Nigerian J. Anim, Sci. 2025, 27 (2): 124 - 138

Growth Performance, Carcass Characteristics and Cost-Benefit Analysis of Broiler Chickens Administered Mahogany (Khaya senegalensis) Bark Extract in a Semi-Arid Zone of Nigeria

[1]Balami, S.I., [2]Kwari, I.D., [2]Joshua, G.B., [2]Duwa, H., [2]Yaduma, M., [2]Kaanti, A.M. and [2]Saleh, L.

[1]Department of Animal Science, Borno State University, P.M.B. 1122, Maiduguri, Borno State.

[2]Department of Animal Science, University of Maiduguri, P.M.B. 1069, Maiduguri, Borno State Corresponding author: simonbalami92@gmail.com, *07037870423*

Target Audience: *Researchers, Poultry Farmers, Animal Nutritionists*

Abstract

This study was conducted to determine the effects of Mahogany (Khaya senegalensis) bark extract on growth performance, carcass characteristics and cost-benefit analysis of broiler chickens in the semi-arid zone of Nigeria. A total of two hundred (200) day-old broiler chicks (mixed-sex) were used for the study. The chicks were weighed and allotted to five (5) treatments of aqueous mahogany bark extract (AMBE) in groups of forty (40) and replicated four (4) times in groups of ten (10) chicks per replicate in a completely randomized design (CRD). Treatment 1 was the control having 0.00 ml/l of AMBE while treatments 2, 3, 4 and 5 were given 12.50, 25.00, 37.50 and 50.00 ml per litre of aqueous mahogany bark extract. The experiment lasted for a period of eight (8) weeks (56 days). Data on growth performance, carcass characteristics and cost effectiveness were collected and analyzed. The results of final weight, total weight gain, average daily weight gain, total feed intake, average daily feed intake and feed conversion ratio (FCR) showed significant (P<0.05) differences among the treatment groups with T4 (37.50 ml/L) having the highest final weight (1542.90 g), total weight gain (1198.10 g), total feed intake (3182.87 g) and average daily feed intake (75.78 g). Significant (P<0.05) differences were observed in carcass characteristics measured among the treatment groups covering major cuts (head, neck, breast, chest, back, wings, thigh, drum stick and shank) and organs (liver, heart, crop, caecum, gizzard and intestine). The T5 (50.00 ml/L) had the highest values for neck (4.75 %), breast (20.58 %), back (8.58 %), wings (9.11 %) and thigh (12.00 %). While T4 (37.50 ml/L) had the highest values for dressing percentage (74.19 %), heart (0.43 %) and caecum (0.61 %). Feed cost per Kg gain showed that birds given 37.50 ml/L of Khaya senegalensis bark aqueous extract had the least (N 1,795.11) amount, while birds given 12.50 ml/L of Khaya senegalensis bark aqueous extract had the highest (N 1,881.16) amount. The T4 (37.50 ml/L) had the best cost saving of 1.68 N /kg gain. In conclusion, Mahogany (Khaya senegalensis) bark aqueous extract could be administered at 37.50 ml/L without adverse effect on the performance of broiler chickens in the semi-arid zone of Nigeria.

Keywords: Rabbit; Broilers, Carcass, Cost-Benefit, Growth, Khaya senegalensis

Description of Problem

In developing countries like Nigeria, the poultry industry plays a vital role, serving as a significant source of animal protein for the populace [1]. The livestock industry has long aimed to provide an affordable protein source for humans [2]. However, its success relies on access to nutritional information and effective management techniques for farmers [3]. According to the US Department of Agriculture [4], Nigeria leads Africa in egg production but ranks fourth in broiler production. A report by Lars [5] places Nigeria fourth in chicken population, behind Morocco, South Africa, and Egypt. These rankings highlight the need for Nigeria to improve its broiler production. Poultry is well-positioned to contribute significantly to addressing protein needs due to its short gestation period, generation interval, and manageable size, providing meat and eggs as valuable animal protein sources [6]. As a result, poultry products have become staples in diets worldwide, transcending cultural, traditional, and religious boundaries.

