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Testicular Characteristics and Daily Sperm Production of Male Rabbits Placed on Varying Levels of Pawpaw Seed (*Carica Papaya*) Meal

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Abstract In a 12 weeks feeding trial, forty weaned mixed breed buck rabbits with average weight of 691g were used to assess the testicular characteristics and daily sperm production of rabbit fed pawpaw seed meal. Pawpaw seed meal was included at 0%, 10%, 20%, 30% and 40% in the experimental diet. The animals were randomly and equally allotted to the diets and housed individually. At the end of the feeding trial 6 animals per treatment were sacrificed and their testes dissected. The testes were weighed and processed. Right testis volume, left testis volume, left testis density and relative testes weight were not significantly different ($p>0.05$). However, right testis weight, left testis weight, right testis density, paired testes weight and daily sperm production were significantly ($p<0.05$) influenced by the treatment. The result showed that animals on 20%PSM compete favourably with the animals on control diet (0%PSM) in terms of right testis weight, left testis weight, right testis density and daily sperm production. This investigation suggests that inclusion of pawpaw seed meal up to 20% in rabbit diet had no deleterious effect on testicular and daily sperm production of rabbits.

Keywords: *testes, daily sperm production, pawpaw seed, rabbit*

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1. Introduction

The reproductive function of the male involves the production of spermatozoa and the deposition of these into the female reproductive tract. Sperm cells are produced in the seminiferous tubules of the testes and are then transported through the rete testes to the epidimymides, where they are stored and matured. Spermatogenesis requires ~60 days in most mammals. It encompasses a series of successive mitotic divisions, two meiotic divisions and the transformation of haploid spermatids into spermatozoa [1]. Spermatogenesis is susceptible to disruption by many physical or chemical agents, which can produce alterations in seminal quality that may be manifested either quickly or weeks thereafter [1]. The production of sperm cells is a continuous process once it has been initiated. However, it can change in rate at times in some species. Sperm cells production rates are breed dependent. Successful reproduction requires two major contributions from the male: the production of adequate numbers of viable sperm, and the capacity to mate or to be used for semen collection, so that sperm may be used for artificial insemination. Accordingly, it is important to select and manage the male to maximize sperm production and its harvest [1]. The two general methods of evaluating the breeding soundness potential of bulls are either breeding a large number of normal, fertile females and determining pregnancy/calving rates or conducting a breeding soundness evaluation [2]. Although a breeding trial is the ultimate test of fertility, it is expensive, particularly if reproductive performance is poor. Therefore, it is strongly recommended to conduct a standard breeding soundness evaluation before the breeding season [2]. The evaluation of breeding soundness remains an important aspect of the farmer's reproductive management practice. Several measurement criteria, such as scrotal circumference, sperm motility and morphology, have been extensively studied in some bulls [3,4]. [3] Suggested that scrotal circumference was highly correlated to paired testes weight, volume and goanadal epididymis reserves in bulls ($r = 0.99$) and this is related to sperm production potential. Also,

[3] affirmed that scrotal circumference is an indirect means of measuring testicular weight and sperm production. Generally, daily sperm production has been variously reported in other animal species to be positively correlated with scrotal circumference [3]. Highly significant correlations were found between daily sperm production and scrotal length, width, and circumference in Maradi bucks [3,5].

Nutrition is an important factor in growth as it enhances the hereditary make-up, resulting in maximum growth. There is a relationship between nutrition and productivity which has a great effect on the production and reproductive performance of rabbits. Effects of nutrition on reproduction of farm animals have been reported [6]. Onset of puberty is a function of body weight than age. The age at puberty is influenced by many factors, including the physical environment, photoperiod, age, environmental temperature, growth rate and body weight. Bulls receiving high nutrition had greater body weight and backfat, but paired testes weight was not affected by diet [2]. Moreover, bulls receiving high nutrition had less daily sperm production and epididymal sperm reserves and greater proportion of sperm abnormalities. It was speculated that increased dietary energy may adversely affect sperm production and semen quality due to fat deposition in the scrotum, thereby reducing heat radiated from the scrotal skin and increasing scrotal and testicular temperatures [7]. In another study, bulls fed high-nutrition diets had greater scrotal circumference than those fed medium-nutrition diets, but paired testes weights were the same [7]. Since scrotal weight was greater in bulls fed high nutrition, perhaps fat deposition in the scrotum increased scrotal circumference in these bulls

Carica papaya is one of the most popular, cheapest economically important fruit tree grown and consumed for its nutritional content. Pawpaw seed contains many active ingredients such as caricacin, an enzyme carpasemine, a plant growth inhibitor and oleanolic glycoside [8]. Pawpaw seed is a waste product of carica papaya which is inedible to human but can be fed to livestock to reduce the competition between human and animals as a substitute to commercial livestock feed ingredients. Since nutrition has direct influence on growth and sperm production, this prompted the design of this investigation to assess the testicular and epididymal sperm reserves and sperm production of rabbits fed pawpaw seed in their diet.

