



Effect of dietary supplementation of neem oil (*Azadirachta indica*) on the growth performance and nutrient digestibility of weaned rabbits

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Abstract

The objective of the present study was to determine the effect of dietary supplementation of neem oil (*Azadirachta indica*) on the growth performance and nutrient digestibility of weaned rabbits. A total of 50 weaned male cross bred rabbits between 5-6 weeks with an average weight of 565.4g-566.8g were divided into five dietary groups of ten (10) weaned rabbits each in a completely randomized design. The dietary treatments include a control, T1 (basal) diet with no neem oil (NOL), T2, T3, T4 and T5 were fed basal diet supplemented with NOL at 0.1%, 0.2%, 0.3% and 0.4% respectively. Feed and water were offered ad libitum throughout the experiment which lasted for 12 weeks. The data obtained was used to evaluate the growth performance: weight gain (WG), feed intake (FI), feed conversion ratio (FCR), mortality and nutrient digestibility (dry matter, crude protein, crude fibre and ether extract). WG, ADFI, TFI were significantly ($P < 0.05$) different among the treatments. T5 had the highest weight gain (755.90 g) followed by T4(734.0g), T3(705.90g), T2(705.0g) and T1(621.80g) respectively. Highest mortality was recorded in T1 (2%) followed by T2 (1%), none was recorded in T3, T4 and T5. Neem oil significantly influenced ($P < 0.05$) all the parameters measured. It could be concluded that neem oil contains some essential nutrients and bioactive chemicals and could be supplemented in the diet of rabbit at 0.4 % without any deleterious effect on the general performance of the animal.

Keywords: Rabbits, neem seeds, *Azadirachta indica*, performance, nutrients

INTRODUCTION

With so many research carried out to find endogenous feed alternatives for rabbit production as the high cost of raw materials that are used for commercial feed increase the production cost., there is also an urgent need to embark on scientific findings on livestock's natural growth promoter which will ensure increasing growth rate, enormous availability of meat and other high value by-products for the entire populace at relatively conservative cost. Producers use growth promoters to increase growth rates and improve overall efficiency and product quality without leaving any toxic residue in the body system of livestock. Their inclusion in feedstuffs should be designed so as to feature a pharmacological characteristic that enhance the immunity of the animal and to help in minimizing the use of the conventional antibiotics in prevention and treatment of diseases of livestock. The conventional artificial growth promoters are known to have deleterious effect on human who are the secondary consumer of residues of artificial growth promoter in the body of livestock (Sinniah, 1981).

Neem belongs to the kingdom: Plantae; Division: Magnoliophyta; Order: Sapindales; Family: Meliaceae; Genus: *Azadirachta*; Species: *indica*., It is a tropical evergreen related to mahogany. Native to east India and Burma, it grows in much of Southeast Asia and West Africa; a few trees have recently been planted in the Caribbean and several Central American countries, including México. The name *Azadirachta indica* is derived from a Persian term "Axaddarakth" (free tree). In Ayurveda it is known as the 'Arishta', which means "relieving sickness" in Sanskrit. It is a medium sized or large evergreen tree with irregular rounded crown, attaining a height of 14m-20m. It is a hardy tree that grows well in sandy, stony shallow soil, and is tolerant to alkaline, saline and acidic soil and it grows well on black cotton soil (Patnaik, 1993).

Neem is ubiquitous in Northern Nigeria. The Neem tree popularly referred to in Hausa language as *Dogonyaro* is a tree in the mahogany family with broad dark brown stem and widely spread branches. According to Subbalakshmi *et al.*, (2012), all parts of neem like seeds, flowers, bark and leaves are beneficial due to their medicinal properties. Research has shown that neem will boost the immune system by stimulating the production of T-cells when challenged with infections (Upadhyay, 1990). The role of medicinal plants in disease prevention or control has been attributed to antioxidant properties of their constituents, usually associated to a wide range of amphipathic molecules, broadly termed polyphenolic compounds (Demiray *et al.*, 2009). The bark of the neem has been reported to have higher phenolic and antioxidant activity compared to the leaf (Ghimeray *et al.*, 2009; Olabinri *et al.*, 2009). Neem oil, bark and leaf extracts have been therapeutically used as folk medicine to control diseases

like leprosy, intestinal helminthiasis, respiratory disorders, constipation and skin infections (Biswas *et al.*, 2002). The neem tree contains more than 100 bioactive ingredients and the most important bioactive compound is azadirachtin (Nahak and Sahu, 2010). The Neem leaves, neem oil and de-oiled neem seed cake are used as animal feeds (Ogbuewuet *et al.*, 2010a). The neem leaves contain appreciable amounts of proteins, minerals, carotene and adequate amount of trace minerals (Ogbuewuet *et al.*, 2010). Neem tree as one of the most researched tree in the world has attracted world-wide prominence due to its vast range of medicinal properties like antibacterial, antiviral, antifungal, antiprotozoal, hepatoprotective and other various properties without showing any adverse effect (Kale *et al.*, 2003).

