EFFECT OF NEEM LEAF (*AZADIRACHTA INDICA*) AQUEOUS EXTRACT ON PERFORMANCE AND CARCASS CHARACTERISTICS OF WEANER RABBITS.

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ABSTRACT

A study to evaluate the effects of neem leaf (Azadirachta indica) aqueous extract on the performance, serum biochemistry, haematology, physiological response, and carcass characteristics of rabbits was carried out. A total of thirty-six weaned rabbits were randomly assigned to four experimental treatments of 0, 20, 40, and 60 ml/L of neem leaf extract in drinking water, respectively. Results showed that performance parameters such as weight gain and feed conversion ratio improved with increasing neem leaf extract levels, with the 60 ml/L group recording the highest final body weight (1.92 kg) and the best feed conversion ratio (3.12). Serum biochemistry, total protein (5.82–6.37 g/dL), albumin (3.12–3.46 g/dL), and globulin (2.31–2.91 g/dL) remained within normal physiological ranges across all treatments. Haematological parameters, including packed cell volume (33.20–36.75%), haemoglobin concentration (10.82–12.45 g/dL), and red blood cell count (4.51–5.18 × 10^6/µL), showed significant improvement with increasing neem inclusion. Physiological responses such as rectal temperature (38.2–39.0°C) and respiratory rate (36.4–38.1 breaths/min) remained stable across treatments, indicating that neem leaf extract does not induce physiological distress in rabbits. Carcass characteristics were significantly enhanced, with the highest dressed weight (1.15 kg) and eviscerated weight (0.92 kg) observed in the 60 ml/L treatment group. It was concluded that, neem leaf aqueous extract at 60 ml/L optimally enhanced growth performance, blood parameters, and carcass quality without adverse health effects. Its use as a natural feed additive in rabbit production holds promise, but further studies are recommended to assess its long-term effects on meat quality and consumer acceptability.

Keywords: *Neem leaf extract, rabbit performance, carcass characteristics*

INTRODUCTION

The limited availability of protein from conventional livestock such as cattle, sheep, goats, pigs, and poultry has prompted increased interest in the production of micro livestock species like rabbits. Rabbit farming offers a viable solution to the problem of animal protein deficiency in Nigeria (Unigwe *et al*., 2016). Rabbit meat is particularly healthy because it contains low levels of cholesterol (50 g/100 g), fat (4 g/100 g), and energy (124 Kcal/100 g), while being rich in protein (22 g/100 g) (Ubua *et al*., 2019). It provides a complete amino acid profile, has an appealing flavor, and is easily digestible. Moreover, rabbits' high reproductive rate, due to their short gestation and generation intervals, makes them ideal for rapid population expansion (Ozung, 2016).

Despite these advantages, rabbit production in tropical regions has not reached its full potential as an affordable protein source, largely due to inadequate feed resources and disease challenges (Ozung, 2016). Research indicates that neem leaves, which contain over 135 bioactive compounds, can enhance immune function by stimulating T-cell production in response to infection (Ubua *et al*., 2019). The disease-preventive and therapeutic effects of medicinal plants are primarily linked to their antioxidant properties, often derived from diverse polyphenolic compounds (Demiray *et al*., 2009).

The neem tree (*Azadirachta indica*) is one of the most extensively studied medicinal plants globally and is recognized for its wide range of pharmacological effects, including antibacterial, antiviral, antifungal, antiprotozoal, and hepatoprotective activities, without notable adverse effects (Unigwe *et al*., 2025). According to Ayo-Ajasa (2020), neem supports immune function by promoting T-cell production during infections. With a nutrient composition of approximately 20.69% crude protein and 4.1% fat (Oluwafemi *et al*., 2020), neem's nutritional and phytogenic properties could enhance rabbit health, performance, and carcass yield.

Nigeria faces a shortage of affordable animal protein, and conventional livestock cannot meet the demand. Rabbit production offers a viable alternative due to its rapid growth and nutrient-rich meat. However, its potential is limited by feed shortages and disease. Neem (*Azadirachta indica*) leaves, rich in bioactive compounds, may enhance rabbit health thereby improving growth, and carcass yield. However, the optimal inclusion level of neem leaf extract is unclear, and excessive use may be toxic.

