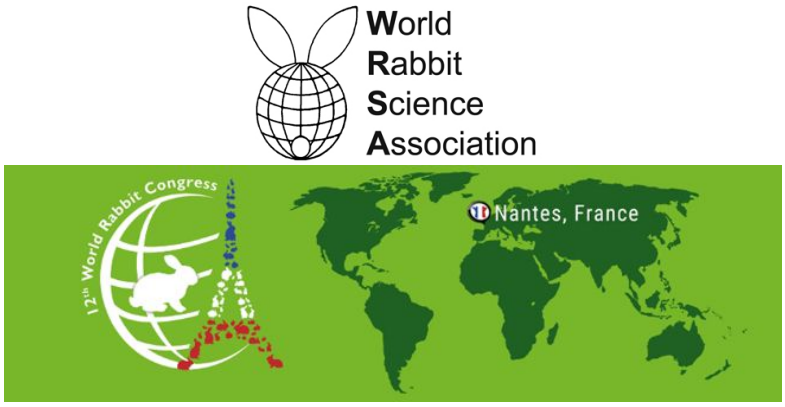

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THE INFLUENCE OF ORGANIC AND SYNTHETIC ANTIOXIDANT ON THE REPRODUCTIVE PERFORMANCE OF HEAT STRESSED RABBIT UNDER TROPICAL CONDITION OF NIGERIA

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THE INFLUENCE OF ORGANIC AND SYNTHETIC ANTIOXIDANT ON THE REPRODUCTIVE PERFORMANCE OF HEAT STRESSED RABBIT UNDER TROPICAL CONDITION OF NIGERIA

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ABSTRACT

The aim of this study was to evaluate the influence of organic and synthetic antioxidant on the reproductive performance of heat stressed rabbit under tropical conditions of Nigeria. A total of forty (40) matured rabbits were used. The rabbits were allotted into the treatment groups with ten (10) rabbits per treatment in a completely randomized design. Rabbits in the first group (T_1) were the control, animals in the treatment 2 (T_2) were fed with diets as in the controls and given sodium bicarbonate ($NaHCO_3$) buffer water. Rabbits in treatment three (T_3) were fed diet containing synthetic vitamin C and the forth group (T_4) was fed diet containing Baobab Fruit Pulp Meal as an organic antioxidant. Rabbits were given access to feed and water *ad libitum*. Blood samples (5 ml) were collected from the ear vein at 10.00 h from five animals chosen randomly from each group of rabbits respectively before, during and after gestation and thyroxine hormone concentrations were evaluated. Reproductive performance of the female rabbits was also evaluated. Vitamin C and BFPM significantly ($P<0.05$) increased thyroxine secretion and improved reproductive performance of the does. It was concluded that baobab can be used as an antioxidant for alleviating heat stress and was recommended to be included in rabbit diets during the hot period.

Key Words: Antioxidants, Heat Stress, Reproduction and Hormone

INTRODUCTION

Rabbit production holds promise for relieving widespread micronutrient and protein malnutrition, while making positive contribution to the sustainable intensification of smallholder agriculture. Heat stress has been known to reduce reproductive efficiency in rabbits and was reported to have affected hormones secretion, litter size at birth as well as litter size at weaning (Marai *et al.,* 2004). Ameliorating heat stress with anti-oxidants was found to be cheaper and physiologically friendly for rabbits compared to other methods. Vitamin C has been widely used as an antioxidant (Abdel – Monem 2001; Sahin, and Kucuk, 2001) and sodium bicarbonate buffer was reported to be effective in alleviating heat stress respectively (Peart, *et al*., 2013). The recent advocacy on the use of organic products rather than synthetic products that may be hazardous brought about a renewed interest in the use of organic products that are viable and physiologically safe. Baobab has been reported to contain high amount of vitamin C (Agbessi Dos-Santos, 1987), and was effective in alleviation heat stress in rabbits (Anoh, 2017).
This study was designed to evaluate the influence of organic and synthetic antioxidant on the reproductive performance of heat stressed rabbit under tropical condition of Nigeria.

MATERIALS AND METHODS

Experimental site

This study was carried out at the Rabbit Unit of the National Animal Production Research Institute (NAPRI) Shika, Zaria. Shika lies between 11^o 12’ 42” N and 7^o 33’ 14” E at an altitude of 691 m above sea level (Ovimaps, 2014). Zaria has an average rain fall of 1100mm which starts from late

April and early May to mid-October and an average temperature of 37^{o}C and average relative humidity of 75%

Housing
The animals were housed in perforated metallic hutches measuring 75 X 75 X 75 cm and raised 80 cm from the floor level. The hutches were thoroughly washed and disinfected with a locally made disinfectant and allowed to dry for one week before the animals were brought. Feed and watering troughs which were made of bunt clay were provided in each hutch. The rabbits were placed individually in clearly labeled cells.

