and 111.75 kcalW$^{0.75}$d^{-1} respectively. It can be concluded that rabbits offered diets contained energy 2600 kcal ME kg^{-1} and 17% CP (R3) and housed in underground shelter cage found efficient use of energy and protein for growth.

Keywords: Local Rabbit, Microclimate, Energy Retention, Under Ground Shelter cage and Battery cage.

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INTRODUCTION

Rabbit is an ideal small livestock enterprise for rural area, especially in developing countries. These are due to the fact that rabbit husbandry has some advantages that are prolific and relatively odorless and need less space. Based on economic considerations, several developing countries have chosen rabbit as a source of animal protein to provide animal protein needs of the community (Mailafia *et al.*, 2010). Rabbit production in hot climate regions has some problems such as heat stress, could not utilize high lignin containing feed, diseases and parasites and among these, heat stress is the most important factor (McNitt *et al.*, 1996).

The energy and protein content of the diet play a vital role in rabbit nutrition (McNitt *et al.*, 1996). However, nutrient requirement of the rabbit will affected by temperature and humidity of the cages. At lower temperature than Thermo Neutral Zone (TNZ) Metabolic Energy (ME) was converted directly into sensible heat while at high temperature than TNZ energy is lost as work through physiological process such as increased pulse rate, rectal and skin temperature, respiration rate and gasping. This energy loss reduced the overall efficiency of nutrient utilization for production and increase heat output for energy maintenance. A combination of high temperature and humidity is very stressfully to most rabbit and affects energy and protein retention in the body of the rabbit (Prasad *et al.*, 1996). Current experiment was carried out undertakes to study and provide additional information for rabbit husbandry particularly, on microclimate and energy retention on local rabbit housed at different cages and offered diets with different energy and protein level in lowland tropical regions.

MATERIAL AND METHODS

Rabbit

Sixty four male of five weeks old domestic rabbits, with nearly equal live body weight (189, 25 ± 1,54g) was used in this experiment. Thirty two housed in underground shelter cages and another thirty two in battery cages. Each cage was provided with feed and water trough. The battery cage size was 70 × 50 cm wide, with 45 cm height and placed 75 cm above the ground. While those housed underground shelter has similar size than those house in battery cage.

Feed and Water

Feed were formulated using a mixture of yellow corn, rice bran, palm waste, fish meal, soy bean meal, cassava, elephant grass, copra meal, wood saws, bone meal and mineral mix and were made in the pellets form. Feed containing 2200 kcal ME kg^{-1} and 14.00% CP, 2400 kcal ME kg^{-1} and 15, 50% CP, 2600 kcal ME kg^{-1} and 17, 00% CP, 2800 kcal ME kg^{-1} and 17, 50% CP as R1, R2, R3, R4 respect ply. During the experiment feed and water were provided *ad libitum*, feed and water intake were recorded daily.

Body Composition

The estimation of energy and protein requirement of local male rabbits was using body composition method (Fernandez and Fraga, 1996). Briefly, the rabbit samples were taken at 17 week old, then being killed.

The fresh body from each treatment was chopped, ground using meat grinder, than the ground meat mixed thoroughly. Four samples from each treatment taken for calorie and protein determination. Energy content of the carcass was determined used bomb calorimeter and Kejelidhal apparatus for protein determination. Energy and protein concentration of diets, feces and empty bodies was measured with adiabatic bomb calorimeter (Xiccato *et al.*, 1999).

Design of the experiment and statistical analysis

A split-plot design consisted of two main treatments: underground shelter (K0) and battery housing systems (K1) and four different energy and protein diets with four replications each was used in this experiment. K0 and K1 was used as the main plot whereas, the sub plot are the diets with different energy and protein contents (R) consisting of diets containing 2201.15 kcal ME/kg and 14.03% CP (R1), 2402.17 kcal ME/ kg and 15.50% CP (R2), 2603.45 kcal ME/kg and 17.01% CP (R3), 2801.81 kcal ME/kg and 18.50% CP (R4). All data were recorded, tabulated, and analyzed using analysis of variance. Whenever significantly differences among treatment were found, analysis will be continued using Duncan's Multiple Range Test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Table 1 showed that temperature and humidity in cage K1 was higher ($P < 0.05$) than cage K2, however those two different cages did not give significant effect to the solar radiation intensity, minimum and maximum temperature inside the cage. In this experiment, the battery cage (K1) was placed on stage about 75 cm from the ground surface and this condition makes the battery cage received higher long-wave radiation (heat) than the underground shelter cage (K0) so temperature and humidity in K1 cage higher ($P<0.05$) than K0 cage. Similar trend was reported by Lean and Rin (1996), that more long-wave radiation received by an object made higher object temperature. There was no significant difference ($P> 0.05$) of solar radiation intensity in different cages, indicating that temperature differences between underground shelter and battery cage is not a reflection of differences in solar radiation intensity. The maximum temperature in cage K1 was higher than cage K0 (31.29 °C vs. 30.97 °C). Probably, effect of the distance between floor cage with roof made less long-wave radiation from roof materials. The position of K1 cage was higher than cage K0, causing maximum temperature in cage K1 was higher than cage K0. Table 1 also showed that minimum temperature at cage K1 was lower than cage K0 (21.85 ° C vs. 21.96 ° C).

