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Impact of diurnal temperature - humidity index and sex on the physiological traits of weaner rabbits raised in the derived Savannah.

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ABSTRACT

A study was carried out to determine the effect of diurnal temperature - humidity index (THI) and sex on the physiological parameters of weaner rabbits raised in the derived Savannah zone of Nigeria. Twenty female and thirteen male rabbits were studied in the experiment. Air Temperature (AT) and Relative-Humidity (RH) were monitored with a thermohygrometer at two days interval for 7 weeks while THI was estimated from the recorded AT and RH. Physiological indices of the animals (Respiratory Rate (RR), Skin Temperature (ST), Ear Core Temperature (ECT) and Rectal Temperature (RT) were simultaneously monitored with AT and RH over the same duration. AT (28.19 - 33.29°C) and THI (25.34 - 28.93) contrary to RH (29.95 - 25.49%) were significantly higher ($p < 0.05$) in the afternoon compared to the morning though all the three differed significantly ($p < 0.05$) across the weeks. Similarly, RR, ST, ET and RT were higher in the afternoon and varied significantly ($p < 0.05$) among the weeks. Sex had no effect ($p > 0.05$) on the physiological response of the rabbits regardless of the period of the day. The study concluded that THI was higher in the afternoon and emphasis should be placed on the period of the day rather than sex in mitigation of heat stress in rabbits raised in the derived Savannah.

Keywords: Diurnal, Heat Stress, Temperature - Humidity Index, Physiological, Weaner Rabbits

INTRODUCTION

Rabbits are susceptible to heat stress because they have difficulty in eliminating excess body heat when the environmental temperature is high due to non-functional sweat glands (1). It is established that when growing rabbits are exposed to high Temperature Humidity Index, they suffer slow growth rates, reduction in resistance to diseases and impaired reproductive functions (2).

A significant part of Nigeria ecological zone including Ilorin metropolis is categorized as derived Savannah (3) and usually experience extended periods of high ambient temperature and lower rainfall compared to the rain forest (4). Since the interaction between environmental temperature and relative humidity depicted as Temperature - Humidity Index (THI) affects the welfare and productivity of the rabbit (5), understanding its influences on the physiology of the animal raised in the zone becomes critical. There is paucity of information on thermoregulatory reaction of rabbits to heat stress under the derived Savannah ecological zone of Nigeria where there is an increase in rabbit production.

The study was therefore focused on the thermophysiological responses of rabbit raised in Ilorin metropolis to ambient temperature under different relative humidity regime

Rabbit despite its prolificacy may be prone to heat stress in the derived Savannah due to the zone's relatively longer dry season and higher ambient temperature. However, differences in period of the day and sex of the animal might be effective in mitigating the lethal effect of heat stress.

MATERIALS AND METHODS

This study was carried out at Captain All Rabbit Farm, Oke Odo, Balogun area, Tanke off University Road, Ilorin, Kwara state. The experiment lasted for 7 weeks between January and February 2020 in the dry season. Thirty-three weaned rabbits aged 8 weeks old with an average weight of 0.7kg of mixed breed (comprising of New Zealand White, Californian, Chinchilla and Cottontail) were grouped into two based on sex. The rabbits were housed in a single tier conventional cage made with wood and wire mesh. The cages

have four compartments each and were large enough to accommodate three rabbits. The animals were acclimatized for 2 weeks before commencing the experiment. A thermohygrometer was used to take the ambient temperature (AT) and relative - humidity (RH) of the rabbit pen at 2 days interval. Readings were taken in the cool (7am - 9am) and hot (12 noon - 3pm) hours of the day at one hour intervals on alternate days for the entire duration of the experiment.

The respiratory rate (RR) was determined by observing the flank movement of the animals twice weekly at the two days interval for the entire 7 weeks of the study. Body temperature consisting of skin temperature (ST), Ear core temperature (ECT) and rectal temperature (RT) were also monitored simultaneously with the reading of the thermohygrometer by the use of clinical thermometer. Temperature - humidity index (THI) was calculated based on the equation of (6) from the recorded air temperature and relative-humidity.

$$THI = t - [(0.31 - 0.31 \times RH) (t - 14.4)]$$

RH = relative humidity (%), t = temperature (Degree Celsius).

