AMM -08

Thermoregulatory Response of Heat Stressed Growing Rabbits Administered Baobab Fruit Pulp Meal Supplement

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Abstract
The study was designed to evaluatethe thermoregulatory response in heat stressed growing rabbits administered with BFPM. A total of thirty (30) weaned rabbits were used. The rabbits were randomly allotted into five experimental treatment groups, with six (6) rabbits per treatment in a completely randomized design. The animals were fed diets containing graded levels [0.0% (Control), 2.5%, 3.5%, 4.5% and 5.5%] of BFPM. Microclimate parameters of ambient temperature (AT) and relative humidity (RH) of the rabbitry were taken daily from February through June. The values were used to calculate temperature-humidity index (THI). Thermoregulatory parameters such as respiratory rate (RR), heart rate (HR), rectal temperature (RT) and ear temperature (ET) were monitored and measured on weekly basis. The experiment lasted for nine weeks. It was found that THI values kept increasing from the month of February with a peak in May and declined in the month of June. The values of THI from March to May indicated that environmental conditions were stressful to the animals. The treatments with 4.5% and 5.5% significantly ($p<0.05$) reduced thermoregulatory parameters compared to the control. It was concluded that BFPM was effective in ameliorating heat stress in rabbits.

Keywords: Thermoregulation, supplements, Heat stress

Introduction
Rabbit is one of the most important livestock animals which have a vital role in solving the world problem of deficiency of animal proteins because of their high-quality protein, short generation interval, prolificacy and fast growth rate. Improvement andincreasing rabbitpopulation have a significant role inmitigation of poverty in the developing countries, where it israised. Rabbitenterprise has also a main role in employment of rural communities' population.

Heat stress in tropical and subtropical countries is a major limitation on rabbits leading to impairment of both production and reproduction performance. The neutral zone of growing rabbit (6-12 weeks of age) is 15-18^{o}C (Daader *et al*., 2003). This value shows that the neutral zone is narrow and may be narrower in newly weaned rabbits which may cause a great variation in stress tolerance in rabbits. Thermoregulatory parameters are the easiest means of evaluating for heat stress in rabbits. Using supplements rich in vitamin C may be helpful in ameliorating heat stress in rabbits as other methods (Air conditions, fans etc) may be expensive and risky.

This study was designed to evaluate the thermoregulatory response in heat stressed growing rabbits administered BFPM as a supplement.

Materials and Methods
This study was carried out at the Rabbit unit of the National Animal Production Research Institute(NAPRI) Shika-Zaria Nigeria. Shika-Zaria lies between 11^{o} 12' 42" N and 7^{o} 33' 14" E atan altitude of 691m above sea level (Ovimaps, 2014).A total of 30 weaned rabbits were used in this study. The rabbits were divided into five groups, with six rabbits per treatment in a completely randomized design. The rabbits were each randomly allotted to one of the five treatments based on BFPM supplementation. Rabbits in the Group 1 were not supplemented and served as the control T1; while those in groups 2 – 5 were fed diets, containing graded levels of BFPM, T2, T3, T4 and T5, respectively. The diets were formulated to meet NRC (1995) recommendation for weaned rabbits. All animals were given access to feed and water *ad libitum*. All recommended managerial practices were dully observed.

The microclimate (ambient temperature and relative humidity values) within the rabbit house were recorded twice daily at 08:00 h and 15.00 h during the study period using a digital thermometer (Cocet, Shenzhen-Guangdong, China). The data collected was used to compute the temperature humidity index (THI), an indicator of the thermal comfort level of the rabbits. The THI was calculated using the modified formula for the rabbit by Marai*etal*. (2001) as follows: $THI = t - [(0.31 – 0.31 \times RH) (t – 14.4)]$
Where RH = relative humidity /100.

t = ambient temperature.
The values of THI obtained were compared to that classified for tropical regions as shown below: a. <27.8 = Absence of heat stress, b. 27.8 - 28.9 = Moderate heat stress, c. 28.9 – 30 = Severe heat stress and d. above 30 = Very severe heat stress.

Parameters measured included rectal temperature (RT) and ear temperature (ET), respiratory rate (RR) and heart rate (HR). Measurements were taken at 14.00 h to 15.00 h of the day. Rectal and ear temperature were measured with a digital thermometer. The ear temperature was measured by placing the digital thermometer in direct contact with the central area of the auricle. RR was measured by visually counting the flank movements for one minute with the help of a stop clock. HR was measured by counting the heart beat for one minute with the help of a stethoscope.

