Nigerian J. Anim. Sci. 2022, 24 (1): 49-56

Growth performance, testicular and epididymal characteristics of rabbit bucks fed black seed (*Nigella sativa*) supplemented diets

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***Target Audience:** Rabbit breeders, Farmers, Animal scientists.*

Abstract

This study investigated supplementation effect of unprocessed black seed on the growth, testicular and epididymis characteristics of rabbit bucks. Forty (40) weaned male rabbits were weight-balanced and assigned to four dietary treatments with 10 animals each. The rabbits were fed with diet containing 16% crude protein and 2300 Kcal/kg metabolizable energy. The four experimental treatments were supplemented with black seed at levels of 0, 0.5, 1.0 and 1.5% denoted as T1, T2, T3 and T4, respectively. Data were obtained for weight gain and feed intake. Feed conversion ratio (FCR) was calculated accordingly. Other parameters evaluated include testicular and epididymal characteristics. Data collected were subjected to one-way analysis of variance. A significant ($p<0.05$) increase was observed in the growth indices as black seed supplementation increased up to 1.0%. Rabbits fed T3 recorded significantly ($P<0.05$) higher average daily gain, average daily feed intake and the best FCR. Significant ($p<0.05$) increase was observed in all the testicular and epididymal variables as black seed supplementation increased up to 1.0%. In conclusion, supplementation of black seed improved the growth performance, testicular and epididymal characteristics of rabbit bucks. Rabbits fed 1.0% black seed supplementation elicited the best performance in terms of the growth, testicular and epididymal characteristics.

***Key words:** Reproduction; production; rabbits; testis; epididymis.*

Description of Problem

In developing countries, rabbits are excellent and economical producers of animal protein to cover the ever-increasing human needs (1). Herbal medicinal plants and their extracts have been used for different purposes for improvement of growth, productive and reproductive performance in rabbits. Plant feed supplements constitute a wide group of biologically active compounds with potential positive effects on animal health and productivity (2). Many studies have been carried out to explore the probable beneficial effects of herbal medicine plants as anti-oxidant, anti-inflammatory and immune-modulatory (3).

Black seed (*Nigella sativ*a) has been reported as a healthy supplement alternative in animal's diets. The beneficial effects of *Nigella sativa* in gynecologic disorders have also been reported extensively. *Nigella sativa* has been proved to improve reproductive performance of male animals concerning semen quality (4). *Nigella sativa*'s safety upon administration in animals and human has also been documented (5).

Nigella sativa does not only promote animal's health and productive performance, but also plays a significant role as a natural antioxidant and immuno-stimulant. The use of natural and effective alternatives might be helpful compared to synthetic supplements. Despite the numerous beneficial phytochemicals embedded in *Nigella sativa*, and how these phytochemicals make it an excellent natural supplement alternative in livestock's diet, it is still underutilized for improvement of livestock performance.

Thus there is paucity of information on the supplementation of unprocessed *Nigella sativa* grains in rabbit buck's diet. Therefore, the present experiment was conducted to determine appropriate supplementation level of *Nigella sativa* that can enhance productive, reproductive performances and generally improve the physiological wellbeing of rabbit bucks without adverse effect(s).

Materials and methods

Experimental site

The experiment was carried out at the Rabbit Production and Research unit, Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso. Ogbomoso is situated in a derived savannah zone of southwest of Nigeria and lies on lat. 8° 8' 31.7940" N and long. 4° 14' 42.6696" E. The altitude is between 300m and 600m above the sea level while the mean temperature and annual rainfalls are 27^0C and 1247mm respectively (6).

