Nigerian J. Anim. Sci. 2019, 21 (2): 85-92

Some factors influencing the physiological parameters of greater grasscutter (Thryonomys swinderianus) in the rainforest ecological zone of Nigeria

***Boluwaji O.V.[1], Amusa R.F.[2], Ola S.I.[2]**

[1] *Department of Animal Production and Health, Federal University, Oye-Ekiti, Ekiti State*
[2] *Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife, Osun State*

****Corresponding Author:** oluwapelumi.adameji@fuoye.edu.ng* ***Phone number:** 08166370218*

***Target Audience:** Grasscutter producers, Animal science lecturers and students*

Abstract

The study was conducted to determine the effects of sex, body weight, time of the day and temperature-humidity index (THI) on the rectal temperature and respiratory rate of greater grasscutters. The study was carried out in the grasscutter unit of the Obafemi Awolowo University Teaching and Research Farm, for 6-weeks, using fourteen apparently healthy grasscutters. The rectal temperature and respiratory rate of each animal were measured daily using a digital clinical thermometer and a stopwatch respectively. These measurements were taken at different alternating times each day. The exact hours of measurement were 8.00 - 9.00 hrs for mornings, 12.00 - 13.00 hrs for afternoons and 17.00 - 18.00 hrs for evenings. The results showed that there was no significant difference (P>0.05) between the rectal temperature of male and female, 37.08±0.05 °C and 36.94±0.06 °C, as well as the respiratory rate, 143.98±1.06 counts/min and 142.62±1.50 counts/min, respectively. The results also indicated that the weight of the grasscutters had no effect on the rectal temperature but rather on the respiratory rate. The average rectal temperature was lower in the morning than afternoon and evening (P<0.05), while there was no significant difference in respiratory rates of the grasscutters between the morning, afternoon and evening periods. Also, rectal temperature increased as THI increased, while there was no effect of THI on respiratory rate. It was concluded that there is no difference in rectal temperature and respiratory rates of the male and the female grasscutters, the weight of the grasscutter did not influence the rectal temperature of the grasscutter, though influenced the respiratory rate. The time of the day and the THI did not influence the respiratory rate but had an effect on the rectal temperature.

***Keywords**:* Grasscutter; rectal temperature; respiratory rate; body weight; Temperature-Humidity Index; diurnal variation

Description of the Problem

The human population growth in developed countries is stabilizing while that of developing countries such as Nigeria is still increasing rapidly (8). Economic indices indicate that as this population trend continues, more people are to be fed. Thus, the search for alternative sources of protein to meet the population challenge is imperative (8). It is evident in Nigeria today that the average citizen does not meet the protein requirements for humans. In order to maximize food production and meet protein requirements in Nigeria, there is still the need to develop other sources of acceptable meat in addition to conventional sources (14). Among such alternatives are rodents such as grasscutters which possess a number of features that might

be of advantage in the small holder subsistence integrated farming in developing countries.

The grasscutter (*Thryonomys swinderianus),* also known as cane rat or cutting grass, is a hystricomorph rodent found currently only in Africa (2). The grasscutter is widely distributed and exploited in most areas south of the Sahara, particularly West Africa (10). They are eaten in some African countries and are the most preferred and perhaps the most expensive meat in West Africa (5,10). The grasscutter meat accounts for the greater proportion of bush meat sold in most of sub-Sahara Africa, particularly West Africa where they are hunted aggressively (10). There is no religious edict on the consumption of the meat.

The high demand for grasscutter meat and the economic benefit that accrues from its sale has encouraged its domestication to make it more readily available and also reduce the environmental destruction that accompanies its hunting from the wild (10,11). Other justifications for its domestication include the fact that the grasscutter does not require an extensive area to function and that it can be easily fed any agricultural by products available as it does not require imported raw material inputs to succeed. Grasscutter has a high litter size, producing up to 4 -12 kits per litter and can litter twice in a year, with a low mortality rate of about 10% among its offspring (1). Its excretory wastes do not have offensive odour, thus making it suitable for rearing in homestead and kitchens in rural areas.

There is paucity of information on the normal physiological parameters of grasscutters under captivity and factors affecting rectal temperature and the respiratory rates of grasscutters. This study therefore aims to provide information on the thermo-respiratory physiology of grasscutter, specifically, the effects of sex, body weight, time of the day and temperature-humidity index (THI) on the rectal temperature and respiratory rate.