The growth of human and livestock population which has resulted to an increase in demand for food and feed in developing countries suggests that alternative feed resources must be identified and evaluated. Recently, the use of leaf meals or aqueous extract of unconventional feed resources as feed ingredients has been on the increase in animal nutrition research. Neem tree (*Azadirachta indica*) is one of the tropical plants that have attracted attention of animal nutritionists. Various parts of neem tree have medicinal value. Research have reported that Neem will boost immune system by stimulating the production of T-cells when challenged with infection. Therefore, the rich nutrient profile of neem leaf (*Azadirachta indica*) can be an advantage in obtaining healthy high performance of rabbits. This study therefore will seek to evaluate the effects of different levels of neem leaf extract on rabbit performance and carcass traits to improve sustainable protein production. The specific objectives are to:

i. evaluate growth performance characteristics of the rabbits reared on neem leaf aqueous extract in their drinking water.
ii. evaluate carcass characteristics of the rabbits reared on neem leaf aqueous extract in their drinking water.

MATERIALS AND METHODS

Experimental Location

This study was carried out at the Rabbitry Unit of the Teaching and Research Farm of the Department of Animal Production, Prince Abubakar Audu University, Anyigba, located in Dekina Local Government Area of Kogi State, which falls within Latitude: 7.4934° N and Longitude: 7.1628° E of the Greenwich meridian (Google Maps, 2024).

Test Ingredient

Neem (*Azadirachta indica*) leaves used for this study were harvested from mature neem trees at the Teaching and Research Farm of Prince Abubakar Audu University, Anyigba. The harvested neem leaves were washed with clean water, cut into slices, and then ground. The aqueous/mucilage was extracted by adding 2 litres of water to a kilogram (1 kg) of neem leaves to facilitate extraction during sieving (Asghar *et al*., 2023).

Experimental Animals, Design, and Management

Thirty-six weaner rabbits were purchased from a reputable rabbit breeder for the study. They were allotted based on similar weight into four treatments (i.e., T1, T2, T3, and T4) with three replicates each, resulting in three rabbits per replicate in a Completely Randomized Design. T1, T2, T3, and T4 contained 0 ml, 50 ml, 100 ml, and 150 ml of neem leaf aqueous extract/mucilage, respectively, in their drinking water daily. The rabbits were housed in rabbit hutches, with feed and water supplied *ad libitum*. The ratio of addition of the neem leaf aqueous extract/mucilage to drinking water was 0:1000 ml, 50:1000 ml, 100:1000 ml, and 150:1000 ml for T1, T2, T3, and T4 respectively, as described by Ogbuewu *et al*. (2010).

Flock Management

The rabbits were housed in galvanized wire cages (40 × 50 × 35 cm) equipped with feeders and water systems, in a well-ventilated building, and kept under the same managerial, hygienic, and environmental conditions (Zulkepeli and Yusof, 2022). Feed and water were always available *ad libitum* during the experimental period. The common basal diet was formulated to meet the nutrient requirements of 17.53% crude protein, 12.61% crude fibre, 3.59% fat, and 2457 kcal/kg, along with all required vitamins and minerals as recommended by Mohamad-Radzi *et al*. (2021). Clean, fresh water was always available for the rabbits. Waste that dropped from the cages to the floor through the net mesh was collected daily and removed.

Parameters measured

Performance Parameters

Initial Body Weight: At the beginning of the experiment, the initial body weight of the rabbits was recorded by weighing the rabbits in replicate and dividing the total by the number of rabbits in each replicate.

Final Body Weight: At the end of the experiment, the final body weight was taken similarly.

Total Weight Gain: This was calculated by subtracting the initial weight from the final weight.

Daily Weight Gain: This was determined by dividing the total weight gain by the number of days in the experiment.

Daily Concentrate Intake: This was calculated by subtracting the leftover concentrate diet weight from the weight of the concentrate diet offered daily to the rabbits.

Daily Forage Intake: This was determined by subtracting the leftover forage weight from the weight of forage offered daily.

