

## Influence of baobab (*Adansonia digitata*) fruit pulp meal on semen characteristics and morphology of rabbit buck during hot season in Nigeria



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### Abstract

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The objective of the study was to evaluate the effect of baobab fruit pulp meal on semen characteristics and morphology of rabbit bucks during hot season in Nigeria. A total of 25 bucks of 10-12 months old were used. There were five (5) rabbits per group grouped as follows; T<sub>1</sub> (control) and T<sub>2</sub>-T<sub>5</sub> (Diets with graded levels of baobab fruit pulp meal BFPM at 2.5, 3.5, 4.5 and 5.5% inclusion levels). The experiment lasted for nine weeks. All managerial practices were duly observed. Semen was collected with the help of artificial vagina, and the semen samples were evaluated for ejaculate volume (ml), semen pH, semen colour, sperm motility (%) and sperm concentration ( $\times 10^6$  /ml). Sperm morphological parameters evaluated were live cells, dead cells, normal sperm, free tail and coil tail. It was observed from this study that 4.5% inclusion of baobab fruit pulp meal significantly ( $P < 0.05$ ) influenced semen volume, colour, motility, pH and concentration compared to 5.5% inclusion level and was similar to 2.5% and 3.5% inclusion levels, respectively. The treatment with 4.5% BFPM also significantly ( $P < 0.05$ ) improved the number of live cells (74.38%), reduced dead cells (25.62%) and increased number of normal cells (77.71%) compared to 65.67, 34.33, and 60.67% recorded by the control for live cells, dead cells and normal cells, respectively. This study revealed that 4.5% inclusion of BFPM improved semen quality during hot season.

**Keywords:** Baobab fruit pulp; heat stress; semen quality

### Introduction

Nigeria is characterized by two major seasons; dry and wet seasons. The dry season is sub divided into dry-hot and dry-cold season. However, on the average, temperature in Nigeria has never gone below 20°C. An average maximum temperature of 45°C has been recorded in some parts of Nigeria. Generally, periods of hotness is more than cold periods. Animals reared in Nigeria are always prone to heat stress. Heat stress has been a great challenge to successful animal improvement and production in the tropics. Several studies have been carried out on the effects of season on performance of rabbit bucks (Marai *et al.*, 2002; Theau-Clément *et al.*, 2009) and was reported that hot season was detrimental to semen

characteristics compared to cold season. Because Nigeria has hotter period than cold period, it became imperative to advocate research into ways of ameliorating heat stress with materials that are cost effective, readily available, and efficient. Baobab fruit pulp meal has these qualities (Agbessi Dos-Santos 1987).

*Adansonia digitata* is a massive deciduous tree, up to 20-30 m tall with a diameter up to 2-10 m at adult age (Sidibé and Williams 2002). The endocarp consists of a white mealy pulp, completely dry at maturity. The white, powdery pulp is reported to have a high content of vitamin C (Agbessi Dos-Santos 1987). When compared with synthetic vitamin C on a trial involving broilers chicken, it was reported that baobab improved feed intake, reduced rectal

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temperature and respiratory rate during hot season in Nigeria. BFPM can serve as an organic source of antioxidant because of the high vitamin C content it is reported to contain. Castellini, (2008), reported that the administration of antioxidants such as vitamin E, selenium, vitamin C, and carotenoids may reduce the oxidative stress and improve sperm motility. There are scanty or no literature on the use of baobab on the improvement of semen quality in rabbits especially during hot season. The aim of this study was to attempt to use baobab fruit pulp meal in improving semen characteristics, sperm morphological characteristics of rabbit buck during hot season in Nigeria.

### **Materials and methods**

#### ***Experimental Site***

This study was carried out at the Rabbit Unit, National Animal Production Research Institute (NAPRI), Shika-Zaria, Nigeria. Shika-Zaria lies between 11° 12' 42" N and 7° 33' 14" E at an altitude of 691m above sea level (Ovimaps, 2014).