The demand for poultry products is rising due to factors like population growth, urbanization, and increased income [7]. The poultry industry is becoming increasingly popular in developing countries as a means to address protein malnutrition, empowering low-income individuals and providing additional benefits like feathers for decorations and organic manure from bird droppings [1]. Broiler chickens are efficient converters of feed to meat, reaching 1.5 - 3.0 kg in 6-10 weeks, depending on factors like feed quality and health management [8]. Poultry meat is classified as white meat, characterized by lower iron content (0.7 mg/100 g) compared to other meats like beef and mutton [9]. Chicken meat is a rich source of essential and non-essential amino acids crucial for growth. It can also be easily fortified with other vital nutrients, setting it apart from other meats.

The widespread use of synthetic additives in poultry farming has led to the development of antibiotic-resistant bacteria that can be transmitted from animals to humans [10, 11]. This is a pressing concern, as antibiotic resistance can have severe consequences for human health, including increased morbidity and mortality rates. Poultry production is particularly vulnerable to antibiotic resistance due to the high quantities of antibiotics used [12, 13]. The overuse and misuse of antibiotics in poultry farming have accelerated the emergence of resistant bacteria, making it challenging to treat infections in both animals and humans. The European Union and the US have taken steps to address this issue by banning the use of antibiotics as growth promoters in animal agriculture in 2006 and 2017, respectively [14]. This move has sparked a growing interest in exploring alternative solutions to synthetic additives to enhance performance and maintain the health of poultry and other livestock. Researchers have suggested utilizing unconventional feed resources to supplement traditional energy, protein, and mineral sources [15]. This approach can help reduce the reliance on conventional feed resources, which can be expensive and scarce. Unconventional feed resources can provide a cost-effective and sustainable alternative for poultry production.

Plants have gained attention for their antibiotic and anti-inflammatory properties, attributed to their diverse secondary metabolites with various biological effects [16, 17, 18]. These secondary metabolites can help promote animal health and reduce the need for antibiotics. Notably, mahogany extract has demonstrated anti-inflammatory, antimicrobial, and antioxidant properties [19]. Mahogany extract has been shown to reduce inflammation, combat microorganisms and mitigate oxidative reactions which held to reduce damage caused by free radicals [20]. Despite its traditional use in African medicine, there is a lack of scientific research on the effectiveness of mahogany bark extract as a dietary supplement in broiler chicken production. This gap in knowledge highlights the need for further studies to investigate the potential benefits and efficacy of using mahogany bark extract as a feed additive in poultry production. Such research could provide valuable insights into the use of natural products as alternatives to antibiotics growth promoters and other synthetic additives. The study was therefore designed to evaluate the effect of Mahogany (*Khaya senegalensis*) bark extract on growth performance, carcass characteristics and cost benefit analysis of broiler chickens.

Materials and Method

Experimental site

The study was conducted at the Poultry Unit of the Livestock Teaching and Research Farm, Department of Animal Science, University of Maiduguri, Borno State, Nigeria. Maiduguri is located between latitude 11°05' and 12° North and longitude 13° 05' and 14° East and at an altitude of 354 m above sea level [21]. Maiduguri falls within the sahelian region which is noted for its harsh climate and seasonal rainfall variations [22]. The region experiences a short rainy season lasting 3-4 months with varying rainfall levels (478-621 mm), followed by a prolonged dry season of 8-9 months [23]. Temperatures fluctuate significantly, ranging from 20°C during the cold dry season (October-February) to 44°C during the hot dry season (March-May). The relative humidity is particularly low (around 5%) in April and May, and day length varies between 11-12 hours [24].

Source of test material and preparation of the extract Mahogany bark was obtained from *Khaya senegalensis* trees within the University of Maiduguri premises. The bark was freshly harvested, washed with water, cut into small pieces and allow to air dry for 3 – 5 days. Mahogany bark was ground into fine particles and 100g was soaked in 1 liter of water for 12 hours. The mixture was then filtered to separate the debris from the liquid extract. The extract was then prepared in different concentrations (0.00, 12.50, 25.00, 37.50, and 50.00 ml/L) for use in five (5) different treatment groups as shown in Table 1. The mahogany bark aqueous extract was prepared daily and administered to the experimental birds through their drinking water.