Preparation of buffer
Potassium bicarbonate, sodium bicarbonate and carbonate anhydrous salts were purchased from a laboratory equipments and chemicals vendor in Samaru-Zaria. Distilled water was prepared in the Multiuser Laboratory of the Department of Chemistry, Ahmadu Bello University Zaria. The buffer solution was prepared according to the methods of Chandra (2006) at a pH of 7.5 in the Department of Biochemistry, Ahmadu Bello University Zaria.

Experimental animals, diets and design
A total of forty (40) Adult rabbits (New Zealand White crosses) with average weight of 2600g were used in this study. The rabbits were randomly allotted into the experimental treatments of five treatment groups with Ten (10) rabbits per treatment in a Completely Randomized Design (CRD). The treatment groups consisted of: Control (Water without anti-stress), Sodium Bicarbonate ($NaHCO_3$), solution with feed respectively, Feed- Vitamin C, and BFPM as additives respectively (designated T1, T2, T3 and T4 respectively). The water was offered *ad libitum* but changed daily in morning. All rabbits were fed the same concentrate feed and the study lasted for 20 weeks. All recommended managerial practices were dully observed.

Determination of thyroxine (T4) concentration
Five (5) ml of blood samples were collected through the ear vein from five (5) rabbits, before (24 hours before mating), during (14th day of pregnancy) and after gestation (24 hours after kindling) from rabbits randomly selected from the treatment groups, respectively into a bottle without anticoagulant and allowed to clot. The blood samples were centrifuged at 3000 rounds/minute for 15 minutes. The serum harvested was stored at -10^{o}C until analyzed for T_4. The T4 concentration was determined using ELISA kits (Liaison® T4 Byk-Sangtec Diagnostica, Dietzenbach, Germany) according to the manufacturer's instructions. The sensitivity of this assay, or Lower Limit of Detection (LLD) was distinguished from zero calibrator; was at 10ng/ml.

Reproductive performance of Rabbit Does
The rabbits were allowed to adjust to the treatment for four weeks before mating. Does were brought individually to be serviced by the buck (1 buck: 1doe / treatment). 7th day weight increment and abdominal palpation was used to confirm pregnancy. Does that were not pregnant were re-mated. Parameters monitored included, date of kindle, litter size, weight of litter, weight of kits, survivability (%) of kits at weaning and kits weight at weaning. Data were obtained from two parities and the experiment lasted for 20 weeks.

Statistical analysis
Data obtained from the study were subjected to analysis of variance using the general liner model procedure of SAS (2002). Significant differences among treatment means were separated using the pair wise difference (Pdiff) in the SAS package.

RESULTS AND DISCUSSION

The initial thyroxine levels (Table 1) of the rabbits were low, compared to the values obtained during and after gestation. During pregnancy, thyroxine secretions increased a little above the initial thyroxine value and this may be due to the important role the hormone play in body metabolism,

leading to increase in serum protein, fat and carbohydrate to fulfill the high demand of the foetus from glucose and other components (Damiano *et al.*, 2017). Thyroxine is considered necessary for cellular metabolism of the mammary gland and energy utilization which could be considered as important factors in milk biosynthesis. After kindling, vitamin C and BFPM significantly increased thyroxine levels, compared to the treatment with $NaCO_3$. BFPM is high in vitamin C, vitamin C is known to reduce oxidative stress and improve body metabolism, leading to the increase in serum thyroxine (Lin *et al*. 2004). Vitamin C has also been reported to be effective in the alleviation of retardation in thyroid functions (Coates, 1984).

Table1: Effects of Bicarbonate Buffers, Vit C and BFPM on Thyroxine Levels (ng/ml) in Adult Rabbit Does

Parameters	CONTROL	$NaCO_3$	Vit. C	BFPM	SEM
Initial (24 h before mating)	56.00	55.33	62.67	64.67	4.80
During (14th Day of Pregnancy)	66.67^{c}	68.33^{bc}	76.35^{ab}	82.42^{a}	2.26
After (24 h after kindling)	68.50^{b}	70.00^{a}	70.33^{a}	71.00^{a}	1.73

Means within rows with different superscripts are significantly different: P<=0.05
Vit C = Vitamin C, BFPM = Baobab fruit pulp meal