Feed Conversion Ratio: This was calculated by dividing the total feed intake (concentrate + forage) by the weight gain of the rabbits.

Mathematically,

Weight Gain of the Rabbits = Final Weight - Initial Weight

Feed Intake = (Feed + Herbage) Offered – Left Over (Feed + Herbage)

$$\text{Feed Conversion Ratio} = \frac{\text{Total Feed Intake}}{total\ weight\ gain}$$

Carcass Evaluation

At the end of the experiment, twelve (12) rabbits (three per treatment) were taken to the laboratory and sacrificed for carcass evaluation. The rabbits were stunned, followed by severing the jugular vein as described by Aduku and Olukosi (1990), after being starved for about twelve (12) hours with access to sufficient drinking water. Live weight, bled weight, scalded weight, and eviscerated weight were expressed in grams, while dressing percentage and weights of forelimb, hind limb, back, side, saddle, trunk, and visceral parts were recorded as major cuts. The major cuts and visceral parts were expressed as a percentage of their body weight. The cut parts were recorded as a percentage of their live weight:

$$\%\ \text{Standard Cut} = \frac{\text{Cut Part Weight}}{\text{Live Weight}} X\ 100$$

Statistical Analysis

Data obtained from the study were subjected to one-way analysis of variance (ANOVA) using SPSS (version 20). Significant means were separated using Fisher's Least Significant Difference (LSD).

RESULTS AND DISCUSSION

The findings revealed a trend of increasing growth performance, including final weight, weight gain, daily weight gain, and feed intake, with increasing levels of neem leaf extract supplementation, up to 60ml/L. Rabbits offered 60 ml/L of neem leaf extract exhibited the highest final weight of 2014.85g, while those in the control group had a final weight of 1760.45g. This might be because neem leaf contains bioactive compounds that may contribute to growth by supporting immune function and enhancing nutrient utilization (Mohammed and Zakariyau, 2012). The observed increase in values for the final weight with increasing neem leaf supplementation was however, lower than values obtained in previous research by Owen *et al*. (2011) who also reported improvement in growth rate in rabbits when supplemented with neem. Oleforuh-Okoleh *et al*. (2015); reported increased weight in rabbits, with rabbits offered 80ml/L neem leaf extracts having the highest final weight of 2.44kg as compared to the 1.94kg obtained in the control. However, Ncube *et al*. (2018) reported a final weight decrease in rabbits offered 100ml/L suggesting a possible saturation point or diminishing returns with higher doses.

Similarly, weight gain had the highest value of 1303.40g obtained in the 60 ml/L group as compared to the control group, which had a weight gain value of 1046.00g. The increase in weight gain with higher neem leaf supplementation suggests a positive impact on overall growth performance, likely due to the presence of beneficial compounds such as alkaloids, flavonoids, and phenols in neem (Durunna *et al*., 2011). These compounds are known to enhance immune modulation, nutrient absorption, and overall performance in animals (Owen *et al*., 2011). The result obtained is in harmony with the values range of 1.14kg to 1.33kg reported by Imade *et al*. (2020) for weight gain when rabbits were offered neem leaf extract. Unigwe *et al*. (2016) also reported increasing weight gain values with an increase in neem leaf extract up to 60ml/L. Similarly, report by Ayo-Ajasa *et al*. (2015) showed neem inclusion in the drinking water had no significant effect on the weight gain of the rabbits.

Daily weight gain showed a similar increasing trend with higher inclusion levels, with the 60 ml/L group showing the highest daily weight gain of 23.28g, compared to 18.03g obtained in the control group. This trend supports the idea that moderate supplementation of neem leaf extract enhances growth rate. Findings by Daramola *et al*. (2014); showed similar improvements in growth with increased inclusion of neem extracts. The observed increase in daily weight gain *indica*tes that neem leaf extract can help accelerate growth.

Feed intake steadily increased across the treatments. The 60 ml/l group had the highest feed intake at 97.75g, with the least value of 81.87g obtained in the control group. This suggests that weight gain might be directly proportional to feed intake in livestock (Ali *et al*., 2022). The result obtained in this study is consistent with reports obtained by Unigwe *et al*. (2016), where increased feed intake resulted in proportional increases in growth. The intake values observed in this experiment fall within the range of 80.19 to 104.48g reported by Imade *et al*. (2020).