Animals and Management

Forty (40) weaned rabbit bucks (Chinchilla X New Zealand white, 5-6 weeks old) obtained from a reputable breeding farm in Ogbomoso, Oyo State, Nigeria were used for the experiment. The bucks were individually housed in wooden hutches and subjected to two weeks acclimatization period. They were treated against potential endo- and ecto-parasites and fed diet containing 16% crude protein and about 2300 kcal/kg metabolizable energy. They were balanced for weight and assigned to four treatment groups of ten rabbits each in a completely randomized design. The four treatment groups were designated as T_1, T_2, T_3 and T_4. The rabbit bucks were weighed at the commencement of the experiment and subsequently once per week. They were offered measured quantity of feed but *ad libitum and* cool, clean water was made available throughout the feeding trial which lasted twelve weeks. All routine management practices were well observed. *Nigella sativa* was supplemented in their diets at different levels as follows:

T1 (**Contro**l**):** No *Nigella sativa* supplementation
T2: 5g of *Nigella sativa* per kg of diet
T3: 10g of *Nigella sativa* per kg of diet
T4: 15g of *Nigella sativa* per kg of diet

Proximate analysis of black seed (*Nigella sativa*)

The crude protein, ether extract, ash and crude fiber contents were determined through the conventional procedure of (7). Total nitrogen was determined by micro-Kjeldahl method using Markham's distillation apparatus while the CP content was calculated by multiplying %N by factor of 6.25. Table 1 shows the gross composition of experimental diets.

Table 1: Gross composition of experimental diets

Feed Ingredients (%)	T1 (Control)	T2 (0.5% *N.sativa)*	T3 (1.0% *N.sativa)*	T4 (1.5% *N.sativa)*
Maize	32.61	32.61	32.61	32.61
Soyabean meal	16.39	15.89	15.39	14.90
Nigella sativa	0.00	0.50	1.00	1.50
Brewers dried grains	15.00	15.00	15.00	15.00
Rice husk	30.00	30.00	30.00	30.00
Fish meal (72%)	3.00	3.00	3.00	3.00
Oyster shell	2.00	2.00	2.00	2.00
Bone meal	0.25	0.25	0.25	0.25
Vitamin premix*	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Lysine	0.15	0.15	0.15	0.15
Methionine	0.10	0.10	0.10	0.10
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**
Determined Nutrients				
CP (%)	16.17	16.14	16.11	16.15
CF (%)	13.73	13.74	13.74	13.73
Metabolizable Energy (Kcal/kg)**	2335.76	2336.00	2336.24	2336.49

Vitamin Premix: Supply per kg diet: 2 000 000 iu vit. A; 400 000 iu D_3; 8.0 g vit. E; 4 g vit. b_1; 1.0 g vit. B_2; 0.6 g vit.; 0.4 mg vit. B_{12}; 24.0 g Niacin; 0.2 g Folic acid; 8.0 g Biotin; 48.0 g Choline; 320.0 g BHT; 16.0 g Manganese; 8.0 g iron; 7.2 g] Zinc; 0.32 copper; 0.25 iodine; 36. 0 mg cobalt; 16.0 mg selenium.** Metabolizable Energy calculated using (8)

Data collection

Growth performance

At the end of the feeding trial, weight change of the rabbits was obtained by subtracting the initial weight from the final weight. Feed intake was determined by subtracting feed left over from feed offered to the animals. Feed conversion ratio (FCR) was determined by calculating the ratio of daily feed consumed in gram to daily weight gain in gram per treatment.

Testicular morphometry

Five rabbits were randomly selected and humanely sacrificed from each treatment group on day 84 of the experiment. Testes were carefully dissected from the sacrificed animals. Testis length, testis width and testis volume were measured. The testis length and testis width were measured with the aid of a pair of vernier calipers, while the testis volume was measured by water displacement according to Archimedes principle (9).

Statistical analysis

Data obtained from the experiment were subjected to one-way analysis of variance (ANOVA), using SAS (10). Means were separated using Duncan's multiple range test (DMRT) of the same statistical package.

Results

Growth performance of rabbit bucks fed diets supplemented with black seed (Nigella sativa)

Table 2 shows the growth response of rabbit bucks fed diets supplemented with black seed.

Significant ($p<0.05$) variations were observed in the final weight, total weight

gain, average daily gain and average daily feed intake. Bucks that were supplemented with 1% *Nigella sativa* had significantly ($p<0.05$) lower FCR than other treatments.

