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Evaluation of Heat Tolerance of Heterogeneous Rabbit Population Raised in Southwestern Nigeria

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ABSTRACT

The study was conducted to evaluate heat tolerance of heterogeneous rabbit population raised in Southwestern Nigeria. Eighty-eight rabbits (fifty-four adult does, fifteen adult bucks and nineteen growers) were used for the study which was conducted during rain and dry seasons (early and late rain as well as early and late dry seasons). Ambient temperature and relative humidity were monitored across these seasons using dry bulb thermometer and wet and dry hygrometer respectively. Physiological parameters (rectal temperature, respiratory rate and heart rate) to obtain categorical heat stress indices were taken on each animal. Data collected on physiological traits of the animals were analyzed using statistical analysis system. One-way analysis of variance (ANOVA) was performed to compare variations in physiological traits of the animals as influenced by season, sex, age and coat colour of the rabbits. Duncan's Multiple Range test was used to separate the means where significance was indicated. There were no significant effects ($p > 0.05$) of coat colour, age and sex of the animals on their rectal temperature. However, season of the year had significant effects on rectal temperature of the rabbits. The heart rate and respiratory rate of the animals were significantly affected ($p<0.05$) by coat colour, age, sex and season. The coat colour, age and sex of composite population of rabbits as well as seasons of production were adjudged to be important sources of variation in evaluating heat tolerance of the rabbits.

Keywords: Heterogenuos population, physiological traits season, tolerance.

INTRODUCTION

Domestic animals are homeotherms that tend to maintain a constant body temperature through a balance of heat gain or loss. Homeotherms have optimal temperature zones for production within which no additional energy above maintenance is expended to warm or cool the body (West, 2003). The environment surrounding an animal at any particular instant

influences the amount of heat exchange between it and the environment. Under humid tropical climatic conditions, high temperature and relative humidity are major environmental factors that result in heat stress which in turn influence the productivity and physiological development of animals. In such an environment, rabbits are susceptible to heat stress since they have few functional sweat glands and have difficulty in elimination of excess body heat (McNitt *et al*., 2000; Marai *et al*., 2002). Rabbits are highly prone to heat stress in arid and tropical environments where a tremendous potential exists for small-scale meat rabbit enterprises to alleviate hunger and poverty in lesser-developed countries (Jackson *et al*., 2008).

Stocks of rabbits used in many developing countries are composite or heterogeneous populations derived either from crosses between local breeds and exotic meat type, commercial rabbits or from crosses among exotic rabbit breeds (Lukefahr and Cheeke, 1991; Lukefahr, 2000). Heterogeneous stocks are the result of years of planned and unplanned crosses among different exotic (and / or local or indigenous) breeds of rabbits introduced to most developing nations by colonial settlers and Christian Missionaries, Lukefahr and Cheeke (1991) and more recently, by some agencies like the Heifer Project International, and the United State Agency for International Development (USAID) over fifty years ago. Hence this study sought to evaluation of heat tolerance of heterogeneous rabbits raised in Southwestern Nigeria

MATERIALS AND METHODS

The study was conducted at the Rabbit Unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria (Latitude 07^0 28^I N and Longitude 04^0 33^I E) . Based on the recordings of farm ambient temperature and relative humidity, the whole study period was divided into four seasons (early rain, late rain, early dry and late dry seasons) to compare parameters in normal and heat stress conditions. Temperature and relative humidity in the rabbitry were monitored across seasons (rain and dry) and across day periods (minimum temperature in the morning and maximum temperature in the afternoon) two to three days apart by dry bulb thermometer and wet and dry hygrometer respectively. As far as possible, these instruments were maintained in an empty cage to provide a record of the temperature and relative humidity experienced by the rabbits.

Rabbits for this study were a composite or heterogeneous population reared in Southwestern Nigeria that are products of non-specific crosses of New Zealand White, California, Chinchilla and Flemish giant (Somade and Adesina, 1990; Odubote *et al.*, 1995). A total of eighty-eight rabbits were used at the start of the experiment, their ages range from six months to one year with weight range of 1.0-2.9 kg comprising of fifty-four adult does, fifteen adult bucks and nineteen growers.

The cool part of the day for this study was considered to be 7:30 am, whilst the hot part of the day was determined by taking ambient temperature readings at an hour intervals from 7:30 am to 5:30 pm daily over three continuous days. The hot part of the day was found to be 1:30 pm.

Physiological parameters to obtain categorical heat stress indices were taken on each animal and these include; rectal temperature, respiratory rate and heart rate. These physiological parameters were measured two times a week to avoid undue stress to the animals. The rectal temperature was measured using a digital rectal thermometer inserted into the rectum and left in position till the thermometer gave beeping sound, thereafter the reading was taken. Respiration rate was recorded as the number of frequency of flank movements per 20 seconds and later was calculated as breaths / minute (Thwaites *et al*., 1990). Heart rate was also recorded as beats per seconds by placing the stethoscope on the chest of the rabbits to determine the rhythmic beats of the heart which was later calculated as beats / minute (Thwaites *et al*., 1990).

Data collected on physiological characteristics traits of the animals were analyzed using statistical analysis system (SAS, 2004). One-way analysis of variance (ANOVA) was performed to compare variations in physiological traits of the animals as influenced by season, sex, age and coat colour of the rabbits. Duncan's Multiple Range test was used to separate the means where significance was indicated. The summary statistics for climatic variations were also analysed within each season.