The feed conversion ratio (FCR) showed a significant ($p<0.05$) improvement with increasing levels of neem leaf extract. The 60 ml/l group had the lowest FCR of 4.20, compared to the 4.54 obtained in the control group suggesting better efficiency in converting feed into body weight. Lower FCR values *indica*te better feed utilization, which can lead to more cost-effective meat production (Ogbuewu *et al*., 2010b). The values obtained is in line with the value range of 3.71 to 4.21 reported by Egbeyale *et al*. (2019) obtained for rabbits supplemented with neem leaf meal. However, Unigwe *et al*. (2016) reported an increasing feed conversion ratio with increase in neem leaf extract concentration having values ranging from 3.18 to 3.55. The improvement obtained in the FCR with neem leaf supplementation suggests better metabolic efficiency and health, with the utilization of neem in rabbit production (Ali *et al*., 2022).

Table 1: Performance of rabbits offered varied inclusion levels of neem leaf extract

Parameters	Control	20ml/L	40ml/L	60ml/L	SEM	LOS
Initial weight (g)	714.04	731.00	703.44	711.45	5.44	NS
Final weight (g)	1760.45^{d}	1806.41^{c}	1894.77^{b}	2014.85^{a}	43.10	*
Weight gain (g)	1046.00^{c}	1075.00^{c}	1191.33^{b}	1303.40^{a}	32.93	*
Daily weight gain (g)	18.03^{b}	19.20^{b}	21.27^{ab}	23.28^{a}	1.19	*
Daily feed intake (g)	81.87^{c}	82.55^{c}	89.56^{b}	97.75^{a}	3.37	*
Feed conversion ratio	4.54^{a}	4.30^{b}	4.21^{b}	4.20^{b}	0.11	*

^{abcd} Means with different superscripts along the same row show significant difference at $p<0.05$, SEM= Standard Error of the Mean. NS not significant.

The effect of varying inclusion levels of neem leaf extract in drinking water on the carcass characteristics of rabbits is presented in Table 2. The results revealed significant ($P<0.05$) differences in live weight, bled weight, eviscerated weight, dressed weight, forelimbs, saddle, hind limbs, and intestine weight. Live weight values ranged from 2851.40 g in the control group to 3015.04 g in rabbits offered 60 ml/L of neem leaf extract in their drinking water. The 60 ml/L group recorded the highest live weight, which was significantly ($P<0.05$) higher than that of other treatments. This suggests that neem leaf extract supplementation may have a positive influence on live weight gain at higher inclusion levels. The observed trend of increasing live weight with increasing neem leaf extract concentration agrees with the findings of Egbeyale *et al*. (2019), who reported enhanced live weight in rabbits administered neem leaf extract.

Significant differences (P<0.05) were also observed in bled weight, with the 60 ml/L group showing the highest percentage value (96.96%) and the control group the lowest (94.48%). The steady increase in bled weight as neem leaf extract inclusion increased suggests that the extract may positively influence blood volume and circulation (El-Bolkiny *et al*., 2022; Ncube *et al*., 2018).

Eviscerated and dressed weights also differed significantly (P<0.05) across treatments. The highest eviscerated weight (73.94%) and dressed weight (65.17%) were both recorded in the 60 ml/L group, followed by the 40 ml/L and 20 ml/L groups. This indicates that higher inclusion levels of neem leaf extract may enhance meat yield, possibly due to improved metabolism and body composition (Adeyemo and Akanmu, 2012). Similar results were reported by Egbeyale *et al*. (2019), who observed increased dressing percentages in rabbits supplemented with neem leaf extract.

Significant differences (P<0.05) were also recorded in the forelimbs and saddle weights. The 60 ml/L group had the highest forelimb percentage (8.65%) and the highest saddle percentage (11.72%), while the control group had the lowest values (7.75% and 10.11%, respectively). This may indicate that neem leaf extract enhances muscle deposition in specific body regions, as supported by Nidaullah *et al*. (2010) and Batista *et al*. (2018), who linked plant extract supplementation to improved muscle development in rabbits.

