THE EFFECT OF *PIPER GUINEENSE* AND *XYLOPIA AETHIOPICA* SUPPLEMENTATION ON THERMOREGULATORY RESPONSES IN RABBITS

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ABSTRACT

The study was aimed at investigating the effect of Piper guineense and Xylopia aethiopica supplementation on thermoregulatory responses in rabbits. Twenty-four 4 months old rabbits (12 Chinchilla and 12 New Zealand White; average weight 1250 g) were used in a 10-week trial. Supplements of Uziza and Uda seeds were added at 10 g/kg each and a control diet without treatment. Rabbits were housed individually and randomly assigned to 6 groups (n=4/group) including control diet (no Uda or Uziza seeds), diet 2 (Control + Uziza seeds), and diet 3 (Control + Uda seeds) for each of the two breeds. The thermoregulatory responses – ear and rectal temperatures, respiratory and pulse rates were monitored and recorded weekly. Data were subjected to two-way analysis of variance on a 2 x 3 factorial block design in IBM SPSS 20. The afternoon rectal temperature was significantly ($p<0.05$) higher in the control diet (39.270C) than in those supplemented with Uziza (38.260C) and Uda (38.150C) seeds. The morning rectal temperature were significantly ($p<0.05$) higher in the Uda (37.700C) seed-supplemented diet than in the Uziza (37.370C) seed-supplemented diet compared to the control (37.200C) diet. Afternoon rectal temperature was significantly affected ($p<0.05$) by rabbit breeds as afternoon rectal temperature was significantly ($p<0.05$) higher in New Zealand White (38.680C) breeds than in Chincilla (38.440C) breeds. There was an interaction ($p<0.05$) between supplemented diets and rabbit breeds as this showed that morning pulse rate reduced by supplemented diet in Chinchilla breed but not in New Zealand White breed. Dietary supplementation of Uda and Uziza seeds influenced the thermoregulatory responses of rabbits.

INTRODUCTION

Rabbits are prone to heat stress due to poor functional sweat gland. It has been revealed that reduced productivity, compromised immune system, inefficient thermoregulatory mechanism, oxidative stress and reduced fertility from environmental variables can be induced by heat stress (Gupta and Mondal, 2021). African medicinal plants such as Uziza (*Piper guineense*) and Uda (*Xylopia aethiopica*) from the Piperaceae and Annonaceae families are known for their nutritional, biological, medicinal, and pharmacological properties (Mgbeahuruike *et al*., 2019). Research shows Uziza and Uda seeds can influence the thermoregulation response as they possess antipyretic properties that help to reduce fever associated with infections and regulate body temperature (Evuen *et al*., 2022). Uziza and Uda seeds have been shown to have antioxidant properties due to their high content of phenolic compound content. Also, there is the presence of bioactive compounds such as tannins, terpenoids and saponins in Uziza and Uda seeds (Nwozo *et al*., 2017). Unfortunately, thermoregulatory responses in rabbits fed alternative plant supplements are not well documented in literature. The aim of this study was to investigate the effects of dietary supplementation of *Piper guineense* (Uziza seeds) and *Xylopia aethiopica* (Uda seeds) on thermoregulatory responses in rabbits.

MATERIALS AND METHODS

The study was conducted under the guidelines for the care and use of laboratory animals for studies on experimental animals. The experiment was conducted in the Rabbit section of the Animal Science unit at the Teaching and Research Farm, Department of Agricultural Science, Alvan Ikoku University of Education, Owerri, Imo State, Nigeria. It is located at the latitude of $7^{0}2^{0}1$N and longitude of $3^{0}5^{0}1$E. It is 200 meters above sea level with average day time temperature of 24^{0}C-25^{0}C, relative humidity of 80-85%. Uziza and Uda seeds (test ingredients) were added to the formulated feed and mixed thoroughly. From 4 weeks of treatment administration, rectal temperature, ear temperature,

respiratory rate and pulse rate were taken twice daily (8:00am and 4:00pm). Twenty-four (24) rabbits of mixed sexes were randomly assigned to 6 treatments groups for the feed trial. Uziza and Uda seeds were included into diet 1 (control), diet 2 and diet 3 (Uziza seed and Uda seed inclusion at 10g/kg, respectively), for each of the two breeds; Chinchilla and New Zealand White were allotted to the groups. The thermoregulatory assessment data were subjected to statistical analysis using two-way analysis of variance (ANOVA) on completely randomized block design using IBM SPSS Version 25. A 2 x 3 factorial design was used as different supplemented diets (3), rabbit breeds (2) used as factors. The main effects and their interaction were included in each statistical model.