Rozari (1987) stated that greater surface friction occurred was affected by distance between the wind flows to the soil surface, as a results friction caused surface wind flow rate decreases. Diets with different protein and energy content did not influence the air temperature in the rabbit house. Metabolic heat produced, by the rabbit consumed diet contained different energy and protein did not affect the air temperature (Table 2). Similarly, McNitt *et al.* (1996) reported that higher energy and protein consumption produced higher metabolic heat on rabbits.

Cage ventilation caused air movement well so the difference of heat from metabolic rate differences not accumulated and affecting the air temperature. Table 2 also showed that dietary treatments did not give significant effect on solar radiation intensity and air temperature in the cage so air temperature in cage where rabbit fed diets R1, R2, R3 and R4 were similar.

Table 1. Microclimate and Energy Retention of Rabbits Housed at Under Ground Shelter and Battery.

Variable	Treatment		
	K0	K1	SEM
Effect of Different Cages on Microclimate			
Temperature Humidity Index (THI)	26.17[b]	28.59[a]	0.12
The intensity of solar radiation (lc)	6.49[a]	5.86[a]	0.94
Effect of Different Cages on Energy Retention			
Energy Consumption (kcal d^{-1})	252.23[a]	270.72[a]	16.29
Energy in Feces (kcal d^{-1})	67.50[a]	64.12[a]	6.81
Digestible Energy (kcal d^{-1})	184.73[a]	206.59[a]	7.66
Metabolizable Energy (kcal d^{-1})	175.49[a]	196.26[a]	2.74
Retained Energy (kcal d^{-1})	50.58[a]	37.40[b]	0.23
Heat Production (kcal $W^{0.75}d^{-1}$)	85.51[a]	120.68[a]	2.60
ME Consumption/gain (kcal/g gain)	10.11[a]	13.13[b]	1.3
Effect of Different Cages on Protein Retention			
Protein Consumption (g d^{-1})	10.60[a]	11.09[a]	0.48
Protein in Fecal (g d^{-1})	2.42[a]	2.45[a]	0.10
Digestible Protein (g d^{-1})	8.18[a]	8.64[a]	0.38
RetainedProtein (g d^{-1})	3.93 [a]	2.72[a]	0.2
Weight gain (g d^{-1})	15.84[a]	14.92[a]	1.29
Effect of Different Cages on Digestibility			
Dry Matter Digestibility (%)	68.33[a]	68.70[a]	1.42
Energy Digestibility (%)	72.76[a]	76.58[a]	0.62
Protein Digestibility (%)	78.33[a]	78.27[a]	0.41

1) K0: Under Ground Shelter Cage
   K1: Battery Cage
2) Value with same superscripts in the same row indicating no significant difference (P> 0.05)
3) SEM: Standard Error of the Treatment Means

Table 2. Micro Climates and Nutrient Retention by Rabbit Offered Diets with Energy and Protein Different.