Materials and Methods

Site of study and study animals

The study was carried out over a period of 6 weeks, between the months of April and May, at the grasscutter unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile Ife, Nigeria. A total of 5 colonies of grasscutters were used for the study. Each colony consisted of a male and two female grasscutters except for one colony without a male grasscutter. Thus, a total of 14 animals were used for the study. The grasscutters were about 11 months old. The males were generally bigger (2.23 kg) than the female animals (1.56 kg).

The grasscutters were housed in an indoor pit pen (1m x 1m x 0.7m) made of plastered concrete blocks and covered on top by wire netting door. Each colony was housed in a pen made up of two pit cages linked together like a room and parlour for easy movement of the animals. Wooden slabs were placed on the floor of each cage to serve as insulation against cold and also to prevent contact with faeces. The animals were always provided with food and water. The grassscutters were fed rodent pellets (crude protein 18%, metabolizable energy 2450 kcal/kg) and grasses, which included elephant grass *(Pennisetum purpureum)* and guinea grass *(Panicum maximum).* Sometimes the grasscutters were fed sweet potato tubers. Water was also offered to the grasscutters ad libitum. The grasscutter pens were swept cleaned daily and the feed and water troughs were also washed daily.

Data Collection

Each animal was daily placed in a restrainer cage and hung on a standard weighing balance after which the weight was usually taken. The rectal temperature of each animal was measured daily using a digital clinical thermometer calibrated at degrees centigrade. The tip of the thermometer was

inserted into the rectum of the grasscutters at approximately 3cm for 1 minute and the temperature measurements were always taken at different times each day, that is, morning for day 1, afternoon for day 2, evening for day 3, morning for day 4 up till 42 days. The exact hours of measurement were 8-9.00 hrs for mornings, 12-13.00 hrs for afternoons and 17-18.00 hrs for evenings.

The respiratory rate of each animal was also determined alongside by visually counting the movement of the flanks and a stopwatch was used to get the accurate flank movement for 15 seconds. This measurement was done when the animal was sitting quietly and breathing regularly.

The ambient temperature and relative humidity, as well as the pit temperature and pit relative humidity were also measured once daily, alternating between mornings (8.00 - 9.00 hrs), afternoons (12.00 - 13.00 hrs) and evenings (17,00 - 18.00 hrs) for each day. All the measurements lasted for 6 weeks. Data gotten for temperature and relative humidity were used to develop an index (THI) for measuring the thermal comfort level for the grasscutters. It was measured according to the following equation, as developed by (9).

THI= t [(0.31-0.31RH) (t-14.4)]

Where t°C = dry bulb temperature in degrees Celsius, and RH = RH percentage/100.

Data Analysis

Analysis of variance (ANOVA) test was used to examine the effect of sex, time of the day, body weight and THI on rectal temperature and respiratory rate of grasscutters. Correlation analyses was also carried out between the environmental measurements and the animal physiological variables. The experimental data are expressed as mean values ±standard error of mean. The separation of means was done by Duncan Multiple Range Test. The analyses were carried out using the Statistical Package for Social Sciences (SPSS), version 16.

Results

Table 1 indicates that there was a significant difference between the relative humidity of the pens in the morning, afternoon and evening ($P<0.05$). The relative humidity of the pens was higher in the morning, lower in the afternoon and lowest in the evening. The temperature of the pens was however lower in the morning than in the afternoon and evening. The table also shows that the THI was lower in the morning than in the afternoon and evening.

Table 1: Diurnal Variation in Relative Humidity, Ambient Temperature and Temperature-Humidity index of the Greater Grasscutter Pens

	Morning	Afternoon	Evening	P-value
Relative humidity (%)	78.188^{c}±0.39	73.159^{b}±0.52	70.578^{a}±0.50	0.000
Temperature (°C)	27.375^{a}±0.13	29.722^{b}±0.16	29.836^{b} ±0.16	0.000
THI	30.209^{a}±0.16	32.876^{b}±0.19	32.894^{b} ±0.19	0.000

$^{a\ b}$Means (±SEM) within the same row with different superscripts are significantly different ($P<0.05$)

Table 2 shows the mean rectal temperature and respiratory rate of greater grasscutters as influenced by sex, body weight and time of the day. It shows that there was no significant difference ($P>0.05$) between the mean rectal temperature and respiratory rate of the male and female grasscutters. Body weight also had no significant effect on the rectal temperature of the different weight ranges of the grasscutters but respiratory rates was higher in bigger (1.51 - 2.6 kg) grasscutters. There was no significant difference in the rectal

temperature of the grasscutter between afternoon and evening periods, although rectal temperature was lower in the morning period. The respiratory rate of the animals was not different between these time periods.