#### ***Meteorological data of rabbit microclimate***

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 *et al.* (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:

< 27.8 = Absence of heat stress, 27.8 - 28.9 = Moderate heat stress, 28.9 – 30 = Severe heat stress and above 30 = Very severe heat stress.

#### ***Experimental animals, diets and design***

A total of twenty five Hyla crosses bucks with average weight of 2.7 kg were used in this study. The bucks were about 8 months old. The rabbits were randomly allotted into the experimental treatments of five treatment groups with five (5) rabbits per treatment in a completely randomized design. The study was carried out between the last weeks of February to May. BFMP was purchased in the powdery form from a local Market in Sabon-gari Zaria. The powdery substances (BFMP) were incorporated into five experimental diets at graded levels. Rabbits in the first group (T<sub>1</sub>) served as the control; rabbits in treatment 2 – 5 were fed diets containing graded levels of Baobab Fruit Pulp Meal (BFPM). Feed and water were served *ad libitum*. All recommended managerial practices were duly observed.

#### ***Semen quality evaluation***

The bucks were trained to serve an artificial vagina and a teaser doe two weeks prior to experiment period, as preliminary period in order to assure that the males were reproductively normal according to their libido and semen characteristics and to avoid the collection of ancient spermatozoa owing to prolonged storage within the epididymis. Semen was collected from each buck representing in their respective treatments for semen quality evaluation. Semen was collected twice a week during the study period for nine (9) weeks. Ejaculate volume (ml), semen pH, semen colour, sperm motility (%) and sperm concentration ( $\times 10^6$ /ml) were determined. Sperm morphological parameters evaluated were live cell, dead cells, normal sperm, free tail and coil tail according to the

methods of Rekwot *et al.* (1994) at the Artificial Insemination and Fertility Laboratory of the National Animal Production Research Institute (NAPRI), Ahmadu Bello University Zaria-Nigeria.

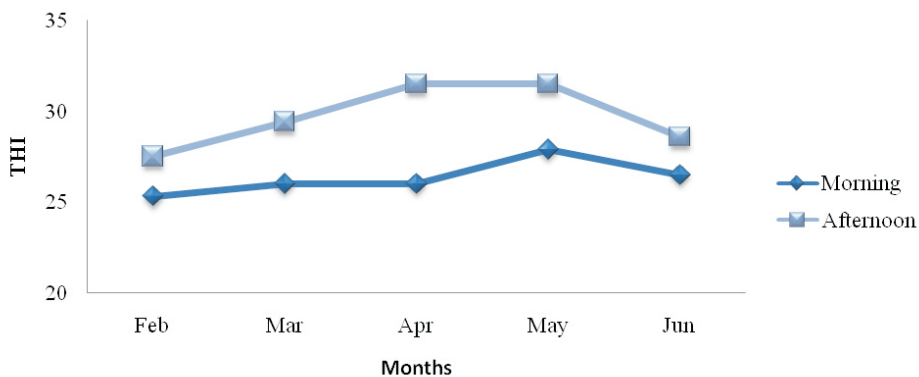
**Statistical Analysis**

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

**Results and discussion**

The monthly THI inside the rabbitry during the experimental period is shown in Figure

1. THI in the mornings averaged 26.44°C while the Afternoon THI averaged 28.74°C. The THI values kept increasing from the month of February with a peak in May. There was a decline in THI in June. The THI values of 29.4 (March), 30 (April), 31.5 (May) and 28.49 (June) indicated that the rabbit house was thermally severely stressful and very severely stressful (Marai *et al.*, 2001) in these months. The averaged THI of 29.85 during the experimental period showed that the rabbit house was thermally stressful and may exert adverse effects on the rabbits (Marai, 2001). Overall, data obtained indicated that THI in the afternoon was higher by 1.45 % than THI in the morning.