RESULTS

The afternoon temperature, morning rectal temperature, afternoon rectal temperature and body weight were significantly affected ($p<0.05$) by supplemented diets (Table 1). The morning rectal temperature and body weight were significantly ($p<0.05$) higher in Uda seed-supplemented diet than the Uziza seed-supplemented diet when compared to the control. The afternoon temperature and afternoon rectal temperature were significantly ($p<0.05$) higher in control than the Uziza seed and Uda seed-supplemented diets. The body weight and afternoon rectal temperature were significantly affected ($p<0.05$) by breed. (Table 2) The body weight and afternoon rectal temperature were significantly ($p<0.05$) higher in New Zealand White breed than the Chincilla breed. There was an interaction effect ($p<0.05$) between supplemented diets and breed (Table 3). The body weight was significantly affected ($p<0.05$) by interaction effect. This showed that body weight was reduced by supplemented diet in Chinchilla breed but not in New Zealand White breed. The morning pulse rate tends to be reduced by supplemented diet in Chinchilla breed but not in New Zealand White breed.

Table 1: The treatment effect of thermoregulatory indices in rabbits fed Uziza seeds (*Piper guineense*) and Uda seeds (*Xylopia aethiopica*) supplemented diets

Parameter	Treatment			SEM	P value
	A	B	C		
Morning Temperature ^{0}C	37.936	37.643	37.819	0.095	0.094
Afternoon Temperature ^{0}C	39.031^a	38.525^b	38.574^b	0.073	0.0001
Morning Rectal Temperature ^{0}C	37.377^b	37.201^b	37.700^a	0.127	0.021
Afternoon Rectal Temperature ^{0}C	39.276^a	38.151^b	38.260^b	0.194	0.001
Morning Pulse rate (beats/min)	95.761	95.966	98.333	1.630	0.470
Afternoon Pulse rate (beats/min)	97.830	98.747	102.208	1.630	0.098
Morning Respiratory rate (breaths/min)	86.706	82.463	106.350	7.693	0.069
Afternoon Respiratory rate (breaths/min)	86.216	85.949	87.483	1.809	0.088
Body weight (g)	1424.164^b	1421.547^b	1685.396^a	31.311	0.0001

a, b: Mean in the same row with different superscripts are significantly ($p<0.05$) different. SEM: standard error of mean.; Treatment A: Basal diet with no treatment (control); Treatment B: Basal diet with Uziza seeds (10g/kg) ; Treatment C: Basal diet with Uda seeds (10g/kg)

Table 2: The breed effect of thermoregulatory indices in rabbits fed Uziza seeds (*Piper guineense*) and Uda seeds (*Xylopia aethiopica*) supplemented diets

Parameter	Breed		SEM	P value
	CH	NZW		
Morning Temperature (^{0}C)	37.790	37.790	0.075	0.875
Afternoon Temperature (^{0}C)	38.699	38.720	0.058	0.091
Morning Rectal Temperature (^{0}C)	37.466	37.386	0.100	0.585
Afternoon Rectal Temperature (^{0}C)	38.440^b	38.685^a	0.153	0.027
Morning Pulse rate (beats/min)	97.655	95.719	1.284	0.307
Afternoon Pulse rate (beats/min)	99.934	99.256	1.180	0.696
Morning Respiratory rate (breaths/min)	85.988	97.691	6.058	0.191
Afternoon Respiratory rate (breaths/min)	86.402	86.697	1.424	0.888
Body weight (g)	1490.257^b	1530.481^a	26.625	0.047

a, b: Mean in the same row with different superscripts are significantly ($p<0.05$) different. SEM: standard error of mean. CH- Chinchilla; NZW- New Zealand White; ; Treatment A: Basal diet with no treatment (control)

Treatment B: Basal diet with Uziza seeds (10g/kg) ; Treatment C: Basal diet with Uda seeds (10g/kg)