Variable	Treatment				
	R1	R2	R3	R4	SEM
Effect of Different Diets on Microclimate					
Temperature Humidity Index (THI)	26,92^{a}	26,92^{a}	26,99^{a}	26,89^{a}	0,06
The intensity of solar radiation (fc)	6,94^{a}	4,51^{a}	6,06^{a}	7,19^{a}	1,79
Effect of Different Diets on Energy Retention					
Energy consumption (kcal d^{-1})	212,77^{c}	248,92^{b}	286,53^{a}	297,68^{a}	10,42
Fecal Energy (kcal d^{-1})	57,30^{b}	61,16^{a}	63,53^{ab}	81,27^{a}	0,79
Digestible Energy (kcal d^{-1})	155,47^{c}	187,76^{b}	223,00^{a}	216,41^{a}	7,66
Metabolizable Energy (kcal d^{-1})	147,7^{c}	178,37^{b}	211,85^{a}	205,56^{a}	6,13
Retained Energy (kcal d^{-1})	31,63^{b}	35,64^{b}	60,05^{a}	48,65^{a}	3,59
Heat Production (HP) kcal$W^{0,75}d^{-1}$)	106,86^{a}	111,75^{a}	89,12^{a}	104,64^{a}	9,44
ME Consumption /gain (kcal/g gain)	12,84^{a}	12,37^{a}	9,99^{a}	11,28^{a}	1,8
Effect of Different Diets on Protein Retention					
Protein Consumption (g d^{-1})	7,92^{d}	10,26^{c}	11,78^{b}	13,45^{a}	0,44
Fecal Protein Feses (g d^{-1})	2,01^{a}	2,12^{a}	3,05^{a}	2,60^{a}	0,64
Digestible Protein (g d^{-1})	5,91^{c}	8,14b^{b}	8,73b^{b}	10,85a^{a}	3,21
Retained Protein (g d^{-1})	2,05^{b}	2,68^{b}	4,70^{a}	3,8^{b}	0,15
Weight gain (g d^{-1})	11.33^{c}	14.14^{b}	18.95^{a}	17.06^{a}	0,72
Effect of Different Diets on Digestibility					
Dry Matter Digestibility (%)	64,38^{a}	68,66^{a}	66,83^{a}	72,21^{a}	3,17
Energy Digestibility (%)	72,76^{a}	75,17^{a}	77,78^{a}	72,97^{a}	3,79
Protein Digestibility (%)	75,67^{a}	79,44^{a}	76,00^{a}	82,09^{a}	1,75

1) R1: Diet containing 2200 kcal ME/kg and 14,00% crude protein
   R2: Diet containing 2400 kcal ME/kg and 15,50% crude protein
   R3: Diet containing 2600 kcal ME/kg and 17,00% crude protein
   R4: Diet containing 2800 kcal ME/kg and 18,50% crude protein
2) Value with same superscripts in the same row indicate no significant difference (P> 0.05)
3) SEM: Standard Error of the Treatment Means

Underground shelters and the battery cages did not have any significant affect (P> 0.05) on total energy intake, digestible energy (DE), metabolizable energy (ME) as shown in Table 1. Different cage did not cause large differences in temperature (1.59 °C) so there was no heat stress experienced by the rabbit, and this condition causing no differences in gross energy consumption, DE and ME. Rabbit offered diet R3 and R4 consumed energy 297,68 kcal d^{-1} and 286,53 kcal d^{-1} respectively and this was higher (P<0,05) than those R2 and R1 which was 248,92 kcal d^{-1} and 212,77 kcal d^{-1} respectively (Table 2). Result of this study was in agreement with the report of Prasad *et al.* (1996) that the new zealand white rabbits given a diet containing 2585 kcal DE kg^{-1} and 16% CP, 2778 kcal DE kg^{-1} and 20% CP, 3034 kcal DE kg^{-1} and 22.70% CP consumed DE 296 kcal d^{-1}, 318 kcal d^{-1} and 287 kcal d^{-1} respectively. Table 1 also showed that energy retention in local rabbits weighing 1480 g at the age of 17 weeks is 43.99 kcal d^{-1}. The previous researchers, de Blas and Wiseman (1998) reported that the New Zealand white rabbits weighing 2400 g at 12 weeks had energy retention 84.69 kcal d^{-1}. These differences probably due to the difference of body weight, strain and age of rabbits. This in line with the report of Adu *et al.* (2010) who found that New Zealand white rabbits grew faster than the local rabbit. Energy Retention of the rabbits housed in cages K0 was higher than those in K1 (50.58 kcal d^{-1} vs. 37.40 kcal d^{-1}). K0 cage had temperature and humidity lower than K1, indicating that rabbit in cage K0 were more comfortable than those in cages K1. The more comfortable conditions of K0 cage caused the heat production of the rabbit in cage K0 lower than cage K1 (85.51 kcal $W^{0.75}d^{-1}$ vs. 120 kcal $W^{0.75}d^{-1}$). This calculation data in this study showed that the energy need to be maintained in cage K0 less than K1 (70.79 kcal $W^{0.75}d^{-1}$ vs. 109.35 kcal $W^{0.75}$ d^{-1}) so rabbits maintained in cages K0 had higher energy retention than those in K1. A linear regression between Metabolizable Energy (MEi, kcal $W^{0.75}d^{-1}$) intake and Retained Energy (RE) of local rabbit in underground shelter (K0) was obtained (equation 1), using 32 animals.