Table 2: Growth responses of rabbit bucks fed varying supplementation of black seed (*Nigella sativa*)

Parameters	T1 (Control)	T2 (0.5% *N. sativa*)	T3 (1.0% *N. sativa*)	T4 (1.5% *N. sativa*)	±SEM	P value
Initial weight (g)	702.00	684.00	672.50	695.00	9.01	0.74
Final weight (g)	1808.00^{c}	2115.40^{b}	2446.50^{a}	2169.33^{b}	53.45	0.00
Average weight change (g)	1106.00^{c}	1431.40^{b}	1774.00^{a}	1474.33^{b}	55.82	0.00
Average daily weight gain (g/day/rabbit)	45.20^{c}	52.38^{b}	61.16^{a}	53.99^{b}	1.31	0.00
Average daily feed intake (g/day/rabbit)	45.20^{c}	52.38^{b}	61.16^{a}	53.99^{b}	1.31	0.00
Feed conversion ratio	3.44^{a}	3.08^{b}	2.90^{c}	3.13^{b}	0.50	0.00

abc: Means on same row with different superscripts differ significantly ($P<0.05$)
SEM: Standard Error of Mean

Testicular morphometrics of rabbit bucks fed black seed (Nigella sativa) supplemented diet

Table 3 shows the effect of *Nigella sativa* supplemented diets on the testicular morphometrics of rabbit bucks. Testicular morphometrics were significantly ($p<0.05$) affected by the treatment diets. A significant ($p<0.05$) increase was observed in all the variables as the supplementation level increased up to 1% *Nigella sativa* supplementation level (T3). However at T4 (1.5% *Nigella sativa*) there was a decline in values for all the parameters evaluated.

Rabbit bucks supplemented with 1% *Nigella sativa*, recorded a significantly higher ($p<0.05$) testicular morphometric values compared to T1, T2 and T4. The control (T1) recorded the lowest value ($p<0.05$) for all the parameters compared to other treatment groups.

Table 3: Responses of rabbit bucks Testicular morphometrics to black seed (*Nigella* sativa) supplemented diets

Parameters	T1 (Control)	T2 (0.5% *N. sativa*)	T3 (1.0% *N. sativa*)	T4 (1.5% *N. sativa*)	±SEM	P value
Left testis weight (g)	1.05^{c}	1.31^{bc}	1.92^{a}	1.42^{b}	0.80	0.00
Right testis weight (g)	1.07^{c}	1.43^{b}	1.96^{a}	1.53^{b}	0.84	0.00
Left testis length (cm)	2.12^{c}	2.50^{bc}	3.10^{a}	2.54^{b}	0.19	0.00
Right testis length (cm)	2.18^{c}	2.55^{bc}	3.30^{a}	2.63^{b}	0.11	0.00
Left testis width (cm)	0.72^{c}	0.83^{b}	0.97^{a}	0.83^{b}	0.02	0.00
Right testis width (cm)	0.73^{c}	0.84^{b}	0.97^{a}	0.83^{b}	0.02	0.00
Left testis volume (ml)	0.22^{b}	0.25^{b}	0.39^{a}	0.27^{b}	0.02	0.00
Right testis volume (ml)	0.22^{c}	0.23^{c}	0.39^{a}	0.29^{b}	0.02	0.00
Tunica albuginea weight (g)	0.94^{c}	0.16^{b}	0.19^{a}	0.16^{b}	0.01	0.00
Parenchyma weight (g)	0.96^{c}	1.15^{bc}	1.73^{a}	1.32^{b}	0.07	0.00

abc: Means on same row with different superscripts differ significantly ($P<0.05$)
SEM: Standard Error of Mean

Epididymal characteristics of rabbit bucks fed black seed (Nigella sativa) supplemented diets

The effect of black seed-supplemented diets on the epididymal characteristics of rabbit bucks is presented in Table 4. The left epididymal weight, right epididymal weight, left epididymal length and right epididymal length were significantly ($p<0.050$) affected by the treatments. Rabbit bucks fed the control diet had significantly ($p<0.05$) lower values for all the epididymal variables evaluated. The rabbit bucks on T3 recorded significantly ($p<0.05$) higher values than the rest of the treatment groups for all the parameters. However T2 and T4 had similar values all the epididymal characteristics.