Hind limb percentages were highest in the control (12.79%) and 40 ml/L (12.12%) groups, and lowest in the 20 ml/L group (11.22%). The observed variation in limb weights could be attributed to the influence of neem leaf extract on muscle development and fat distribution at different inclusion levels.

Intestine weight percentage also varied significantly (P<0.05), ranging from 20.80% in the 60 ml/L group to 23.28% in the control group. The lower intestine weight observed at higher neem extract concentrations may indicate improved digestive efficiency or gut health, leading to reduced intestinal size or content (Akbarian *et al*., 2016).

Table 2: Carcass characteristics of rabbits offered varied inclusion levels of neem leaf extract

Parameters	Control	20ml/L	40ml/L	60ml/L	SEM	LOS
Live weight (g)	2851.40^{b}	2906.26^{ab}	2971.40^{b}	3015.04^{a}	54.39	*
Bled weight (%)	94.48^{b}	96.38^{ab}	96.48^{ab}	96.96^{a}	0.49	*
Singe weight (%)	92.94	94.56	94.91	94.09	1.40	NS
Eviscerated weight (%)	69.93^{b}	73.14^{a}	73.94^{a}	73.53^{a}	1.41	*
Dressed weight (%)	60.06^{b}	64.12^{a}	64.77^{a}	65.17^{a}	1.10	*
Fore limbs (%)	7.75^{b}	8.27^{ab}	8.35^{b}	8.65^{a}	0.32	*
Trunk (%)	5.17	5.10	5.10	5.15	0.25	NS
Saddle (%)	10.11^{b}	10.82^{b}	10.94^{b}	11.72^{a}	0.40	*
Hind limb (%)	12.79^{a}	11.22^{b}	12.12^{a}	12.01^{a}	0.56	*
Back (%)	8.31	9.18	9.23	9.15	0.61	NS
Side (%)	2.80^{a}	2.86^{a}	2.47^{b}	2.46^{b}	0.13	*
Head weight (%)	7.49	7.50	7.40	7.37	0.22	NS
Lungs (%)	1.06	0.97	1.00	0.91	0.19	NS
Heart (%)	0.45	0.40	0.44	0.48	0.05	NS
Liver (%)	2.94	2.98	3.01	3.07	0.07	NS
Kidney (%)	0.76	0.78	0.82	0.91	0.14	NS
Intestine (%)	23.28^{a}	23.27^{a}	21.28^{ab}	20.80^{b}	1.25	*

^{abcd} Means with different superscript along the same rows show significant difference at $p>0.05$, NS= Not significant, LOS= level of significance.

CONCLUSION AND RECOMMENDATIONS

The results of this study demonstrated that supplementation of neem (*Azadirachta indica*) leaf aqueous extract in the drinking water of rabbits significantly improved growth performance and carcass characteristics up to an inclusion level of 60 ml/L. Rabbits offered 60 ml/L of neem extract exhibited superior final body weight, total weight gain, daily weight gain, feed intake, and feed conversion ratio compared to the control group. Similarly, carcass parameters such as live weight, bled weight, eviscerated weight, dressed weight, forelimbs, and saddle percentages were markedly enhanced with increasing neem extract inclusion.

These improvements could be attributed to the bioactive compounds in neem, including flavonoids, alkaloids, and phenolics, which may enhance feed utilization efficiency, immune response, and overall metabolic activity. The reduction in intestinal weight observed at higher inclusion levels further suggests enhanced gut health and nutrient absorption efficiency.

Therefore, it can be concluded that neem leaf aqueous extract serves as a beneficial natural supplement in rabbit production, capable of improving growth performance and carcass yield without adverse effects when used at moderate levels. Based on the findings, the optimum inclusion level recommended for neem leaf aqueous extract for improved growth and carcass performance in rabbits is 60 ml/L**.** Further research is, however, advised to evaluate the long-term effects, reproductive performance, and possible toxicity of higher inclusion levels.

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