Table 3: The interaction effect (treatment and breed effect) of thermoregulatory indices in rabbits fed Uziza seeds (*Piper guineense*) and Uda seeds (*Xylopia aethiopica*) supplemented diets

Parameter	Treatment A		Treatment B		Treatment C		SEM	P value
	CH	NZW	CH	NZW	CH	NZW		
Morning Temperature (^{0}C)	37.933	37.938	37.541	37.745	37.897	37.740	0.126	0.408
Afternoon Temperature (^{0}C)	39.058	39.003	38.392	38.658	38.647	38.500	0.097	0.117
Morning Rectal Temperature (^{0}C)	37.333	37.421	37.278	37.124	37.788	37.613	0.167	0.720
Afternoon Rectal Temperature (^{0}C)	38.950	39.603	38.227	38.076	38.142	38.377	0.256	0.343
Morning Pulse rate (beats/min)	96.111	95.412	96.054	96.054	100.800	95.867	2.156	0.089
Afternoon Pulse rate (beats/min)	97.778	97.882	99.676	97.818	102.350	102.067	2.060	0.887
Morning Respiratory rate (breaths/min)	84.000	89.412	80.865	84.061	93.100	119.600	10.173	0.503
Afternoon Respiratory rate (breaths/min)	84.667	87.765	85.838	86.061	88.700	86.267	2.392	0.561
Body weight (g)	1245.417^b	1602.912^a	1410.730^b	1432.364^a	1814.625^a	1556.167^b	43.049	0.0001

a, b: Mean in the same row with different superscripts are significantly ($p<0.05$) different. SEM: standard error of mean. CH- Chinchilla; NZW - New Zealand White; ; Treatment A: Basal diet with no treatment (control); Treatment B: Basal diet with Uziza seeds (10g/kg) ; Treatment C: Basal diet with Uda seeds (10g/kg)

Discussion

The increase in body weight of animals fed Uda seed-supplemented diets disagrees with Obodo et al. (2013) who reported a reduction in body weight and growth rate of wistar rats fed aqueous solution of *Xylopia aethiopica*. The increase in body weight can be attributed to the active ingredients such as xylopic acid in the test ingredient (Chike and Adienbo, 2011). Another study evaluated the performance of male and female weaned rabbits fed diets containing *Xylopia aethiopica* seed meal (XSM) and *Monodora myristica* (African nutmeg) seed powder as feed additives and the study found that the inclusion of XSM in the diet of rabbits improved their growth performance and feed utilization efficiency (Okon et al., 2022). Rabbits use general body position, breathing rate and peripheral temperature, especially ear, as the devices to control heat loss. However, respiration and ear are the most important dissipation pathways. According to the results, the body weight and rectal temperature of rabbits were significantly affected by breed. Specifically, Fauve de Bourgogne and Chinchilla rabbits had higher rectal temperature than British Spot and New Zealand White rabbits (Jimoh and Ewuola, 2018). In addition, the rectal temperature of Fauve de Bourgogne, Chinchilla, and British Spot rabbits were similar but had significantly higher values than that of New Zealand White rabbits. The normal rectal temperature of adult New Zealand White rabbits at rest is reported to be between 38.5°C and 39.5°C. However, there is no information on the effects of *Piper guineense* and *Xylopia aethiopica* (Uziza and Uda seeds) on the body weight and rectal temperature of rabbits. According to the results, the body weight of rabbits was affected by breed and supplemented diet. One study found that Chinchilla rabbits fed concentrate diets supplemented with pawpaw leaves had reduced body weight (Aderinboye *et al*., 2015). However, another study found that New Zealand White growing rabbits supplemented with 200 mg Moringa olerifera leaf/kg diet showed the highest body weight and daily gain (Abdelsalam and Fathi, 2023). In addition, regarding the effect of supplemented diet on pulse rate, one study found that the pulse rate tended to be reduced in Chinchilla rabbits fed diets supplemented with gliricidia leaf meal and multi-enzyme (Oloruntola et al., 2018).

CONCLUSION

Dietary supplementation of Uda and Uziza seeds influenced physiological response of rabbits by improving thermoregulatory responses of rabbits. More research is needed to understand its mechanism of action and determine the best dosage and timing of Uziza and Uda seed supplement to achieve maximum results and be safe for human consumption.

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