THI values obtained in the experiment was categorized as observed for the tropics; <27.8 = absence of heat stress, 27.8-28.90 =

moderate heat stress, 28.90-30 = severe heat stress and above 30 = very severe heat stress (6)

Data Analysis

The collected data was compared between week, period and sex using multivariate analysis of the General Linear Method (GLM). Significant means were separated using Duncan Multiple Range Test. A computer software package of SPSS 21 was used for the statistical analysis.

RESULTS AND DISCUSSION

The air temperature (AT) recorded in the afternoon were significantly higher ($p < 0.05$) to those of the morning across the weeks (Table 1) similar to the observations of researchers in the rainforest of Nigeria (7). Contrary to AT the observed relative - humidity (RH) in the morning were significantly higher ($p < 0.05$) compared with RH to the afternoon (Table 1) which is comparable to the conclusions of (7). In addition, temperature humidity index THI values observed in the morning (23.34 - 26.89) showed absence of heat stress contrary to that of the afternoon (26.46 - 31.82) which indicated absence of heat stress to very severe heat stress based on the categorization of (6) across the weeks.

Table 1: Relative - humidity, air temperature and temperature - humidity index monitored during the experiment

		Week								
Parameters	Period	1	2	3	4	5	6	7	SEM±	Grand Mean
AT(°C)	Morning	27.13 ^{ab}	26.41 ^{ab}	28.12 ^a	30.22 ^c	29.03 ^{ab}	28.97 ^{ab}	27.46 ^b	0.28	28.19 ^a
	Afternoon	33.25 ^{ab}	34.06 ^{ab}	31.13 ^a	36.41 ^c	31.34 ^{ab}	31.71 ^{ab}	35.14 ^b	0.10	33.29 ^{a*}
RH(%)	Morning	24.06 ^a	24.98 ^a	35.06 ^b	29.20 ^c	33.89 ^c	33.15 ^c	29.27 ^d	0.91	29.95 ^b
	Afternoon	10.00 ^a	10.26 ^a	10.00 ^b	23.75 ^c	18.26 ^c	57.75 ^e	48.42 ^d	0.25	25.49 ^{b*}
THI	Morning	24.20 ^a	23.68 ^a	25.55 ^a	26.89 ^c	26.19 ^a	26.16 ^b	24.74 ^{bc}	0.25	25.34 ^c
	Afternoon	27.99 ^a	28.59 ^a	26.46 ^a	31.20 ^{bc}	27.05 ^a	29.37 ^b	31.82 ^c	0.70	28.93 ^{c*}

^{a,b,c} Means with different subscripts and superscripts with asterisk are significantly different across the row and column respectively ($P < 0.05$). AT= Air Temperature, RH= Relative Humidity, THI= Temperature-Humidity Index, SEM= Standard Error Mean.

The entire thermo - physiological indices, Respiratory - rate (RR), skin temperature (ST), ear core temperature (ECT) and rectal temperature (RT) observed in the study were

significantly higher ($p < 0.05$) in the afternoon compared to the morning (Table 2). This report implied that the animals responded to the higher THI of the afternoon to enhance heat

loss similar to the findings of (8). All the physiological indices observed in the study were not significantly different ($p>0.05$) between male and female animals (Table 3)

which is comparable to the report of (9) with the exception of RR which the referenced authors reported was influenced by sex.

