Original Research Article

Gonadal and Extra-gonadal Sperm Characteristics of Rabbit Bucks Treated With Aqueous Solution of Baobab (*Adansonia digitata* L.) Fruit Pulp

Abstract

This study was conducted to investigate the effect of Baobab Fruit Pulp (BFP) solution on gonadal and extra-gonadal sperm characteristics of rabbit bucks. Twenty-five (25) grower rabbit bucks, (6-7 weeks old) of mixed breed were first raised on standard grower diet for 12 weeks and used for the experiment. The rabbits were housed individually and assigned to five (5) different treatments: T1, T2, T3, T4 and T5 arranged in a 2x2 factorial within a completely randomized design. The treatments were: T1 (control); T2, bucks were administered 50g/l concentration of BFP solution for 7 days; T3 group was administered 50g/l concentration of BFP solution for 14 days; The T4 bucks were administered 100g/l concentration of BFP solution for 7 days and T5 animals were administered 100g/l concentration of BFP solution for 14 days. Animals were sacrificed and their reproductive organs removed and processed for sperm evaluation. The results showed that animals that were treated with 50g/l BFP for 7 days had significantly ($p<0.05$) higher sperm count, motile sperm, normal sperm and live sperm than the control, but similar values with other treatment groups. Main effects of concentration and administration period as well as their interaction effects on the sperm characteristics were not significant ($p>0.05$). It was concluded from the study that 50g/l BFP solution could be administered for 7 days to enhance sperm quality of rabbit bucks meant for breeding purpose.

Key words: Rabbit buck, Baobab fruit pulp, Sperm characteristics

Introduction

Rabbit rearing is becoming more and more attractive to many animal breeders due to its high fecundity, high mothering ability, adaptability to a wide range of conditions, high genetic variability, high roughage utilization and low cost of production (Zarrouki, *et al.,* 2004; Das and Yadav, 2007). However, sperm production and quality may result in foetal losses and pre-weaning mortality which may account for about 78% and in some situations 100% (Rashwan and Marai, 2000). In order to minimize such losses and ensure profitability in rabbit breeding, there is need to enhance the sperm production and quality of rabbit bucks intended for breeding through adequate nutritional supplementation. Baobab *(Adansonia digitata* L.) fruit pulp is one of the natural sources of nutrients that can fulfill that purpose.

Baobab *(Adansonia digitata* L.) is the most widely spread of the Adansonia species on the African continent. African baobab is a long-lived tree with multipurpose uses. Every part of the tree is reported to be useful including the fruit pulp (Gebauer *et al.,* 2002). Baobab Fruit Pulp (BFP) has traditionally been used as immunostimulant, anti-inflammatory, analgesic, pesticide, antipyretic, febrifuge and astringent in the treatment of diarrhoea and dysentery (Al-Qarawi *et al*., 2003). The aqueous extract of baobab fruit pulp has been reported to exhibit significant hepatoprotective activity. Castellini (2008) reported that baobab fruit pulp has the potential to enhance the reproductive and physiological attributes of farm animals. However there is dearth of technical information on the effects of aqueous solution of BFP on the reproductive characteristics of rabbit buck. The objective of this study was therefore, to determine the effects of baobab fruit pulp solution on the gonadal and extra- gonadal sperm characteristics of rabbit bucks.

Materials and Methods

Experimental site

This study was conducted in the rabbitry unit of the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. Ogbomoso is situated on Latitude $8^0 15^1$ N and Longitude $4^0 15^1$ E. The mean annual rainfall is 1247mm and the relative humidity is between 75 and 95%. The altitude is between 300m and 600m above the sea level while the mean temperature is 27^0C (Oguntoyinbo, 1978).

Processing of Baobab Fruit Pulp

The baobab fruits used for the experiment were obtained within the premises of the Ladoke Akintola University of Technology, Ogbomoso. The fruit pods were dipped in water, scrapped, broken and the seeds and pulp were removed manually. The pulp was separated from the seeds by pounding and sieving to give a fine powdery substance designated as Baobab Fruit Pulp (BFP). Aqueous solution of the BFP was constituted such that 50 or 100g of BFP was dissolved in 1 litre of distilled water to give either 50g/L or 100g/L BFP solution.

Experimental design

The experiment was laid out in a 2 X 2 factorial arrangement with a control in a completely randomized design.

Experimental animals and their management

Twenty-five (25) grower rabbit bucks (6-7 weeks old) of mixed breed were first raised on standard grower diet for 12 weeks before being assigned to five (5) different BFP treatments T1,

T2, T3, T4 and T5. The grower diet contained 15% CP and 2500 Kcal/kg Metablizable Energy. The gross composition of the grower diet is presented in Table 1.