Table 4: Responses of rabbit bucks epididymal morphometric to black seed (*Nigella* sativa) supplemented diets

Parameters	T1 (Control)	T2 (0.5% *N. sativa*)	T3 (0.5% *N. sativa*)	T4 (0.5% *N. sativa*)	±SEM	P Value
Left epididymal weight (g)	1.09^{c}	1.69^{b}	2.63^{a}	1.83^{b}	0.13	0.00
Right epididymal weight (g)	1.10^{c}	1.73^{b}	2.80^{a}	1.89^{b}	0.17	0.00
Left epididymal length (cm)	10.84^{c}	13.86^{b}	17.70^{a}	14.10^{b}	0.54	0.00
Right epididymal length (cm)	10.86^{c}	13.86^{b}	17.85^{a}	14.10^{b}	0.55	0.00

abc: Means on same row with different superscripts differ significantly ($P<0.05$)

Discussion

The observation for the growth performance results are in agreement with the report of (11) who reported that the use of diet supplemented with black seed (*Nigella sativa*) oil improved the growth performance and feed conversion ratio of chickens. The study by (12) also found that the weight gain, feed intake and feed conversion ratio were at best for quails that received 2% black seed supplemented diets. The report of (13) indicated that the final body weight, total body weight gain, average daily weight gain and feed conversion ratio were improved significantly in rabbits fed 3% black seed meal for 68 days. El-Nomeary *et al*. (14) also reported an increased body weight, average daily weight gain and better feed conversion ratio in broilers fed 1% *Nigella sativa* seed. The observation in this study suggests that 1% *Nigella sativa* could be used as an additive to enhance feed utilization and consequently the growth performance of growing rabbit bucks.

The growth performance results obtained from this study however contradict the report of (15) who evaluated digestibility and growth performance of growing lambs and calves upon supplementing their diets with *Nigella sativa* meal. The result indicated insignificant differences in average daily gain and final body weight of animals. This could be due to the physiological differences in their digestive systems.

The improvement in growth performance occasioned by *Nigella sativa* may be due to its content of some active compounds such as Nigellone, thymoquinone and thymohydroquinone as bacterial inhibitors (16); fat soluble factors and essential amino acids that play vital roles in growth performance; several macro and micro elements liable for regulation of vital funtions in the body and improve immunity and vitamins (thiamine, riboflavin, pyridoxine and niacin) that play essential roles in growth performance (17), (18) and (3). The favourable effects of *Nigella sativa* on performance are further thought to be due to high nutritive value as well as

pharmacologically active substances present in the seeds. The report of (19) indicated a stimulating effect of black seeds on digestive system, resulting in better absorption and performance. It was opined that addition of *Nigella sativa* in feed increased bile flow rate resulting in increased emulsification that activates the pancreatic lipases, which then aid in fat digestion and absorption of fat soluble vitamins (20).

It was observed from the current study that *Nigella sativa* supplementation has significant effect on the testicular parameters of rabbit bucks. Similar trend has been reported (21) for testicular weight, width and volume in male albino rats fed *Nigella sativa* seeds for 60 days. The observation was also consistent with the result of (22) who reported that 250 mg of *Nigella sativa* oil per kg of rat diets increased testicular weight, width, length and volume in rats after 4 weeks. The observation in this study might be due to the effect of *Nigella sativa* on the pituitary gland which could trigger a rise in spermatogenic hormones and that increases the weight of the reproductive organs (21). The observation that T3 resulted in highest testicular weight, volume, width and length suggests high capacity for sperm production according to the report of (23) that the higher the testicular weight (without any deformity), the higher the capacity of the cells for spermatogenesis. This is in tandem with the report of (24) and (25) who stated that within a specie of animals, there is a good correlation between spermatozoa production, testicular size and the age of the animal.

