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THERMOREGULATORY AND SEMEN QUALITY RESPONSES OF RABBIT BUCKS TO SPICE-SUPPLEMENTED DIETS UNDER THE TROPICAL ENVIRONMENT

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ABSTRACT

The study evaluated the seminal and thermoregulatory effects of ginger, garlic and onion supplementations in rabbit bucks. Fifty-five bucks were allocated to11 experimental diets comprised of a basal diet with no spices and nine others containing ginger, garlic and onion at 5g, 10g or 15g/kg feed with the eleventh diet supplemented with vitamin C at 400mg/kg feed (positive control) in a 3x3+2 factorial arrangement. In the wet and dry seasons respectively seminal and biophysical thermoregulatory responses of the bucks were studied over a period of 8 weeks. Temperature – Humidity index (THI) of the rabbit pen was also monitored during the experiment. Data collected were analysed using factorial analysis of variance and probability value of 5% was considered statistically significant after separation by Duncan Multiple Range Test. Mean THI was significantly higher ($p<0.05$) in the dry season (30.22^0C) than the wet season (28.92^0C). Spice supplementation had no significant effect ($p<0.05$) on the buck's semen parameters, respiratory rate (RR) and rectal temperature (RT) in both wet and dry seasons. RT was significantly lower ($p<0.05$) in the dry season while season had no effect on RR. The study concluded that spice supplementation did not influence seminal and biophysical thermoregulatory responses of the rabbit bucks.

Key words: Fertility, Thermoregulatory, Spice, Temperature - Humidity Index

INTRODUCTION

Rabbit production has the ability to improve animal protein consumption among the rural and urban population of Africa (FAO, 1997; Oseni, 2012). However, high temperature and humidity characteristic of the tropics depress rabbit buck comfortability and fertility through causing of abnormalities and apoptosis in spermatozoa (Finzi *et al*., 1995). The concern that aggregate of hormonal residues in the meat of the treated animals will be harmful to the consumer and the relative unavailability of such hormones discourages farmers from using them in enhancing rabbit buck fertility. Use of plants especially spices are a novel and perhaps more effective approach to ameliorate heat stress and enhance fertility in livestock (Pawar and Hugar, 2012). These plants, especially, *Allium sativum* (garlic), *Zingiber officinale* (ginger) and *Allium cepa* (onion) (Nagendra *et al.*, 2014), contain phytochemicals such as flavonoid and alkaloid that have pro- fertility and anti stress effects (Ramandeep *et al*., 2013). This study therefore investigated the dosage of ginger, garlic and onion that will improve the fertility of rabbit bucks under the tropical condition that is conducive to heat stress.

MATERIALS AND METHODS

The study was conducted at the Teaching and Research Farm, Obafemi Awolowo University, Ile – Ife, Nigeria, situated at latitude 7.521 and longitude 4.530. Fifty-five rabbit bucks of composite population

with an average weight and age of 1.5kg and 9 months, respectively, were used in the study. The experimental diets comprised of a basal diet with no spices, nine others containing ginger, garlic and onion at 5g, 10g or 15g/kg feed and the positive control (supplemented with 400mg of vitamin C/kg feed) in a 3x3+2 factorial arrangement. The bucks' seminal and biophysical thermoregulatory responses were observed over a period of 8 weeks in the wet and dry seasons, respectively. The collection of ejaculates and observation of the bucks' respiratory rate (RR) and rectal temperature (RT) started a week after the introduction of the experimental diets. Observations and samples were collected between 11am - 2pm when the THI was usually highest for the day. Semen samples were collected from the bucks at weekly interval over the experimental period using a disposable artificial vaginal (Ola, 2016). Semen volume, sperm concentration, motility, viability and abnormality were determined according to the procedures of I.R.R.G. (2005) and Al-Eissa *et al*. (2011). A rectal thermometer was used to take the RT of the bucks twice a week at two days interval while determining concurrently the RR of the animals by counting the flank movement of bucks for 1 minute. Ambient temperature and relative – humidity of the rabbit pen were observed by means of a digital thermo-hygrometer to determine the Temperature – Humidity index (THI). Data was subjected to factorial and post-factorial analyses of variance. Means was separated by Duncan Multiple Range Test.

RESULTS AND DISCUSSION

The mean temperature –humidity index (THI) recorded in this study was 28.92°C and 30.22°C (Table 1) in the wet and dry seasons, respectively. These values showed that the studied buck were severely heat stressed since the THI exceeded the thermo-neutral zone established for rabbits in the tropics (Marai *et al.* 2002). The value recorded in this study in the wet season differ from the report of Jimoh and Ewuola (2018) and may be adduced due to the fact that AT and RH in this study were observed during the hot hours of the day while Jimoh and Ewuola (2018) observed both AT and RH in the cool and hot part of the day.

Table 1: Seasonal means of temperature, relative- humidity and temperature - humidity index recorded during the experiment

Parameter	Wet season	Dry season	SEM
Temperature(°C)	30.73[a]	33.11[b]	0.12
Relative- humidity (%)	64.50[a]	50.40[b]	0.59
Temperature- humidity index(°C)	28.92[a]	30.22[b]	0.10

[ab]Means with different superscript within the row are significantly different ($p<0.05$)

Spices' supplementation had no effect on the respiratory rate (RR) and rectal temperature (RT) of the studied animals (Table 2) in the wet and dry seasons in disagreement with the reports of Zeweil *et al.* (2016) though animals feed ginger at 5g/kg feed had significantly lower ($p<0.05$) RT compared to the control group in the dry season. Season had no effect on the bucks' RR as indicated by the seasonal mean but RT was significantly lower in the dry season in disagreement with the conclusions of Marai *et al*. (2002) and Tucker *et al*. (2008). The lower RT recorded in this study was similar to the report of Asemota *et al.* (2017) and implied that RT might not always correlate with thermal stress as concluded by Ogunjimi *et al*. (2007).