The compounds in neem have been divided into two major classes; isoprenoids and others (Singh *et al.*, 1996). The isoprenoids include diterpenoids and triterpenoids containing protomeliacins, limonoids, azadirone and its derivatives, gedunin and its derivatives, vilasinin type of compounds and Csecomeliacins such as nimbin, salanin and azadirachtin. The non-isoprenoids include proteins (amino acids) and carbohydrates (polysaccharides), sulphurous compounds, polyphenolics such as flavonoids and their glycosides, dihydrochalcone, coumarin and tannins, aliphatic compounds and several fatty acids (dodecanoic, tetradecanoic, elcosanic, etc). (Zengin *et al.*, 2016a, Zengin *et al.*, 2016b).

MATERIALS AND METHODS

Experimental Site

The study was carried out at University of Abuja Teaching and Research farm, Airport road, Abuja., in Gwagwalada area council of the Federal Capital Territory, Abuja. Gwagwalada is situated in the North central zone of Nigeria., Lying at the latitude N 9.0765 and longitude E 7.3986 at an average elevation of 476m above sea level.

Collection and processing of neem oil (NOL)

Neem seeds were collected from Gwagwalada, Abuja and identified at the department of biological sciences, University of Abuja, Nigeria. The seeds of Neem were separated from the seed coats manually and sundried for 2 weeks. The dried seeds were granulated into coarse particles using a blender (Model Ap-DKL, Samsung). Oil was extracted using the soxhlet extraction method; it was later poured into a well labeled container for further analysis.

Experimental animals and their management

Fifty (50) apparently healthy, cross bred weaned male rabbits with average initial body weight of 565.4g-566.8g were used for the study and were randomly allotted into Five Treatments with ten (10) rabbits per treatment designated as treatment 1, 2, 3, 4 and 5 in a Completely Randomized Design (CRD), animals were kept in an all wired hutch measuring 35 × 35 × 55cm (width × length × height). All treatments have 5 replicates with two (2) rabbits per replicate. After 14 days of acclimatization, all rabbits were fed diets corresponding to their treatments and given prophylactic treatment with broad-spectrum medication (Kepromec®) against endoparasites and helminthes infestation before the commencement of the experiment. Feed and water was given *ad libitum* and all other management practices were strictly adhered to.

Experimental diets

Basal were formulated to meet the nutritional requirement for rabbits according to NRC (1977).

Treatment 1 – Basal diet + 0 % NOL

Treatment 2 – Basal diet + 0.1 % NOL

Treatment 3 – Basal diet + 0.2 % NOL

Treatment 4 – Basal diet + 0.3 % NOL

Treatment 5 – Basal diet + 0.4 % NOL

Measurements

Daily feed consumption (g) = Amount of feed Supplied – Amount of feed left

Feed conversion ratio (FCR) = $\frac{\text{Dry Matter Intake (g)}}{\text{Live weight gain}} \times 100$

Live weight gain

Average daily gain (ADG) = $\frac{\text{Final body weight} - \text{Initial body weight}}{\text{Total days of the experiment}}$

Total days of the experiment

Digestibility trial

At the last week of the experiments, fifteen (15) rabbits (3 per treatment) were randomly selected and were housed individually in metabolic cages which allow separation of faeces and urine. Each cage was provided with manual feeder and drinker. The digestibility study lasted seven days, average feed consumption 48.60 – 49.04g was accurately determined during the whole experiment period and faeces were collected for seven days as a collection period (Perez

et al., 1995)., the collection was performed at approximately 09:00h each morning before the next daily ration was provided. The rabbits are fed measured amounts of feed and the left over feed and faeces voided are carefully measured .5% of faeces voided were dried at 80⁰C in an oven for 24 hours. The dried faecal samples were stored in air-tight container for chemical analysis. This can be represented using the equation;

$$\text{Digestibility (\%)} = \frac{C_{\text{feed}} - C_{\text{faeces}}}{C_{\text{feed}}} \times 100$$

Where C_{feed} and C_{faeces} refer to the amount of feed eaten and faecal excreted respectively.