A consistent trend was recorded for all the epididymal characteristics of rabbit bucks fed *Nigella sativa* supplanted diets. Rabbit bucks fed diet supplemented with 1% *Nigella sativa* had the highest epididymal weight and length. This implies that Nigella sativa supplementation enhanced the epididymal length and weight. This agrees with the report of (26) who reported higher epididymal weight and length for nicotine-challenged male rats fed *Nigella sativa* oil supplemented diets when compared to the control. Report by (27) also showed that an alcoholic extract of *Nigella sativa* increased reproductive parameters such as epididymal weight and length in rats after 53 days when compared to the control. These authors suggested that the constituents of *Nigella sativa* such as vitamins and minerals (zinc, copper and magnesium) could be responsible for the increase in epididymal length and weight**.**

Conclusion and Application

From the present study, it could be inferred that:

1. Supplementation of unprocessed black seed (*Nigella sativa*) up to 1.0% in diet enhanced the growth performance in terms of body weight gain, feed consumption and feed conversion ratio in rabbit bucks.
2. Supplementing rabbit buck diet with unprocessed black seed (*Nigella sativa*) up to 1.0% enhanced the testicular and epididymal characteristics of rabbit bucks.
3. Dietary supplementation of unprocessed black seed (*Nigella sativa*) up to 1.0% could enhance growth and reproductive performance in growing rabbit bucks.

References

1. Nehad, A.R., Sedki, A.A. and El-Neney, A.M. (2009). New trend in rabbit's growth in relation to energy and protein requirements. *Egypt Journal of Rabbit Science,* 19: 87-107.
2. Gadde, U., Kim, W.H., Oh, S.T. and Lillehoj, S.H. (2017). Alternatives to antibiotics for maximizing growth

performance and feed efficiency in poultry: a review. *Animal Health Research Reviews*, 18(1): 1-20. https://doi.org/10.1017/s1466252316000207

3. Seleem, T.S.T., Abd El-Motaal, A.E.M., Affaf, I.M.M., Torkia, A.M.A. and Leila, B.B. (2007). Some productive performance of rabbits as affected by supplementing *Nigella sativa* of the diet. The 5th Int. Conf. on Rabbit Prod. In Hot Clim., Hurghada, Egypt, pp. 273-286.
4. Babazadeh, B., Sadeghnia, H.R., SafarpourKapurchal, E., Parsaee, H., Nasri, S. and Tayarani-Najaran, Z. (2012). Protective effect of *Nigella sativa* and thymoquinone on serum/glucose deprivationinduced DNA damage in PC12 cells. *Avicenna Journal of Phytomedicine*,2(3): 125-132.
5. Dollah, M.A., Parhizkar, S., Latiff, L.A. and Bin Hassan, M.H. (2013). Toxicity effect of *Nigella sativa* on the liver function of rats**.** *Advanced Pharmacology Bulletin*,3(1): 97-102.
6. Google Earth Map (2021)**.** Geographical location of LAUTECH, Ogbomoso, Oyo state, Nigeria. GoogleLLChttp://earth.google.com/web/search/lautech+ogbomoso: Date accessed 23/8/2021
7. AOAC (2005). Official method of Analysis. Of the association of official analytical chemists international. USA: Maryland.
8. Pauzenga, U. (1985). Feeding parent stock. *Zootecnia International*, 22-25
9. Adu, O.A and Egbunike, G.N. (2010). Fertility, Semen quality and Reproductive organ weights of boars fed dietary copper. *Journal of Applied Agricultural Research*, 2: 61-76.
10. S.A.S (2006). *Statistical Analysis System Institute Inc*. User's Guide. Statistic version 6th ed. Carry. North Carolina, U.S.A.
11. Omar, R.E.M., Mahmoud, E.A., Karousa, M.M. and Randa S.A. (2002). Effects of additives propolis and *Nigella sativa* seed oil on some behavioral patterns, performance products and blood parameters in Sasso chickens. *Egypt Poultry Science*, 21: 140-151.
12. Abou El-Soud, S.B. (2000). Studies on some biological and immunological aspects in Japanese quail fed diets containing some *Nigella sativa* seed preparation. *Egypt Poultry. Science*, 20: 757-776
13. El-Nomeary, Y.A.A., El-Kady R.I. and El-Shahat, A.A. (2015). Effect of some medicinal seed meals supplementation and their effects on the productive performance of male rabbits. *International Journal of Chemical Technology Research*, 8(6): 401-411.
14. El-Ghammry, A.A., El-Mallah, G.M. and El-Yamny, A.T. (2002). The effect of incorporation yeast culture, *Nigella sativa* seeds and fresh garlic in broiler diets on their performance. *Egypt Poultry Science*, 22: 445–459.
15. Mahmoud, A.E.M. and Bendary, M.M. (2014). Effect of whole substitution of protein source by *Nigella sativa* meal and sesame seed meal in ration on performance of growing lambs and calves. Global Vet. 13(3): 391-396.
16. Abd El-Hakim, A.S., Sedki, A.A. and Ismail, A.M. (2002). Black seed forms and its effect on rabbit performance and blood constituents 3rd Science Conf. on Rabbit production in hot climate, 8-11 October, Hurghada, Egypt, pp. 579-588
17. William, H.C. (1999). Organic minerals for pigs. Biotechnology in the feed industry, Proc. of 15th Annual Symposium pp: 51, Nottingham Univ., Press Nottigham, Lecis, UK.
18. Seleem, T.S.T. and Rowida M. R. (2005). Enzymatic activity and