**Figure 1: Monthly Temperature Humidity Index inside the Rabbit house during the Experimental Period for Year 2**

**Semen characteristics evaluation** It was observed from Table 1 that 4.5% inclusion of baobab fruit pulp meal significantly ( $P < 0.05$ ) influenced semen volume, colour, motility, pH and concentration compared to 5.5% inclusion level and was similar to 2.5 and 3.5% inclusion levels respectively. For instance semen motility (77.09%) and concentration ( $102.50 \times 10^6$ ) was documented for 4.5% BFPM compared to 51.88% and  $71.92 \times 10^6$  recorded for semen

motility and concentration respectively at 5.5% BFPM. The poor semen quality recorded in the control of this experiment could be attributed to heat stress and could be explained by the degeneration of the germinal epithelium and to the partial atrophy of seminiferous tubules (Marai *et al.*, 1991). On the improvement in semen quality noticed in the treatment with 4.5% BFPM could be because of the antioxidant properties baobab fruit pulp meal is known

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to contain. Castellini *et al.*, (1999); Castellini, (2008), reported that the administration of antioxidants such as vitamin E, selenium, vitamin C, and carotenoids may reduce the oxidative stress and improve sperm motility. In particular, the role of antioxidants is to contrast the spermatogenic cell membrane lipid peroxidation and sperm DNA fragmentation caused by reactive oxygen species, responsible for male infertility in animals and man (Aitken *et al.*, 2003; Greco *et al.*, 2005).

### ***Sperm morphology evaluation***

Results in Table 2 indicate that the treatment with 4.5%BFPM significantly ( $P<0.05$ ) improved the numbers of live cells (74.38%) and increased numbers of

normal cells (77.71%) compared to 65.67%, 34.33%, and 60.67% recorded by the control for live cells, dead cells and normal cells respectively. This result is similar to the findings of Youssef *et al.* (2003) who found that vitamin C and E improved rabbit male fertility by increasing sperm concentration and total motile sperm and decreasing abnormal and dead sperm after 12 weeks. Vitamin C has been reported to protect cells from oxidation of substrates such as proteins, fatty acids, and DNA (Pincemail *et al.*, 1998). Antioxidants supplementation in drinking water has been observed as an interesting application to improve sperm quality in rabbits (Mangiagalli *et al.*, 2012).

**Table 1: Effect of Graded Levels of Baobab on Semen Quality Characteristics of Adult Buck**

Parameters	Treatments (%)					SEM
	(0)	2.5	3.5	4.5	5.5	
Volume (ml)	0.55 <sup>b</sup>	0.94 <sup>a</sup>	1.00 <sup>a</sup>	0.96 <sup>a</sup>	1.03 <sup>a</sup>	0.22
Colour	1.50 <sup>ab</sup>	1.93 <sup>a</sup>	1.17 <sup>a</sup>	1.2 <sup>ab</sup>	1.0 <sup>b</sup>	0.18
Motility (%)	28.33 <sup>c</sup>	65.67 <sup>ab</sup>	66.25 <sup>ab</sup>	77.09 <sup>a</sup>	51.88 <sup>b</sup>	4.13
pH	7.19 <sup>ab</sup>	7.30 <sup>a</sup>	6.75 <sup>ab</sup>	6.75 <sup>ab</sup>	6.71 <sup>b</sup>	0.12
Concentration (nx10 <sup>6</sup> )	6.61 <sup>c</sup>	82.71 <sup>b</sup>	86.88 <sup>b</sup>	102.50 <sup>a</sup>	71.92 <sup>b</sup>	9.58

**Table 2 Effect of Graded Levels (%) of BFPM on Sperm Morphology of Adult Rabbits (Bulk)**

Parameters	Treatments (%)					SEM
	Control	2.5%	3.5%	4.5%	5.5%	
Live cells (%)	65.67 <sup>b</sup>	68.96 <sup>ab</sup>	67.92 <sup>ab</sup>	74.38 <sup>a</sup>	65.21 <sup>b</sup>	2.30
Dead cells (%)	34.33 <sup>a</sup>	31.71 <sup>a</sup>	32.77 <sup>b</sup>	25.62 <sup>b</sup>	33.96 <sup>a</sup>	3.95
Normal Cells (%)	60.67 <sup>c</sup>	70.33 <sup>b</sup>	71.29 <sup>ab</sup>	77.71 <sup>a</sup>	68.34 <sup>b</sup>	1.73
Detached Head (%)	17.00 <sup>a</sup>	13.33 <sup>abc</sup>	12.54 <sup>bc</sup>	10.25 <sup>c</sup>	14.38 <sup>ab</sup>	0.54
Free tail (%)	6.98 <sup>b</sup>	6.82 <sup>b</sup>	7.11 <sup>ab</sup>	5.70 <sup>c</sup>	8.43 <sup>a</sup>	0.77
Coil Tail (%)	5.50 <sup>a</sup>	4.34 <sup>a</sup>	5.63 <sup>a</sup>	3.34 <sup>b</sup>	3.83 <sup>b</sup>	0.73
Bent Tail (%)	4.77	3.88	5.61	3.56	4.78	0.61