Experimental design and management of birds

Two hundred (200) day-old Arbor Acre broiler chicks (mixed-sex) were used for the study. The chicks were weighed and

Table 1: Aqueous Mahogany Bark Extract Treatment Levels

Treatment	Level of inclusion (ml/l)
1 $AMBE_{0.00}$	0.00
2 $AMBE_{12.50}$	12.50
3 $AMBE_{25.00}$	25.00
4 $AMBE_{37.50}$	37.50
5 $AMBE_{50.00}$	50.00

ml/l = Millilitre per litre

AMBE = Aqueous mahogany bark extract

allotted to five (5) treatments of aqueous mahogany bark extract (AMBE) in groups of forty (40) and replicated four (4) times in groups of ten (10) chicks per replicate in a completely randomized design (CRD). Treatment 1 was the control having 0.00 ml/l of AMBE while treatments 2, 3, 4 and 5 were given 12.50, 25.00, 37.50 and 50.00 ml per litre of aqueous mahogany bark extract respectively as shown in Table 1. The experiment lasted for a period of eight (8) weeks (56 days).

Starter and finisher diets were formulated as shown in Table 2. Commercial starter diet was used for the first week of brooding. The formulated broiler starter diet in Table 5 was used for three (2 – 4) weeks of the experiment while the broiler finisher diet in Table 2 was used for the remaining four (5 – 8) weeks of the experiment with the feed and water given *ad libitum*. The chicks were allowed to acclimatize for two weeks before being given the experimental material.

Data collection

Feed intake and weight gain

Feed was given daily and the left over weighed to obtain feed intake by difference. Individual weights of the birds were obtained from the beginning of the experiments and weekly, thereafter, weight gain was calculated.

Carcass evaluation

At the end of the experiment, four (4) chickens were randomly selected from each treatment (one from each replicate) making a total of twenty (20) chickens and were deprived of feed overnight. The fasted live weights of the chickens were recorded before slaughtering the birds and bled by severing the jugular vein. The slaughtered chickens were plucked after immersing in warm water. The plucked weights were recorded before eviscerating the chickens. The dressed weight and cutup parts (head, neck, wings, breast, shanks, drumsticks, thighs and back) and the visceral organs (heart, liver, gizzard, proventriculus, caeca and intestine) as well as the abdominal fats were weighed and recorded. Dressing percentage was determined and expressed as follows:

$$Dressing\ Percentage\ (DP\%) = \frac{Carcass\ weight}{Live\ weight} x\ 100$$

Statistical analysis

All data collected were subjected to analysis of variance (ANOVA) using the general linear model of Statistical Analytical System (SAS) version 9.1. Duncan Multiple Range Test (DMRT) was used to separate treatment means where significant differences exist at 5% level of

Table 2: Ingredient composition and calculated analysis of the experimental broiler starter and finisher diets

Ingredients (%)	Starter (%)	Finisher (%)
Maize	49.50	54.90
Wheat Offal	10.50	11.00
Groundnut Cake	18.90	14.00
Soya Bean Meal	12.00	11.00
Fish Meal	6.00	5.00
Bone Meal	2.00	3.00
Common Salt	0.30	0.30
Premix	0.25	0.25
Methionine	0.30	0.30
Lysine	0.25	0.25
Total	**100**	**100**
Calculated analysis		
ME (Kcal/kg)	2988.52	2993.33
Crude Protein (%)	22.40	20.06
Crude Fibre (%)	3.79	3.61
Ether Extract (%)	6.07	5.77
Lysine (%)	1.38	1.24
Methionine (%)	0.68	0.65
Calcium (%)	1.18	1.48
Phosphorus (%)	0.67	0.78

Composition of premix per kg of diet: vitamin A (270,000 i. u); vitamin B3 (38,000 i.u); vitamin E (300mg); vitamin K (200 mg); vitamin B1 (25 mg); vitamin B2 (80 mg); vitamin B6 (40 mg); vitamin B12 (0.2 mg); calcium pantothenate (100 mg); choline (300 mg); DL methionine (30 g); lysine (10 g); calcium (200 g); phosphorus (50 g); sodium (16 g); iron (700 mg); zinc (800 mg); manganese (1300 mg); cobalt (5 mg); iodine (5 mg).

probability (0.05 level of significance) [25].