fertilizing ability of rabbit semen supplemented with *Nigella sativa* extraction. The 4th International Conference on Rabbit Production in Hot Climate, Sharm El-Sheikh, Egypt, pp. 183-189

19. Jamroz, D. and Kamel, C. (2002). Plant extracts enhance broiler performance. In non-ruminant nutrition; antimicrobial agents and plant extracts on immunity, health and performance. *Journal Animal Science*, 80: 41.
20. Lewis, J.J. (1980). Lewis's pharmacology, fifth ed. Churchill Livingston, London. Pp. 656–657.
21. Mohammad, M. A., Mohamad, M. M. J. and Dradka, H. (2009). Effects of black seeds (*Nigella Sativa*) on spermatogenesis and fertility of male albino rats. *Research Journal of Medical Science*, 4(2): 386-390
22. Wahba, H.M.A. (2011). Protective effect of Nigella sativa, linseed and celery oils against testicular toxicity induced by sodium valproate in male rats. *Journal of American Science*, 7(5): 687-693.
23. Amao, O.A. and Oladele, P.O. (2016). Testicular and Epididymal characteristics of rabbit bucks fed diets containing cotton seed cake supplemented with carrots (*Daucus corata*) or ginger (*Zingiber officinale roscoe*). *Journal of Biology, Agriculture and Healthcare*, 6(16): 48-53.
24. Morris, J.R., Chen, J.L., Filandrinos, S.T., Dunn, R.C., Frisk, R Geyer, P.K. and Wu, C.T. (1999). An analysis of the transvection at the yellow locus of Drophilia melanogaster. *Genetics*, 151(2):633-651.
25. Oyeyemi, M.O., Oke, A.O., Ajala, O.O. and Idehen, C.O. (2002). Differences in testicular parameters and morphological charcteristcs of spermatozoa as related to age of West African Dwarf bucks. *Tropical Journal of Animal Science*, 5(1):99-107.
26. Cho Ping, N., Hashim, N. H. and Hasan Adli, D. S. (2014). Effects of *Nigella sativa* (Habbatussauda) Oil and Nicotine Chronic Treatments on Sperm Parameters and Testis Histological Features of Rats. *Evidence-Based Complementary and Alternative Medicine*, 2: 121-27.
27. Al-Sa'aidi, J. A. A., Al-Khuzai, A. L. D. and Al-Zobaydi, N. F. H. (2009). Effect of alcoholic extract of *Nigella sativa* on fertility in male rats. *Iraq Journal Veterinary Science*, 23: 123-8.