RESULTS AND DISCUSSION

Effects of coat colour on physiological traits of composite rabbits

There was no significant effect ($p > 0.05$) of coat colour on rectal temperature of composite rabbit population (Table 1). However, highest rectal temperature (39.63 ± 0.37^0C) was obtained in rabbits with white coat while the least was obtained in black and white rabbits (39.12 ± 0.08^0C). The result of this study is contrary to findings of some authors; Shafie *et al*. (1970) who reported significant differences between coat colour in heat tolerance of rabbits; Obeidah (1975) also reported estimated heritability for heat tolerance character of 0.12 for body temperature in young Giza white rabbits, implying that this trait is lowly heritable, and highly influenced by the environment. The heart rate of the rabbits was significantly affected ($p < 0.05$) by coat colour such that highest heart rate (163.60±8.37 beats/min) was obtained in brown rabbits and the lowest heart rate was obtained in black rabbits (125.45 ± 2.47 beats / min). This result agreed with result of Shafie *et al*. (1970) who reported that Baladi white rabbits had lower pulse rate than Baladi red rabbits. Also, the respiratory rates of these animals were significantly affected ($p < 0.05$) by their coat colour. Shafie *et al*. (1970) reported significant effects of coat colour on respiratory rate of Baladi rabbit.

Table 1. Effects of coat colour on physiological traits of composite rabbits

Traits	Coat colour			
	Black	White	Brown	Black and White
Rectal temperature (^{0}C)	39.27±0.07	39.63±0.37	39.40±0.29	39.12±0.08
Heart rate (beats/min)	125.45 ± 2.47^b	128.82 ± 1.33^b	163.60 ± 8.37^a	135.89 ± 1.50^b
Respiratory rate (breath/min)	93.67 ± 1.30^b	94.55 ± 0.74^b	108.40 ± 3.89^a	97.83 ± 1.50^b

Effects of age on physiological traits of composite rabbits

The age of the rabbits had no significant effects ($p>0.05$) on rectal temperature of the rabbits; however, growers had the highest rectal temperature, followed by the adult and the lowest rectal temperature was obtained in wearers. The results imply a trend for increasing heat tolerance as rabbits mature. This result disagreed with the reports of Cardiasis and Sinclair (1972) who reported significant differences ($P<0.05$) in body temperature adult and rabbit kits. Heart rate and respiratory rate of the animals were significantly affected ($p<0.05$) by their age (Table 2).

Table 2. Effects of age on physiological traits of composite rabbits

Traits	Age		
	Adult	Grower	Wearer
Rectal temperature (^{0}C)	39.67±0.32	38.89±0.07	39.25±0.11
Heart rate (beats / min)	133.82 ± 1.26^a	127.55 ± 2.42^a	94.24 ± 1.11^a
Respiratory rate (breath / min)	96.65 ± 0.67^a	94.72 ± 1.48^a	79.93 ± 1.04^b

Effects of sex on physiological traits of composite rabbits

Sex of the rabbits had no significant effects ($p>0.05$) on the rectal temperature of the animals. Contrarily, Johnson *et al*. (1957) reported sex difference with body temperature of rabbits. However, both heart rate and respiratory rate of the rabbits were significantly affected ($p<0.05$) by their sex.

Table 3. Effects of sex on physiological traits of composite rabbits

Traits	Sex	
	Doe	Buck
Rectal temperature (^{0}C)	39.51±0.32	39.37±0.06
Heart rate (beats / min)	132.94±1.27^a	120.94±1.94^b
Respiratory rate (breath / min)	96.84±0.71^a	90.25±0.98^a

Effects of season on physiological traits of composite rabbits

Seasons of the year had significant effects ($p<0.05$) on the physiological traits of these animals. The rectal temperature of the animals during the dry season differed from that of the rainy season. Frangiadaki *et al*. (2003) reported significant difference ($P<0.001$) in rectal temperature of rabbits in hot and cold seasons. Also, higher values of heart rate were recorded in dry season (late and early) which depict the hot-dry conditions. The result obtained in this study agreed with studies conducted on heat tolerance of chicken by Boa-Amponsem (1992) who reported that pulse rate is relatively less effective under hot-humid conditions as compared to hot-dry conditions. Similarly, the respiratory rate also differed with seasons. Frangiadaki *et al*. (2003) reported that respiration rate was highly affected by monthly air temperature changes due to the fact that respiratory rate is considered as one of the major physiological reactions which can keep body temperature within the normal range.

Table 4. Effects of season on physiological traits of composite rabbits

Traits	Season			
	Early Dry	Late Dry	Early Rain	Late Rain
Rectal temperature (^{0}C)	40.07±0.06^a	39.22±0.70^b	39.45±0.06^{ab}	39.41±0.06^{ab}
Heart rate (beats / min)	158.69±2.19^a	162.56±1.66^a	96.46±0.77^b	96.01±0.58^b
Respiratory rate (breath / min)	124.23±1.74^a	77.94±0.37^b	101.84±0.65^d	80.54±0.48^c

CONCLUSION

The coat colour, age and sex of composite population of rabbits as well as seasons of production were adjudged to be important sources of variation in evaluating heat tolerance of the rabbits.

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