Table 2: Mean Rectal Temperature and Respiratory Rate of Greater Grasscutters as determined by sex, body weight and time of the day.

Factor	Rectal Temperature (°C)	Respiratory rate (counts/minute)
Sex		
Male	37.08^{a}±0.05	143.98^{a}±1.06
Female	36.94^{a}±0.06	142.62^{a}±1.50
P value	0.092	0.478
Body Weight		
0.70 – 1.50 kg	36.92^{a}±0.06	137.31^{b}±1.42
1.51- 2.60 kg	37.02^{a}±0.05	146.35^{a}±1.06
P-value	0.212	0.000
Time of the day		
Morning	36.69^{a} ± 0.07	142.42^{a}±1.43
Afternoon	37.16^{b}±0.06	142.77^{a}±1.51
Evening	37.12 ^{b}±0.05	143.97^{a}±1.57
P value	0.00	0.75

Table 3 shows the correlation between the environmental variables and the physiological variables in greater grasscutters. According to the table, there was no correlation between weight and rectal temperature while there was a low positive correlation between weight and respiratory rate. The Table also indicates that there was a positive correlation between the rectal temperature of the grasscutters and temperature of the pens, there was a negative correlation between rectal temperature of the grasscutters and the relative humidity of the pens and there was a positive correlation between the rectal temperature of the grasscutters and the THI. This implies that the higher the relative humidity of the pens, the lower the temperature of the pens, the lower the THI and the lower the rectal temperature of the animal. Also, the lower the relative humidity of the pens, the higher the temperature of the pens, the higher the THI and the higher the rectal temperature of the animals.

Results indicated that there was no correlation between the respiratory rates of grasscutters and the temperature, the relative humidity of the pens and the THI. This confirms that the respiratory rate of the greater grasscutters is not significantly affected by the time of the day.

Table 3: Correlation between environmental variables and physiological variables in Greater Grasscutters

	Rectal Temperature		**Respiratory rate**	
	Pearson Correlation	Sig. (2-tailed)	Pearson Correlation	Sig. (2-tailed)
Body weight	0.029	0.493	0.189	0.000
Ambient Temperature	0.295	0.000	0.067	0.346
Relative Humidity	-0.188	0.008	-0.126	0.075
THI	0.298	0.000	0.056	0.435

Discussion

The results indicated no difference between the rectal temperature and respiratory rate of male and female greater grasscutters. The reason could be due to the fact that similar metabolic activities and reactions take place in male and female animals that are of similar age ranges, that is, the thermoregulatory mechanism and the breathing mechanism of the body of both male and female animals that are of the same age range is alike. Similar results were observed with West African dwarf goats, where it was also reported that sex did not significantly influence rectal temperature and respiratory rate (3, 6). Similar results were also obtained by (16) where they found that sex of rabbits had no significant effects on the rectal temperature of the animals, though respiratory rates were significantly affected by their sex.

Results of this study also showed that body weight has no effect on rectal temperature but has an effect on respiratory rate, with bigger grasscutters having higher respiratory rates. It would have been expected that body weight would have no effect on respiratory rate, since all the male grasscutters fell into the category of the heavy grasscutters. However, there is no interaction between body weight and sex of grasscutters, as some of the female grasscutters also fell into the category of heavy grasscutters, Results of study on West African dwarf goats conducted by (6) also showed that body weight had no effect on rectal temperature and respiratory rate, as kids and adult goats had similar ranges. Generally, respiratory rate is higher in smaller animals than in bigger animals. The higher respiratory rate in bigger grasscutters could be as a result of the aggressiveness of the bigger grasscutters compared to the smaller grasscutters at the time of measurement of the respiratory rate, as psychological factors such as aggressiveness, excitedness etc. leads to an elevated respiratory rate. A report from (18) also observed that respiratory rate was affected by the body size of an animal.