Table 2: Effect of period of day on thermo - physiological responses of experimental rabbits

Parameter	P	Week							SEM±	Grand Mean
		1	2	3	4	5	6	7		
RR (c/m)	M	164.53 ^b	159.33 ^a	181.14 ^{bc}	194.35 ^b	169.72 ^{bc}	175.7 ^d	158.20 ^{cd}	3.37	171.87 ^a
	A	227.23 ^b	173.40 ^a	237.87 ^{bc}	200.09 ^b	231.05 ^{bc}	277.1 ^d	267.69 ^{cd}	3.05	230.64 ^{a*}
ST(°C)	M	38.05 ^a	38.60 ^b	38.69 ^b	38.23 ^b	38.53 ^b	38.52 ^b	38.50 ^b	0.07	38.45 ^b
	A	38.70 ^a	39.33 ^b	39.08 ^b	39.28 ^b	39.33 ^b	38.92 ^b	39.48 ^b	0.05	39.16 ^{b*}
ECT(°C)	M	35.88 ^a	36.05 ^b	36.93 ^b	36.41 ^b	36.32 ^b	36.39 ^b	36.11 ^b	0.10	36.30 ^c
	A	37.21 ^a	38.42 ^b	38.03 ^b	38.16 ^b	38.38 ^b	38.15 ^b	38.57 ^b	0.05	38.13 ^{c*}
RT(°C)	M	37.75 ^a	37.73 ^{ab}	37.87 ^a	37.83 ^a	38.02 ^b	37.69 ^{ab}	37.88 ^b	0.07	37.21 ^d
	A	37.64 ^a	37.92 ^{ab}	37.55 ^a	37.48 ^a	38.17 ^b	37.86 ^{ab}	38.22 ^b	0.05	38.45 ^{a*}

^{a,b,c,d} Means with different subscripts differ significantly across the row and within the column row ($P<0.05$). RR=Respiratory Rate, ST=Skin Temperature, ECT= Ear Core Temperature, RT= Rectal Temperature, M = Morning, A -Afternoon, SEM= Standard Error of Mean.

Table 3: Effect of sex on thermo - physiological responses of experimental rabbits

Parameters	Sex	Week							SEM±	Grand Mean
		1	2	3	4	5	6	7		
RR (c/m)	Female	197.00 ^b	155.52 ^a	194.71 ^{bc}	197.68 ^b	214.44 ^{bc}	227.75 ^d	225.33 ^{cd}	2.86	201.78
	Male	194.77 ^b	177.22 ^a	224.30 ^{bc}	196.77 ^b	186.33 ^{bc}	225.16 ^d	200.56 ^{cd}	3.39	200.73
ST(°C)	Female	38.45 ^a	38.89 ^b	39.07 ^b	38.68 ^b	38.91 ^b	38.73 ^b	38.96 ^b	0.06	39.18
	Male	38.31 ^a	39.04 ^b	38.70 ^b	38.83 ^b	38.96 ^b	38.71 ^b	39.02 ^b	0.09	38.44
ECT(°C)	Female	36.69 ^a	37.26 ^b	37.35 ^b	37.14 ^b	37.46 ^b	37.31 ^b	37.29 ^b	0.07	37.22
	Male	36.40 ^a	37.22 ^b	37.61 ^b	37.42 ^b	37.23 ^b	37.23 ^b	37.39 ^b	0.13	37.21
RT(°C)	Female	37.64 ^a	37.92 ^{ab}	37.55 ^a	37.48 ^a	38.17 ^b	37.86 ^{ab}	38.22 ^b	0.05	37.85
	Male	37.75 ^a	37.73 ^{ab}	37.87 ^a	37.83 ^a	38.02 ^b	37.69 ^{ab}	37.88 ^b	0.07	37.82

^{a,b,c,d} Means with different subscripts differ significantly across the row ($P<0.05$). RR=Respiratory Rate, ST=Skin Temperature, ECT= Ear Core Temperature, RT= Rectal Temperature, SEM= Standard Error of Mean.

CONCLUSION

RECOMMENDATIONS

The study revealed that the physiological parameters of the rabbits were higher in the afternoon due to the higher prevalent THI of the afternoon. In addition, sex did not affect the thermoregulatory mechanism of the animals. It is recommended based on the results of this study that more emphasis should be on the diurnal variation of THI rather than sex in mitigating heat stress in the rabbit raised under the derived Savannah zone.

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