RE = -10.98 + 0.324 MEi, r = 0,72..(1)

The regression equation showed that when the rabbit is not growing (RE = 0) metabolizable energy requirements for the rabbit housed in the cage K0 was 33.89 kcal $W^{0.75}d^{-1}$. Metabolizable energy requirement can be used to calculate basal metabolizable energy requirements. A similar regression to equation (1) was also used to determine between Metabolizable Energy (MEi, kcal $W^{0.75}d^{-1}$) intake and Retained Energy (RE) of local rabbit in battery cage (K1).

At cage (K1), the relationship between metabolizable energy intakes with energy retention is described by the regression equation (2).

RE = -91.26 + 0.655 MEi, r = 0,73...(2)

This indicates that when rabbit is not growing (RE = 0) metabolizable energy requirements was 139.33 kcal $W^{0.75}d^{-1}$. Calculation on basal metabolizable energy of rabbit in cage K 1 was higher than those rabbit in K0. Maintenance energy requirement of rabbits that housed in cages K1 were higher than those in cage K0. (109.35 kcal$W^{0.75}d^{-1}$ vs 70.79 kcal$W^{0.75}d^{-1}$) so that the basal metabolizable energy needed for the rabbits in cage K1 was higher than cage K0.

CONCLUSION

Micro-climatic conditions on the underground shelter was more comfortable than the battery cage but diets with different energy and protein level did not give significant effect (P>0,05) on micro-climatic parameters measured. Rabbits housed in underground shelter had higher energy retention than those in the battery (50 kcal d^{-1} vs. 37.40 kcal d^{-1}). Energy retention by rabbits given diets containing 2600 kcal ME kg^{-1} and 17% CP (R3) , 2800 kcal ME kg^{-1} and 18.50% CP (R4) were higher than those diets containing 2400 kcal ME kg^{-1} and 15.50% CP (R2) and 2200 kcal ME kg^{-1} with 14% CP (R1).

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REFERENCES

Adu, O.A., A. Akinfemi, and O.A. Adebiyi, 2010. Effect of varied levels of dietary copper on performance and blood chemistry of growing female rabbits. *Tropical and Subtropical Agro ecosystems, 12 (2010): 313-319.*

Alhaidary, A., H.E. Mohamed and A.C. Beynen. 2010. Impact of dietary fat type and amount on growth performance and serum cholesterol in rabbits. *American Journal of Animal and Sciences 5(1): 60-64.*

AOAC. 1990. Official methods of analysis (15th Ed). *Association of Official Analytical Chemists, Arlington, VA.*

De Blass, C. and J. Wiseman 1998. The nutrition of the rabbit. *CABI Publishinr. University of Nottingham. Nottingham.*

Fernandez, C. and M.J. Fraga. 1996. Effect of fat inclusion in diet for rabbits on the efficiency of digestible energy and protein utilization. World Rabbit Science 4(1), 19-23.

Lean, J., D. Rin. 1996. The sun and climate. *Available at: http://grico.org/CONSEQUENCES/winter 96/index.html. Accessed 24 Juli 2010.*

Mailafia, S., M.M. Onakpa and O.E. Oweleke. 2010. Problem and prospect of rabbit production in Nigeria – a review. *Journal of Pure and Applied Sciences, 3(2): 20 – 25.*

Mc Nitt, J.I., N.M. Nephi, S.D. Lukefahr and P.R. Cheeke. 1996. Rabbit Production. *Interstate Publishers, Inc.U.S.A.*

Prasad, R., S.A. Karim and B.C. Patnayak. 1996. Growth Performance of Broiler Rabbits Maintained on Diets with Varying Levels of Energy and Protein. World Rabbit Science 1996, 4(2), 75-78.

Rozari, Mr. B.I. de. 1987. Microclimate. *Training Materials Lecturer of State West Indonesia Agro climatology topic . IPB ,Bogor.*

Steel, R.G.D. and J.H. Torrie 1980. Principles and procedures of statistics. A biometric approach, second edition. *Translated by Sumantri. Gramedia. Jakarta.*

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