There was a significant difference in the rectal temperature of the grasscutters based on the time of the day. The rectal temperature was lower in the morning and higher in the afternoon and in the evening. This could be as a result of the low temperature and high relative humidity of the pen in the morning. Studies on diurnal variation in temperature and humidity in a grasscutter pen by (20) showed that temperature in the afternoon was generally higher than in the morning and evening whereas relative humidity was much lower ($P<0.05$) in the afternoon than in the morning and evening. There is usually a diurnal variation in core body temperature of mammalian species (19) and this variation is always within a narrow range even if environmental fluctuation is high (17). This was clearly seen in the results of this study. Results of study conducted by (6) and (7) also showed that the rectal temperature of West African dwarf goats and African giant rats, respectively were higher in the evening, compared to the morning.

Results also showed that there was no significant difference between the respiratory rates of the grasscutters at the different periods of the day, that is, the respiratory rate of greater grasscutter was not affected by the time of the day. Most animals respond to hot environment by resulting to an increased respiratory rate but this is different in grasscutters in which the time of the day does not affect their respiratory rates. Results of study conducted by (6) showed that the respiratory rates of West African dwarf goats were higher in the evening, compared to the morning.

Also, there was a significant difference in the rectal temperature of the grasscutter, based on the THI, that is, as the THI increased in the afternoon and evening, the rectal temperature of the grasscutter also increased. The THI is an

indicator of thermal comfort level for animals in enclosure. The observed increased rectal temperature of the grasscutters from morning to evening, as THI increased could be attributed to heat stress. (12) reported that increase in rectal temperature is a good indicator to the level of heat stress upon the animal. The THI, however had no effect on the respiratory rate of the grasscutter, although (4) stated that respiratory rate can also be used as an indicator of heat stress. Similar results were obtained in experiment carried out by (15) on the effects of heat stress on physiological parameters of West African Dwarf Goat. The result showed that rectal temperature increased as THI increased.

This study is very important as these physiological parameters; rectal temperature and respiratory rate are used as an indicative of health or diseases in animals, and are yet to be determined in greater grasscutters. With fever and hyperthermia, the body's core temperature rises to a higher temperature, hence, the animal has a high rectal temperature. A higher rectal temperature in the morning and a lower rectal temperature in the afternoon and evening can be indication of fever and hyperthermia, and a sudden rise in rectal temperature can be an indication of heat stress, and should be appropriately managed by the animal producer. Extreme heat can have a profound effect on productivity, especially if the onset of heat is sudden, not giving livestock ample time to adapt. Prolonged high temperatures can impair reproduction. High rectal temperature can also be detrimental to embryo survival and fetal development and heat stress lowers the natural immunity of animals, making them more susceptible to disease.

Conclusion and Applications

The study showed that in Grasscutter,

1. There is no difference in rectal temperature and respiratory rates of the male and the female of similar ages.
2. The weight of the grasscutter did not influence the rectal temperature of the grasscutter, though the weight influenced the respiratory rate of the animal as heavier greater grasscutter had a higher respiratory rate.
3. The time of the day had no effect on the respiratory rate, though it had an effect on the rectal temperature.
4. THI had no effect on respiratory rate, though it had an effect on the rectal temperature.

References

1. Addo, P.G, Awumbila, B., Awotwi, E. and Ankrah, N-A (2007): Reproductive characteristics of the female grasscutter (Thryonomys swinderianus) and formulation of colony breeding strategies. *Livestock Research for Rural Development*. 19:59.
2. Adoun, C. (1993). Place De l'aulacode (*Thryonomysswinderianus*) Dans Le Regne Animal Et Sa Repartition Geographique in: Schrage R and Yewadan L T (editors), 1ère Conférence Internationale sur l'aulacodiculture: *Acquuis et Perspectives.* 35-40.
3. Adedeji, T.A. (2012). Effect of some qualitative traits and non-genetic factors on heat tolerance attributes of extensively reared West African Dwarf (WAD) goats. *International Journal of Applied Agriculture and Apiculture Research*. 8: 68-81.
4. Al-Haidary, A.A., Aljumaah, R.S., Alshaikh, M.A., Abdoun, K.A., Samara, E.M., Okah, A.B. and Aluraiji, M.M. (2012). Thermoregulatory and physiological responses of Najdi sheep exposed to environmental heat load prevailing in Saudi Arabia. *Pakistan Veterinary Journal*. 32(4):515–519.