The proximate composition of the diets and faecal samples were determined according to AOAC (1990).

STATISTICAL ANALYSIS

All data were subjected to one -way analysis of variance (ANOVA) using SPSS (18.0) and significant means were separated using Duncan multiple range tests (Duncan, 1955). Significant was declared if $P \leq 0.05$.

RESULTS AND DISCUSSION

Proximate composition of experimental diet

Table 1 shows the proximate composition of experimental diet. The proximate components contained crude protein (18.22 %), crude fibre (13.22 %), ether extract (3.20 %), ash (6.15 %) and energy (2566.5 kcal/kg). The crude protein, crude fibre and energy values reported in this experiment is in agreement with the findings of Ahmed *et al.* (2018); Alagbe and Oluwafemi (2019) but contrary to the reports of Ahmed *et al.* (2019) when thyme oil was fed to growing rabbits. However, all values were within the nutritional requirement of growing rabbits according to NRC (1977). Adequate intake of dietary fibre lowers the serum cholesterol level, risk of coronary heart disease, constipation and colon and breast cancer (Fashola, 2011; Alagbe, 2019; Olanipekun *et al.*, 2016). Ash content gives an indication of the amount of minerals present in a feed, which are important in many biochemical reactions functioning as co-enzyme and aid physiological functioning of the major metabolic processes in the body (Ojewuyi *et al.*, 2014).

Table1: Chemical composition of experimental diet

Materials	Quantity (Kg)
Maize	30.0
Wheat offal	20.0
Soya meal	16.25
Groundnut cake	10.0
Palm kernel meal	20.0
Bone meal	2.00
Limestone	1.00
Lysine	0.01
Methionine	0.01
*Premix	0.25
Salt	0.25
Total	100.0
Calculated analysis	
Crude protein (%)	17.22
Crude fibre (%)	13.20
Ether extract (%)	3.02
Ash (%)	6.15
Energy (Kcal/kg)	2566.5

*Premix supplied per kg diet: Vit A, 7,000 I.U; Vit E, 5mg; Vit D3, 3000I.U, Vit K, 3mg; Vit B2, 5.5mg; Niacin, 25mg; Vit B12, 16mg; Choline chloride, 120mg; Mn, 5.2mg; Zn, 25mg; Cu,

2.6g; Folic acid, 2mg; Fe, 5g; Pantothenic acid, 10mg; Biotin, 30.5g; Antioxidant, 56mg.

Effect of different levels of neem (*Azadirachta indica*) oil on the performance of weaned rabbits

Table 2 revealed the performance characteristics of weaned rabbits graded level of neem oil. Initial body weight (IBW), final body weight (FBW), weight gain (WG), average daily weight

gain (ADWG), average weekly weight gain (AWWG) and total feed intake (TFI) ranged between 566.20 – 566.80 g, 1188.40 – 1322.10 g, 6.21 – 755.9 g, 8.88 – 10.80 g, 62.18 – 75.60 g and 2900.1 – 3433.1 g respectively. All the values were higher in T4 and T5, intermediate in T2 and T3 and lowest in T1 ($P < 0.05$). FCR value ranged between 4.50 – 5.50 and it was significantly different among the treatments ($P < 0.05$). Mortality were recorded in T1 and T2 ($P < 0.05$), none were recorded in the other treatments. The higher weight gains in T4 and T5 could be attributed to the presence of bioactive chemicals or phytochemicals in neem oil. According to Oluwafemi *et al.* (2020) phytochemicals performs multiple biological activities such as anti-inflammatory (Hyun *et al.*, 2018; Alagbe *et al.*, 2020), antibacterial (Tomoriet *et al.*, 2007), antioxidant (Manita and Gaurav, 2020), immunostimulatory (Kavita *et al.*, 2014), antifungal, hepatoprotective and cardiovascular effects (Joy *et al.*, 2019; Olafadehan *et al.*, 2020), antiviral (Olafadehan *et al.*, 2020). Bioactive chemicals include: tannins, saponins, flavonoids, alkaloids, phenols, terpenoids etc. The supplementation of neem oil in the diet of the animals promotes eubiosis, thus enhancing the activities of beneficial bacteria (lactobacilli) and lowering pathogenic bacteria (Alagbe *et al.*, 2020). This result is in agreement with the findings of Ikyume *et al.* (2019); Cardinal *et al.* (2007); Castellini *et al.* (2007); Abd El-Hady *et al.* (2013) but contrary to the reports of Eibenet *et al.* (2008); Musa *et al.* (2020) on feed additives as they affect the fattening performance of rabbits. Mortality was not recorded in T3, T4 and T5; this could be possibly attributed to the presence of phenols, saponins and tannins. According to Hollman (2001), phenols are strong antioxidants capable of scavenging free radicals. Tannins possess antibacterial and antiviral activities (Adisa *et al.*, 2010; Enzo, 2007) while saponins have been suggested to be involved in antimicrobial and anti-inflammatory activities (Cheeke 2000; Alagbe *et al.*, 2019; Akintayo and Alagbe, 2020).