The rabbits were housed individually in wooden hutches and fed *ad-libitum* but with measured quantity of feed. Clean cool water was available throughout the experimental period.

Administration of Baobab Fruit Pulp

The BFP was administered (5ml/rabbit/day) by gavage to each rabbit for either 7 or 14 days according to the treatment.

Gonadal and Extra-gonadal Sperm evaluation

After two weeks of BFP administration, the rabbits were sacrificed and their reproductive organs carefully excised and processed for sperm evaluation. The sperm characteristics were determined by homogenate method as described by Amao *et al.* (2012). A smear of the samples was made by cutting the left testis in the equatorial region and rubbing the cut tissue on a clear glass slide. Two drops of eosin- nigrosin dye that had been thoroughly mixed were added. A smear was made on another slide and viewed under a light microscope to identify normal and abnormal cells from several fields on the slides. The cells were then expressed as the percentage number of cells counted on each field of the slide. Dead cells were also identified and recorded.

Sperm count was determined haemocytometrically by homogenization technique as described by Adejumo, (2006) and Amao *et al*. (2012). The tunica albuginea was carefully removed from the testis and the testicular parenchyma was weighed. A portion of the parenchyma tissue was taken and homogenized by maceration with a pair of scissors for 5 minutes in a beaker containing 10ml of physiological saline solution. The homogenate was filtered through a double layer cheese

cloth and the filtrate diluted to ratio 1:20 with deionized water. Some drops of the homogenate were introduced into an improved Neubauer haemocytometer counting chamber. All the elongated spermatids and mature sperm cells in the four diagonal and the centre squares of the haemocytometer were counted in each diluted homogenate. Motility was determined by a modification of the method of Ewuola and Egbunike (2010). A portion of the caudal epidydimis was also homogenized and filtered. A drop of the homogenate was placed on a sterile slide, covered with a cover slip and the movement of the sperm observed under the microscope at X 400 magnification and scored between 0 and 100%.

Statistical analysis

All data generated were subjected to factorial analysis of variance (ANOVA) (SAS, 2001). Means were separated by Duncan's option of the same statistical software.

Results and Discussion

Results

The results of this study are presented in Tables 2-5. Table 2 shows the effect of aqueous solution of baobab fruit pulp on the sperm characteristics of rabbit bucks. The aqueous solution of baobab fruit pulp had a significant ($p<0.05$) effect on the sperm count, sperm motility, sperm morphology and live sperm of the rabbit bucks. Animals that were treated with 50g/l BFP for 7 days had significantly ($p<0.05$) higher sperm count, motile sperm, normal sperm and live sperm than the control, but similar values with other treatment groups.

Table 3 shows the effect of the concentration of aqueous solution of baobab fruit pulp on the sperm characteristics of rabbit bucks. The concentration had no significant effect on the sperm

characteristics of rabbit bucks. However, sperm count and live sperm had higher numerical values at 50g/l concentration than at 100g/l concentration.

Table 4 shows the effect of duration of administration of aqueous solution of baobab fruit pulp on the sperm characteristics of rabbit bucks. The sperm characteristics were not significantly ($p>0.05$) affected by duration of administration of the BFP solution.

Table 5 shows the interactive effect of concentration and duration of administration of baobab fruit pulp on the sperm characteristics of rabbit bucks. The interaction effect on the sperm characteristics of rabbit bucks was not significant ($p>0.05$). However, sperm count for rabbit bucks administered BFP solution at 50g/l and 100g/l concentration for 14 days was numerically higher than for 7 days, while live sperm and normal sperm were numerically higher for bucks that were treated for 7 days.

Discussion

The observation from this study that sperm characteristics of rabbit bucks treated with BFP solution were significantly higher than the control group is an indication that BFP supported sperm production in the rabbit bucks. This could be attributed to the high natural vitamin C content and antioxidant capability of the BFP (Vertuani *et al*., 2002; Besco *et al*., 2007; Lamien-Meda *et al*., 2008; Blomhoff *et al*., 2010; Brady, 2011). This observation is in agreement with the findings of Najjar *et al.* (2013) and Anoh *et al*. (2016). Anoh *et al.* (2016) reported that Vitamin C and baobab fruit pulp meal increased ejaculate volume, motility and sperm concentration. This suggests a high fertility rate for rabbit bucks treated with BFP. Oyeyemi and Okediran (2007) reported that high concentration of spermatozoa is an indication of possible high fertility rate. From this study, the aqueous solution of baobab fruit pulp enhanced sperm

morphology by increasing the proportion of the normal sperm. This observation is consistent with the results of Anoh, *et al*. (2016). The improvement in sperm motility of the bucks treated with BFP solution over the control could also be due to the high vitamin C and some mineral contents of baobab fruit pulp as reported by Castellini (2008). Baobab fruit pulp has been reported to be rich in antioxidants. Vitamin C is one of the potent antioxidants that are widely used for animals and man. Antioxidant supplementation in drinking water has been proven to improve sperm quality in rabbits (Mangiagalli *et al*., 2012). The fact that bucks that were administered 50g/l BFP for 7 days had significantly higher sperm characteristics than the control, but similar values with other treatments is an indication that only a low concentration not higher than 50g/l is sufficient to stimulate increased sperm quality and quantity in rabbit bucks.