**Conclusion** Ameliorating heat stress with BFPM improved sperm quality and sperm morphology. A 4.5% inclusion of BFPM is adequate and effective in semen quality during hot season. It was therefore recommended that BFPM should be included in reproductive rabbit diets during hot periods in the tropics for optimum performance.

### **References**

- Agbessi Dos-Santos, D. 1987.** Tome Manuel de nutrition africaine: elements de base appliquée. Dakar: ACCT, IPD et Editions Karthala.
- Aitken, R. J., Irvine, M. D. and Wu, F. C. 1989.** Prospective analysis of sperm-oocyte fusion and reactive oxygen species generation as criteria

- for the diagnosis of infertility, *American Journal of Obstetrics and Gynecology*, 164: 542-551.
- Castellini, C., Lattaioli, P., Bernardini, M. 1999.** Effect of dietary supplementation with  $\alpha$ -tocopheryl acetate and ascorbic acid on qualitative characteristics and fertilizing ability of rabbit semen. *World Rabbit Sci.*, 7: 217-220.
- Castellini, C. 2008.** Semen production and management of rabbit bucks. In *Proceeding of 9th World Rabbit Congress, 10-13 June. Verona, Italy.* 555-559 .
- Greco, E., Iacobelli, M., Rienzi, L., Ubaldi, F., Ferrero, S. and Tesarik, J. 2005.** Reduction of the incidence of sperm DNA fragmentation by oral antioxidant treatment. *Journal of Andrology*, 26: 349-353.
- Mangiagalli, M. G., Cesari, V., Cerolini, S., Luzi, F., Toschi, I. 2012.** Effect of lycopene supplementation on semen quality and reproductive performance in rabbit. *World Rabbit Sci.*, 20: 141-148.
- Marai, I. F. M., ABD El-samee, A. M., El-gafaary, M. N. 1991.** Criteria of response and adaptation to high temperature for reproductive and growth traits in rabbits. *Options Mediterraneennes, Serie A*, 17, 127-134.
- Marai, I. F. M., Habeeb, A. A. M., Gad, A. E. 2002.** Rabbits' productive, reproductive and physiological performance traits as affected by heat stress: a review. *Livestock Production Science*, 78: 71-90.
- Ovimaps, 2014.** Ovi location map; Ovi earth imagery date; March 5th, 2014
- Pincemail, J., Meurisse, M., Limet, R., Defraigne, J. O. 1998.** Mesure et utilisation des antioxydants. *J. Med. Sphere*, 73: 233-239.
- S.A.S 2002.** Statistical Analysis System Institute, User's Guide. 6<sup>th</sup> Edition. North Carolina, USA
- Sidibe, M. and Williams, J. T. 2002.** Baobab. *Adansonia digitata. International Centre for Underutilised Crops*, Southampton, UK.
- Theau-Clément, M., Sanchez, A., Duzert, R., Saleil, G., Brun, J. M. 2009.** Etude des facteurs de variation de la production spermatique chez le lapin. *13èmes Journées de la Recherche Cunicole, 17-18 novembre 2009, Le Mans (France)*, 129-132.
- Yousef, M. I., Abdallah, G. A., Kamel, K. I. 2003.** Effect of ascorbic acid and Vitamin E supplementation on semen quality and biochemical parameters of male rabbits. *Anim. Reprod. Sci.*, 76: 99-111.

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