5. Asibey E.O.A. and Addo P.G. (2000). The grasscutter, a promising animal for meat production. In: African perspectives. Practices and policies supporting sustainable development (Turnham D ed.) Scandinavian Seminar College, Denmark, in association with Weaver Press, Harare, Zimbabwe.
6. Bello, S.A, Akintunde O.G., Sonibare A.O. and Otesile E.B. (2016). Effect of Sex, Age and Time of the Day on Vital Parameters of Apparently Healthy West African Dwarf Goats in Abeokuta, Nigeria. *Alexandria Journal for Veterinary Sciences*. 49.
7. Dzenda, T., Ayo, J.O., Lakpini, C.A.M. and Adelaiye, A.B. (2011). Diurnal, seasonal and sex variations in rectal temperature of African Giant rats (Cricetomys gambianus, Waterhouse). *Journal of Thermal Biology*. 36:255–263.
8. Mailafia, S., Onakpa, M.M. and Owoleke, O.E. (2010). Problems and prospects of rabbit production in Nigeria - A review. *Bayero Journal of Pure and Applied Science.* 3:20-25.
9. Marai, I.F.M., Ayyat, M.S. and Abdel-Monem, U.M. (2001). Growth performance and reproductive traits at first parity of New Zealand White female rabbis as affected by heat stress and its alleviation under Egyptian condition. *Tropical Animal Health and Production.* 33:451-462.
10. National Research Council (1991). Micolivestock- Little Known Small Animals with a Promising Economic Future. National Academy Press, Washington, DC. 147-155.
11. Ntiamoa-Baidu Y. (1998). Wildlife Development Plan 1998-2003: Sustainable Use of Bush meat. Commissioned by Wildlife Department, Accra. Ministry of Lands and Forestry.
12. Okoikhian, C.S.O., Ovheruata, J.A., Imasuen, J.A. and Akporhuarho, O.P. (2009). Physiological Response of Local (West African Dwarf) And Adapted Switzerland (White Bornu) Goat Breed to Varied Climatic Conditions in South South Nigeria. *African Journal of General Agriculture.* 5:1–6.
13. Okoruwa M.I. (2014). Effect of Heat Stress on Thermoregulatory, Live Bodyweight and Physiological Responses of Dwarf Goats in Southern Nigeria. *European Scientific Journal*. 10:27.
14. Owen O.J., Alawa, J.P., Wehke S.N., Isirimah N.O., Chukuigwe E.C., Aniebo A.O., Ngodigha E.M. and Amakiri A.O. (2008): Incorporating poultry litter in animal feed: a solid waste management strategy. *Egyptian Journal of Animal Production* (In press).
15. Popoola M.A., Bolarinwa M.O., Yahaya M.O., Adebisi G. L. and Saka A.A. (2014). Thermal Comfort Effects on Physiological Adaptations and Growth Performance of West African Dwarf Goats Raised in Nigeria. *European Scientific Journal Special edition.* 3:275-281.
16. Popoola, M.A., Oseni S.O. and Ajayi. B.A. (2014). Evaluation of Heat Tolerance of Heterogeneous Rabbit Population Raised in Southwestern Nigeria. *Global Journal of Animal Scientific Research.* 2(3): 205-209.
17. Radostits, O.M., Gay, C.C., Hinchcliff, K.W. and Constable, P.D. (2007). Clinical examination and making a diagnosis. In Veterinary Medicine: A Textbook of the diseases of cattle, horses, sheep, pigs and goats. 10th Edition. Elsevier Ltd., Philadelphia, USA. 10-14.

18. West Virginia University. (2010). Unit 1. Lesson III: Body temperature, pulse and respiratory rate. 16-20.
19. White, S. (2002). Alterations in body temperature. In: Large animal internal medicine. 3rd Edition, Edited by B. P. Smith, Copyright: Mosby, Inc., St Louis, Missouri, USA. 36-39.
20. Willams, O.S., Ola S.I., Boladuro B.A and Badmus R.T. (2011). Diurnal variation in ambient temperature and humidity in a pit pen grasscutter (*Thryonomys swinderianus*) house in Ile-Ife, 111-113. In: Value reorientation in animal production: a key to national food security and stable economy. Proceedings of the 36th annual conference of the Nigerian Society of Animal Production, 13-16 March, 2011. 804.