Vitamin C and BFPM diets significantly (P<0.05) increased reproductive performance (Table 2) of the rabbits does compared to the treatments with the buffer and the values were similar to the control. The values were similar to those recorded by Fayeye and Ayorinde (2016). Vitamin C has the potentials of reducing stress, tackling reacting oxygen species, fighting pathogens and improving the immune system of pregnant animals (Sivakumar et al., 2010; Ganaie et al., 2012). The slight increase recorded in the control may be due to slight differences in genetic or physiological status of the rabbits. The poor reproductive performance recorded in Na_2CO_3 is an indication that the buffer does not support pregnancy in rabbits. Litter size and weight at weaning was significantly ($P < 0.05$) higher in the treatment with BFPM compared to the rest of the treatments. The efficiency of feed utilization might also have been better in BFPM supplemented groups as vitamin C scavenges free O_2 radicals, so preventing the oxidative stress of the cell membrane of the digestive system and restoring efficient feed utilization (Abou-Zeid et al., 2000).

Table 2: Effect of Bicarbonate Buffer, Vit C and BFPM on Reproductive Performance of Adult Rabbit Does

	Treatments				
Parameters	**CONTROL**	**Na_2CO_3**	**Vit. C**	**BFPM**	**SEM**
Number of parities/Doe	2 (20 Del)	2 (20 Del)	2 (20 Del)	2 (20 Del)	-
Average Litter size at birth	5.67^{a}	4.00^{b}	5.00^{a}	5.60^{a}	0.23
Average Weight of litter (g)	236.67^{a}	180.00^{b}	200.00^{b}	200.00^{b}	6.68
Average Weight of kit (g)	41.78^{b}	45.00^{a}	40.00^{b}	40.00^{b}	0.06
Average Litter size at weaning	4.00^{a}	0.67^{b}	2.67^{b}	4.67^{a}	0.29
Average Litter weight at weaning (g)	500.00^{b}	550.00^{b}	540.00^{b}	600.45^{a}	12.30

Means within rows with different superscripts are significantly different: P<=0.05
Vit C = Vitamin C, BFPM = Baobab fruit pulp meal, Del= Deliveries

CONCLUSION

In conclusion, heat stress adversely affected thyroxine secretion in reproductive does; the $NaCO_3$ buffer reduce reproductive performance in rabbits, whereas the vitamins especially the organic BFPM improved kits weight at weaning and was recommended to be used in rabbit diets during hot conditions.

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THE INFLUENCE OF ORGANIC AND SYNTHETIC ANTIOXIDANTS ON THE REPRODUCTIVE PERFORMANCE OF HEAT STRESSED RABBIT UNDER TROPICAL CONDITION OF NIGERIA

By

Anoh Kevin U

Introduction

Rabbit production holds promise for:

- **Relieving protein malnutrition**
- **Improving smallholder agriculture**

Heat stress has been known to:

- **Reduce reproductive efficiency in rabbits**
- **affect hormones secretion and fertilization**

Ameliorating heat stress with anti-oxidants was found to be:

- **Cheaper**
- **physiologically friendly for rabbits compared to other methods**

Materials and Methods

- Experimental Site

- Housing

- Preparation of buffer

- Experimental animals, diets and design

Determination of thyroxine (T4) concentration

Reproductive performance of Rabbit Does

Statistical analysis

Results and Discussion

Table1: Effects of Bicarbonate Buffer, Vit C and BFPM on Thyroxine Levels (ng/ml) in Adult Rabbit Does

Parameters	CONTROL	$NaCO_3$	Vit. C	BFPM
Initial (24 h before mating)	56.00	55.33	62.67	64.67
During (14th Day of Pregnancy)	66.67^{c}	68.33^{bc}	76.35^{ab}	**82.42^{a}**
After (24 h after kindling)	68.50^{b}	**70.00^{a}**	**70.33^{a}**	**71.00^{a}**

Table 2: Effect of Bicarbonate Buffer, Vit C and BFPM on Reproductive Performance of Adult Rabbit Does

Parameters	CONTROL	Na_2CO_3	Vit. C
Number of parities/Doe	2	2	2
Average Litter size at birth	5.67[a]	4.00[b]	5.00[a]
Average Weight of litter (g)	236.67[a]	180.00[b]	200.00[b]
Average Weight of kit (g)	41.78[b]	45.00[a]	40.00[b]
Average Litter size at weaning	4.00[a]	0.67[b]	2.67[b]
Average Litter weight at weaning (g)	500.00[b]	550.00[b]	540.00[b]

Conclusion

- **Heat stress adversely affected thyroxine secretion in reproductive does**

- **The $NaCO_3$ buffer reduced reproductive performance in rabbits, whereas the vitamins especially the organic BFPM improved Kitten weight at weaning**

- **Vitamin antioxidants are recommended to be used in rabbit diets during hot conditions**

Many Thanks for Listening