Data generated from the study were analyzed using the general linear model of SAS software (SAS, 2002). Significant differences in means were separated using the pairwise difference (PDIFF) in the SAS package.

Results and Discussion

The monthly temperature humidity index (THI) inside the rabbitry during the experimental period is shown in the Figure I. THI in the mornings averaged 26.44°C and 28.74°C during the afternoon. This graph also shows that the THI values kept increasing from the month of February with a peak in May. There was a decline in THI in the month of June. The THI value of 27°C (Feb) indicated that the month of February had absence of heat stress in the rabbit house, while the THI values of 28°C (March), 29.5°C (April), 31.2°C (May) and 28°C (June) are indications that the rabbit house was moderately, severely and very severely thermally stressful (Marai, 2001) in these months. The averaged THI 28.74°C during the experimental period indicated that the rabbit house was thermally stressful and may have had adverse effects on the rabbits (Marai, 2001). Overall data obtained indicated that THI in the afternoon was higher by 1.24 % than THI in the morning.

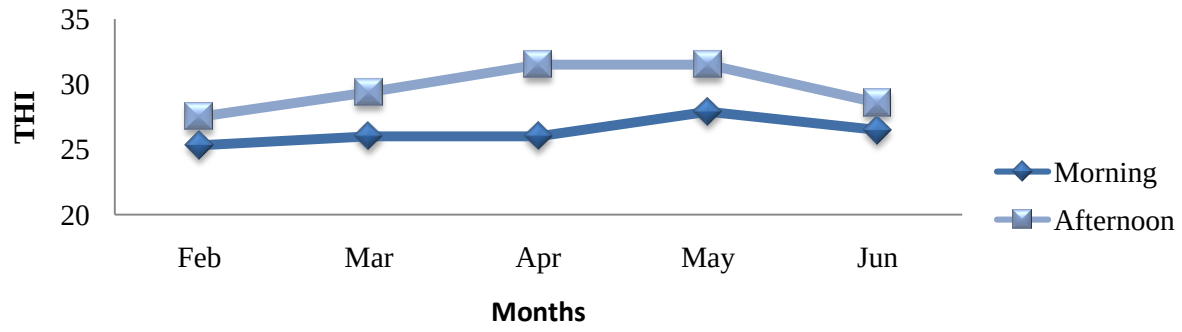

Fig. I: Monthly Temperature humidity index inside the rabbit house during the experimental period

The effect of graded levels of BFPM on the thermoregulatory response of growing rabbits is shown in the Table 1. The BFPM significantly ($p<0.05$) reduced rectal and ear temperatures of the rabbits at 4.5 and 5.5% inclusion levels. Respiratory rate and heart rate did not show any difference. This could be because BFPM contained a high amount of vitamin C. BFPM has been reported to lower the rectal temperature of birds than the value obtained with the control diet (Adeosun, 2012).

Table 1: Effect of Graded Levels of BFPM on Thermoregulatory Response of Growing Rabbits

Parameters	Control	2.5%	3.5%	4.5%	5.5%	SEM
Respiratory Rate (counts/min)	106.81^{a}	94.08^{b}	91.33^{b}	96.92^{b}	107.50^{a}	5.60
Heart Rate (beats/min)	137.44	139.16	136.94	135.75	141.10	2.25
Rectal Temperature (°C)	38.51^{a}	37.80^{b}	37.62^{bc}	37.20^{c}	36.90^{d}	0.14
Ear Temperature (°C)	35.83^{a}	35.20^{ab}	34.88^{bc}	34.30^{c}	33.97^{d}	0.19

Means within rows with different superscripts are significantly different: $P < 0.05$

BFPM has been reported to contain high vitamin C (Agbessi Dos-Santos, 1987), which may enhance its antioxidant properties that scavenges for free radicals, as vitamin C does. This result is similar to the findings of Ayo *et al.* (2011), who reported a reduced rectal temperature for transported rabbits ameliorated with vitamin C. Vitamin C protects the cells from the damage caused by reactive oxygen species and mutagens (Yarube *et al*., 2009). One of the most widely accepted functions of vitamin C is that it acts as an antioxidant by interrupting free-radical chain reactions in the body (Powers and Jackson, 2008) and, thus, significantly decreases the levels of reactive oxygen species in the body (Dröge, 2002; Whitehead and Keller, 2003).

Conclusion

This study revealed that the environmental condition was thermally stressful on therabbits and the use of baobab fruit pulp meal was effective in ameliorating the heat stress rabbits. BFPM being very high in vitamin C may be more biologically safe to use in animal production during hot periods.

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