Conclusion and Recommendation

It could be concluded from this study that aqueous solution of baobab fruit pulp enhanced the sperm characteristics of rabbit bucks. This study shows that a concentration of 50g/l aqueous solution of baobab fruit pulp administered for 7 days resulted in optimum positive effect on the sperm characteristics of the rabbits. Therefore, aqueous solution of BFP at 50g/l for 7 days can be recommended to enhance the sperm quality of rabbit bucks that are meant for breeding purpose.

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Table 1: The gross composition of the grower diet

Ingredients (%)	Composition
Maize	26.24
Soya beam meal (SBM)	5.75
Corn bran	35.00
Palm kernel cake	12.00

Fish meal (FM)	0.50
Wheat offal	17.00
Bone meal	1.50
Oyster shell	1.50
Salt	0.20
Premix*	0.10
Methionine	0.10
Lysine	0.10
TOTAL	100
Calculated nutrients**	
Metabolize energy (kcal/kg)	2522.30kcal/kg
Crude protein (%)	15(%)
Crude fibre (%)	7.99%

*Premix composition (per kg of diet): Vitamin A, 12,500lv; Vitamin D3, 2500lv, Vitamin E, 50.00mg:KB,2.50mg: VitaminB1. 3.00 Vitamin B2, 6.00mg; Vitamin B6, 6.00mg;niacin, 40mg; calcium pantothenate, 10mg; biotin, 0.08mg; Vitamin B12, 0.25mg; folic acid. 1.00mg; chlorine chloride, 300mg; manganese. 100mg, iron, 50mg; zinc, 45mg; copper, 2.00mg; iodine, 1.55mg; cobalt, 0.25mg selenium. 0.10m; antioxidant. 200mg., **Calculated using Pauzenger (1985) formula (kcal/kg).

Table 2: Effect of aqueous solution of baobab fruit pulp on the sperm characteristics of rabbit bucks

Parameters	T1 (control)	T2 (50g/l 7 days)	T3 (50g/l 14 days)	T4 (100g/l 7 days)	T5 (100g/l 14 days)	SEM

Sperm count (x 10^6)	254.00^b	302.67^a	318.33^a	293.67^a	309.33^a	9.10
Motile sperm (%)	65.00^b	80.00^a	74.67^{ab}	75.33^{ab}	79.33^a	2.11
Normal sperm (%)	70.00^b	82.67^a	76.67^{ab}	84.67^a	75.33^{ab}	1.84
Live sperm (%)	74.67^b	88.67^a	86.00^a	86.33^a	81.67^{ab}	1.62

ab: Means with different superscript in the same row are significantly different.

Table 3: Effect of the concentration of aqueous solution of baobab fruit pulp on the sperm characteristics of rabbit bucks

	Concentration (g/l)		
Parameters	50	100	SEM
Sperm count (x 10^6)	310.50	301.50	13.22
Motile sperm (%)	77.33	77.33	3.01

Normal sperm (%)	79.67	80.00	2.77
Live sperm (%)	87.33	84.00	1.89

Table 4: Effect of administration period of aqueous solution of baobab fruit pulp on the sperm characteristics of rabbit bucks

	Administration period (days)

Parameters	7	14	SEM
Sperm count (10^6)	298.17	313.83	12.31
Motile sperm (%)	77.67	77.00	2.91
Normal sperm (%)	83.67	76.00	2.15
Live sperm (%)	87.50	83.83	1.82

Table 5: Interactive effect of concentration and administration period of baobab fruit pulp on the sperm characteristics of rabbit bucks

Concentration	Administration period (days)

Parameters	(g/l)	7	14	SEM
Sperm count	50	302.67	318.33	20.47
(10^6)	100	293.67	309.33	16.62
	SEM	11.19	25.90	
Motile sperm	50	80.00	74.67	3.07
(%)	100	75.33	79.33	4.88
	SEM	2.32	5.63	
Normal sperm	50	82.67	76.67	3.70
(%)	100	84.67	75.33	2.91
	SEM	2.62	3.98	
Live sperm (%)	50	88.67	86.00	3.19
	100	86.33	81.67	1.89
	SEM	1.89	3.19	