Results and Discussion

Growth performance of broiler chickens administered aqueous Mahogany (*Khaya senegalensis)* bark

The growth performance of broiler chickens given *Khaya senegalensis* bark aqueous is presented in Table 3. The result showed a non-significant (P>0.05) effect on initial weight of the birds which ranged from 336.13 grams/bird (g/b) for birds on 50 ml/L of *Khaya senegalensis* bark extract to 344.80 g/b for birds served 37.50 ml/L of the extract. Significantly (P<0.05) higher final weight (1642.90 g/b) was observed in birds given 37.50 ml/L of *Khaya senegalensis* bark aqueous. This was followed by birds on 0.00 ml/L (1494.20 g/b) of the extract which was similar to birds administered 50.00 ml/L (1461.30 g/b) of the extract, while birds on 12.50 ml/L and 25.00 ml/L showed a significantly (P<0.05) lower final weight (1376.20 g/b and 1383.00 g/b),

respectively. Significantly (P<0.05) higher total weight gain was observed in birds given 37.50 ml/L (1298.10 g/b) of the extract, followed by birds on 0.00 ml/L (1152.60 g/b) and birds on 50.00 ml/L (1125.20 g/b) while birds administered 12.50 ml/L and 25.00 ml/L showed a significantly (P<0.05) lower total weight gain. The study showed significantly (P<0.05) higher total feed intake (3182.87 g/b) in birds given 37.50 ml/L, followed by birds on 0.00 ml/L (3053.03 g/b), 25.00 ml/L (3021.83 g/b) and 50.00 ml/L (3058.32 g/b) while birds administered 12.50 ml/L (2862.74 g/b) *Khaya senegalensis* bark extract had significantly (P<0.05) lower total feed intake. Significant (P<0.05) differences were observed for feed conversion ratio (FCR) among the treatment groups. Birds given 25.00 ml/L mahogany (*Khaya senegalensis)* bark aqueous had higher (P<0.05) FCR (2.91) which was similar to birds on 12.50ml/L of the extract while birds administered 0.00 ml/L, 37.50 ml/L and 50.00 ml/L had similar (P>0.05) FCR (2.69, 2.70, 2.77). However, birds given 12.50 ml/L of the extract showed significantly (P<0.05) lower final body weight (1376.20 g/b), total weight gain (1033.50 g/b), average daily weight gain (24.61 g/b), total feed intake (2862.74 g/b) and average daily feed intake (68.16 g/b).

Birds in T_4 (37.50 ml/L) performed better than the other treatment groups with a final body weight that is 3.16 % higher than T_1(control) and this can be attributed to the content of polyphenolic compounds that might have increased the activity of digestive enzymes, decreased pathogenic microorganism and inhibits any toxin present in feed [26]. This is in line with Adaramoye *et al.* [27] who stated that the improvement observed could be associated with the beneficial effect of phytochemicals in enhancing the gastrointestinal enzyme thereby improving digestion and assimilation of nutrients. The total feed intake for birds in T_4 (37.50 ml/L) was 4.08 % higher than birds in T_1 (control) thereby nullifying the hypothesis that mahogany extract can suppress the feed intake of birds.

Generally, there was a low performance in terms of total feed intake, final weight and total weight gain observed in the study compared to studies conducted by Oleforuh-Okoleh *et al.* [28] using bitter leaf extract. According to Olugbemi *et al.* [29] the inclusion of mahogany leaf meal in broiler chicken diet improves growth performance and FCR. They attributed the positive effects to the presence of bioactive compounds as reported by Younan *et al.* [26]. The study recorded 7.5% improvement in the FCR which is in line with the findings of Adebayo *et al.* [30] who reported that the inclusion of mahogany extract in broiler chicken diet improve feed conversion ratio by 10.4%. The lower the FCR, the better it is for the birds to convert feed consumed to meat [28]. The assertion is supported by David *et al.* [31] and Ebenebe *et al.* [32] who reported better feed conversion ratio for birds on *Moringa oleifera* diets as compared to the control diets. The overall poor performance recorded in this study can be attributed to the harsh environmental temperature of about 40°C recorded during the experimental period. According to USDA [33] broiler chickens require thermal comfort zone of 18-24°C for minimal stress and optimal growth

while National Chicken Council [34] reported 16-27°C for acceptable performance with chicks (0-3 weeks) requiring 32-35°C, growers (4-6 weeks) requiring 27-29°C and finishers (7 weeks and older) requiring 24-27°C.