Table 2: Biophysical thermoregulatory response of experimental rabbit bucks to spice – supplemented diets

Parameter		**5 g**	**10 g**	**15 g**	**5 g**	**10 g**	**15 g**	**5 g**	**10 g**	**15 g**	**400 mg**	SEM	Mean
RR1(c/m)	236[a]	225[a]	247[a]	234[a]	216[a]	259[a]	247[a]	239[a]	270 [b]	251[a]	254.2[a]	4.12	**243**
RR2(c/m)	297	213	219	269	227	267	274	243	283	296	288.5	8.58	**255**
RT1(°C)	39.3[ab]	39.2[ab]	39.3[ab]	39.2[ab]	39.1[a]	39.5[b]	39.5[b]	39.3[ab]	39.5[b]	39.4[ab]	39.5[b]	0.03	**39.3[A]**
RT2(°C)	39.2[b]	38.8[a]	38.9[ab]	39.0[ab]	38.9[ab]	38.9[ab]	39.2[b]	38.9[ab]	39.0[ab]	38.9[ab]	38.9[ab]	0.03	**39.0[B]**

Values with different superscript are significantly different within the row and the column ($p<0.05$); RR= Respiratory rate; RT= Rectal temperature; c/m= count per minute; °C= degree Celsius, 1= Wet season; 2= Dry season, Mean = seasonal mean

Season impacted negatively on bucks' semen parameters (Table 3) with the exception of semen volume and sperm concentration in agreement with the findings of Ain-Baziz *et al*. (2012). Spice supplementation has no deleterious effect on bucks' seminal parameters but was not better than the controls in agreement with the findings of Shinkut *et al*. (2016).

Table 3: Semen characteristics of experimental rabbit bucks

Season	Parameter	No spice	Ginger 5 g	Ginger 10 g	Ginger 15 g	Garlic 5 g	Garlic 10 g	Garlic 15 g	Onion 5 g	Onion 10 g	Onion 15 g	Vit. C 400 mg	SEM	**Mean**
Wet	SV(ml)	0.57^{ab}	0.53^{a}	0.60^{abcd}	0.81^{d}	0.59^{abc}	0.78^{bcd}	0.51^{a}	0.60^{abcd}	0.76^{bcd}	0.55^{a}	0.78^{bcd}	0.02	**0.64**
Dry	SV(ml)	0.79^{bcd}	0.62^{ab}	0.63^{ab}	0.85^{cd}	0.50^{a}	0.93^{d}	0.52^{a}	0.67^{abc}	0.80^{bcd}	0.53^{a}	0.61^{ab}	0.02	**0.67**
Wet	SCN x 10^6/ml	320	261	336	295	265	338	300	293	256	249	231	10.50	**186^{A}**
Dry	SCN x 10^6/ml	384^{abc}	363^{abc}	469^{c}	441^{bc}	351^{abc}	388^{abc}	378^{abc}	310^{ab}	278^{a}	243^{a}	253^{a}	14.70	**251^{A*}**
Wet	SM(%)	92.0	89.9	94.00	90.8	83.83	92.2	93.8	98.0	90.8	85.9	84.3	1.40	**91.1^{B}**
Dry	SM(%)	76.5^{bc}	69.6^{abc}	75.17^{bc}	83.6^{c}	62.17^{ab}	66.9^{ab}	779^{bc}	83.8^{c}	75.1^{bc}	64.1^{ab}	54.8^{a}	.161	**73.1^{B*}**
Wet	SVL(%)	85.2	90.8	95.1	90.6	86.7	91.0	91.3	94.2	90.9	90.3	81.3	1.28	**91.2^{C}**
Dry	SVL(%)	82.9^{a}	82.5^{a}	81.46^{a}	87.1^{a}	81.4^{a}	79.5^{a}	81.9^{a}	84.0^{a}	80.1^{a}	78.0^{a}	55.13^{b}	1.42	**81.7^{C*}**
Wet	SAB(%)	12.5^{ab}	12.3^{ab}	12.02^{ab}	8.75^{a}	12.9^{ab}	12.1^{ab}	10.9^{ab}	12.1^{ab}	13.4^{ab}	10.0^{ab}	12.0^{b}	0.38	**11.6^{D}**
Dry	SAB(%)	27.7^{bc}	23.9^{abc}	22.92^{abc}	22.7^{abc}	30.1^{c}	27.9^{bc}	27.5^{bc}	23.8^{abc}	26.8^{bc}	20.6^{ab}	16.4^{a}	0.80	**25.1^{D*}**

Values with different superscripts and superscripts with asterisks indicate significant difference within the rows and column respectively ($p<0.05$); SV = Semen volume; SCN = Sperm concentration; SM= Sperm motility; SVL= Sperm viability, SAB= Sperm abnormality Mean= seasonal mean

CONCLUSION

The findings of this study showed that spice supplementation had no significant effect on rabbit bucks' respiratory rate, rectal temperature and semen characteristics. However, higher values of seminal parameters observed in spice supplemented groups suggests improved seminal characteristics of the rabbit bucks which could be attributed to the positive impact of the spices on epididymal sperm storage and maturation. Hence the incorporation of these spices in rabbit diets could improve the animal's welfare and productivity especially in the tropical environment.

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