2. Materials and Methods

2.1. Experimental Site, Animal Management and General Procedures

The experiment was carried out at the rabbitry unit of the Teaching and Research Farm, The Oke Ogun Polytechnic, Saki. Five diets were formulated including the control (diet 1) with crude protein of 16.19%, crude fibre of 10.18% and digestible energy of 2744kcal/kg. A total of forty weaned rabbits with average weight of 691.00g were randomly assigned to the five dietary treatments such that each treatment had 8 animals housed individually, in a completely randomized designed experiment that lasted for twelve (12) weeks. The animals were fed *ad libitum* twice daily at 08.00h and 16.00h. At the end of the feeding trial, the animals were anesthetized and sacrificed and their reproductive tracts were dissected. The testes were carefully removed and weighed. The right testis and the left testis were homogenized in 0.154M NaCl (physiological saline) at the rate of 5ml/g testis. The suspensions were mixed and filtered through a double layer of sterile gauze into clean glass test tubes and the sperm concentrations therein determined by direct haemocytometric count after proper dilution (1:20 v/v) in 0.154M NaCl [9,10].

2.2. Determination of Daily Sperm Production (DSP)

The daily sperm production was estimated from the testicular sperm reserves. The estimation of DSP from testicular homogenates was based on the fact that the nuclei of elongated spermatids are resistant to physical destruction at some point during spermatogenesis. The DSP of the rabbits was therefore calculated with the formula proposed by [11] as follows:

$$DSP = \frac{Testicular\ sperm\ count}{Time\ divisor\ (3.43)}.$$

2.3. Data Analysis

All data obtained from this investigation were subjected to analysis of variance of completely randomized design using the [12] package and the means were separated using Duncan multiple range test of the same software.

Table 1. Composition of experimental diet

Ingredients	0%PSM	10%PSM	20%PSM	30%PSM	40%PSM
Maize	34.11	34.11	34.11	34.11	34.11
Wheat offal	41.75	41.75	41.75	41.75	41.75
Groundnut cake	10.52	9.42	8.62	7.35	6.31
Pawpaw seed meal	-	1.10	2.10	3.17	4.21
Palm kernel cake	8.62	8.62	8.62	8.62	8.62
Bone meal	4.00	4.00	4.00	4.00	4.00
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Nutrient composition (calculated)					
Energy (Kcal/ME/Kg)	2503.09	2530.00	2528.08	2529.50	2529.81
Crude protein (%)	18.65	18.55	18.93	18.67	18.91
Crude fibre (%)	10.31	10.34	10.30	10.33	10.33

Table 2. Testicular characteristics and daily production of rabbit bucks fed diet containing pawpaw seed meal

Treatment	0%PSM	10%PSM	20%PSM	30%PSM	40%PSM	SEM
Live weight(g)	1350.0	1550.0	1650.0	1625.0	1260.0	30.28
Right testis weight (g)	3.30^{a}	2.11^{ab}	3.11^{a}	2.90^{ab}	1.41^{b}	0.28
Left testis weight (g)	3.35^{ab}	2.76^{bc}	3.58^{a}	2.26^{c}	1.54^{d}	0.30
Right testis volume (ml)	2.25	2.85	2.85	2.75	1.35	0.31
Left testis volume (ml)	3.00	2.25	3.00	3.00	1.40	0.32
Right testis density (g/ml)	1.46^{a}	0.75^{b}	1.10^{ab}	1.05^{ab}	1.05^{ab}	0.08
Left testis density (g/ml)	1.14	1.37	1.13	0.87	1.09	0.14
Paired testes weight (g)	6.59^{a}	4.86^{d}	6.41^{b}	5.53^{c}	2.91^{e}	0.00
Relative testis weight	0.47	0.33	0.37	0.34	0.23	0.04
Daily sperm production($X10^{6}$)	9.81^{a}	7.95^{ab}	9.34^{a}	6.12^{b}	8.25^{a}	0.51