Table 2: Effect of different levels of neem (*Azadirachta indica*) oil on the performance of weaned rabbits

Parameters	T1	T2	T3	T4	T5	SEM
IBW (g)	566.60	565.40	566.80	566.50	566.20	0.31
FWG (g)	1188.40 ^c	1270.40 ^b	1272.70 ^b	1300.50 ^a	1322.10 ^a	9.98
WG (g)	621.80 ^c	705.00 ^a	705.90 ^b	734.00 ^a	755.90 ^a	2.11
ADWG (g)	8.88 ^d	10.07 ^c	10.08 ^c	10.48 ^b	10.80 ^a	0.87

AWWG (g)	62.18 ^d	70.50 ^c	70.59 ^c	73.40 ^b	75.60 ^a	0.04
TFI (g)	3433.10 ^a	3420.10 ^a	3411.80 ^a	3409.20 ^a	2900.10 ^b	11.76
FCR	5.50 ^a	4.85 ^b	4.83 ^b	4.64 ^c	4.50 ^d	0.02
MORT.	2.00	1.00	-	-	-	0.01

Means in the same row with different superscripts differ significantly ($P<0.05$)

Initial body weight (IBW); final body weight (FBW); weight gain (WG); average daily weight gain (ADWG); average weekly weight gain (AWWG) and total feed intake (TFI)

Nutrient digestibility of rabbits fed graded levels of neem oil

Nutrient digestibility of rabbits fed graded levels of neem oil is presented in Table 3. Dry matter, crude protein, crude fibre and ether extract digestibility ranged between 75.11 – 89.30 %, 60.22 – 78.90 %, 50.92 – 69.31 % and 67.89 – 70.47 % respectively. There was a significant difference in the parameters measured ($P<0.05$). This result is in agreement with the findings of Omokore and Alagbe (2019); Bassionyet al. (2015); Bölükbaşı et al. (2006); Çabuket al. (2003); Gaafaret al. (2014); Shittu et al. (2020) when pumpkin (*Cucurbitamoschata*) and black seed (*Nigella sativa*) oils were supplemented in the diets of rabbits but contrary to the reports of Taiwo et al. (2005); Oso et al. (2006) when weaned rabbits were fed rice millings waste based diets. Bioactive chemicals in neem oil ensure proper absorption of nutrient among animals in T4 and T5, thus ensuring better feed conversion among animals.

Table 3: Nutrient digestibility of rabbits fed graded levels of neem oil

Parameters (%)	T1	T2	T3	T4	T5	SEM
Dry matter	75.11 ^c	79.21 ^b	80.93 ^b	85.33 ^a	89.30 ^a	2.71
Crude protein	60.22 ^c	65.97 ^b	69.03 ^b	71.41 ^a	78.90 ^a	1.98
Crude fibre	50.92 ^b	57.90 ^b	61.88 ^a	68.81 ^a	69.31 ^a	1.02
Ether extract	67.89 ^b	61.80 ^b	67.98 ^a	69.41 ^a	70.47 ^a	2.33

Means in the same row with different superscripts differ significantly ($P<0.05$)

CONCLUSION

Bioactive chemicals in neem oil which may have acted singly or in synergy with one another ensure proper absorption of nutrients among animals in T4 and T5, thus ensuring better feed conversion among animals. *A. indicain* diets of growing rabbits had a positive effect on growth performance, feed conversion ratio and on mortality rate.

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