3. Results and Discussion

Live weight, right testis volume, left testis volume, left testis density and relative testis weight were not significantly different ($p>0.05$) among the dietary treatments. However, the testicular weight were significantly ($p<0.05$) influenced by the treatments. Right testis weight of 0%PSM and 20%PSM were similar with that of 10%PSM and 30%PSM but were significantly bigger than the testis weight of 40%PSM ($p<0.05$). Left testis weight of 0%PSM and 20%PSM were similar but were significantly ($p<0.05$) bigger than left testis weight of 30% and 40% PSM. This might result from the level of active ingredients present in pawpaw seed that can be adjudged optimum at 20%. Paired testes weight was significantly influenced by the treatment with 0%PSM having the highest value (6.59) followed by 20% and 30%PSM (6.41 and 5.53 respectively) with 40%PSM having the lowest value. Daily sperm production is significantly higher ($p<0.05$) in 0%PSM, 20%PSM and 30%PSM ($9.81x10^{6}$, $9.34x10^{6}$ and $8.25x10^{6}$ respectively). The DSP of rabbits placed on 20%PSM and 30%PSM were statistically identical to those on the control diet. This agrees with the findings of [13] that sperm production is a function of testicular size. As testicular weight followed the same trend with daily sperm production. In this study the inclusion of pawpaw seed in male rabbit diet showed slight differential effect between the treatments on daily sperm production.

4. Conclusion

Inclusion of pawpaw seed meal up to 30% in buck diet has no deleterious effect on testicular characteristics and daily sperm production of male rabbits. Pawpaw seed meal effect on right testis weight, testis density and daily sperm production at 20% and 30% inclusion level were similar to the results obtained from the control (0%). Reproductive performance of bucks can be enhanced with the inclusion of pawpaw seed meal up to 30% inclusion level.

5. Recommendation

Pawpaw seed meal, a considered waste can be transformed into livestock feed especially in rabbit production as its inclusion up to 30% was investigated not detrimental to male reproduction. Further studies should look into processing the pawpaw seed before inclusion in rabbit diet.

References

[1] Peter J. Chenoweth and Steven Lorton. (2014). Animal andrology: theories and applications Wallingford, Oxfordshire, Uk CABI.

[2] Heriberto Rodríguez-Martínez and Fernando Peña Vega. (2013) Semen technologies in domestic animal species Animal Frontiers Vol. 3, No. 4 pp 26-33.

[3] Farotimi O.J. (2005). Relationships between body weight, body linear measurements and reproductive potential of dutch rabbit bucks. B. Agric Dissertation, Department of Animal science, university of Ibadan, Nigeria.

[4] Memon, A.M. (1983). Large animals practice vol. 5 (3,619).*Vet. Clinic of North America.*

[5] Carew, B. and Egbunike, G.N. (1980). Sperm production rate in Maradi goats extensively Managed in a tropical environmental. In: 9th int'l. Congress of Anim. Reprod. & artificial insemination. 16th-20th June, 1980. Madrid, Spain.

[6] Vincent, L. C., Williams, H. and Hill. R. (1985). The Influence of a low nutrients intake after mating on gestation and pre-natal survival of lambs. *Brazilian Vet. Journal* 141: 611-617.

[7] John P. Kastelic (2013) Male involvement in fertility and factors affecting semen quality in bulls Animal Frontiers Vol. 3, No. 4 pp 20-25.

[8] Kobayashi H., Wang, C. and Pomper, K.W. (2008). Phenolic content and antioxidant capacity of pawpaw fruit at different ripening stages. Hortscience 43; 268-270.

[9] Egbunike, G. N., Holtz, W., Endell, W. and Smidt, D. (1975). Reproductive capacity of German Landrace boars. I. Gonadal and extra-gonadal sperm reserves. *Zuthhygiene*, II, 35-37.

[10] Igboeli, G. and Rakha, A. M. (1971). Gonadal and extra gonadal sperm reserves of indigenous Central African bulls. *J. Reprod. Fert.* 25: 107-109.

[11] Amann, R.P. (1970). Sperm production rates. In: the testis. Ed. A.D. Johnson, W.R. Gomes and N.L. VanDenmark. Academic press, N.Y.

[12] SAS (1999). SAS/STAT User's Guide. Version 8 for windows. SAS Institute Inc., SAS Campus Drive, Cary, North Carolina, USA.

[13] Ekeocha, AH. (2002). Effect of "Inhibin" from bovine testicular and follicular fluids on attainment of puberty in male rabbits. M.Sc. Dissertation of the Dept. of Anim. Sci. University of Ibadan, Nigeria.

[14] Bongso, T.A., Jainudeen, M.R. and Sithzalrah, A. (1982). Relationship of scrotal circumference to age, bodyweight and onset of spermatogenesis in goats. Theriogenesis. 18(15): 513-524.

[15] Devendra, C. and Burns, M. (1979). Goats prod. in the tropics. Farnham Royal, England. Common Wealth Agricultural Bureau.

[16] Khalil, M.M.H, Ismail, E.H., El-Baghdady, K.Z. and Mohamed D. (2014). Green synthesis of silver nanoparticules using olive leaf extract and its antibacterial activity. *Arabian Journal of Chemistry*, 7(6): 1131-1139.

[17] Marire, B.N. (1987). Prediction of sperm production from scrotal circumference in red sokoto bucks. Proceedings11th Annual conf. NSAP, ABU, Zaria. 148-151.