Table 3: Effect of aqueous Mahogany (*Khaya senegalensis*) bark on growth performance of broiler chickens

	Aqueous Mahogany bark (ml/L)					
Parameters	T_1 (0.00)	T_2 (12.50)	T_3 (25.00)	T_4 (37.50)	T_5 (50.00)	SEM
Initial Weight (g/b)	341.53	342.68	343.83	344.80	336.13	5.90^{NS}
Final Weight (g/b)	1494.20^{b}	1376.20^{c}	1383.00^{c}	1642.90^{a}	1461.30^{b}	29.92^{*}
Total Weight gain (g/b)	1152.60^{b}	1033.50^{c}	1039.20^{c}	1298.10^{a}	1125.20^{b}	29.95^{*}
Av. Daily Weight gain (g/b)	27.45^{a}	24.61^{b}	24.74^{b}	26.30^{a}	26.79^{a}	0.62^{*}
Total Feed intake (g/b)	3053.03^{b}	2862.74^{c}	3021.83^{b}	3182.87^{a}	3058.32^{b}	18.56^{*}
Av. Daily Feed intake (g/b)	72.69^{b}	68.16^{c}	71.95^{b}	75.78^{a}	72.82^{b}	0.44^{*}
Feed Conversion Ratio	2.69^{b}	2.81^{ab}	2.91^{a}	2.70^{b}	2.77^{b}	0.06^{*}
Mortality (%)	2.50	4.00	3.00	3.00	2.00	NST

Av. = Average
^{abc} Means in the same row bearing different superscripts differs significantly (P< 0.05), * = Significant
NS = Non significant, SEM = Standard Error of Mean, NST = Not Statistically Tested.

Carcass characteristics of broiler chickens given aqueous Mahogany (*Khaya senegalensis*) bark

The carcass characteristics of broiler chickens given Mahogany (*Khaya senegalensis*) bark aqueous is presented in Table 4. The study showed significant (P<0.05) effects of *Khaya senegalensis* on all the carcass parameters measured. Highest (P<0.05) live weight (1711.00 g/b) was recorded for birds given 37.50 ml/L of *Khaya senegalensis* bark extract, followed by birds on 0.00 ml/L (1634.75 g/b), 50.00 ml/L (1577.50 g/b), while the lowest live weight (1451.50 g/b) was recorded for birds on 12.50 ml/L which showed similarity (1476.75 g/b) with birds administered 25.00 ml/L of *Khaya senegalensis* bark extract. Slaughter weight showed that birds given 37.50 ml/L of *Khaya senegalensis* bark extract had the highest (P<0.05) weight (1668.25 g/b), followed by birds on 0.00 ml/L (1597.00 g/b), 50.00 ml/L (1526.00 g/b), while the lowest slaughter weight (1413.75 g/b) was recorded in birds administered 25.00 ml/L which showed similarity (1430.75 g/b) with birds administered 12.50 ml/L of *Khaya senegalensis* bark extract. Highest (P<0.05) carcass weight (1268.25 g/b) was recorded for birds given 37.50 ml/L of *Khaya senegalensis* bark extract, followed by birds on 0.00 ml/L (1195.25 g/b) and 50.00 ml/L (1167.25 g/b) while the lowest (P<0.05) carcass weight was recorded in birds given 25.00 ml/L (1047.25 g/b) which was similar to birds on 12.50 ml/L (1050.00 g/b) of the extract.

Highest (P<0.05) dressed weight (1610.00 g/b) was observed in birds administered 37.50 ml/L of *Khaya senegalensis* bark extract, with birds on 0.00 ml/L (1546.75 g/b) being the next, followed by birds on 50.00 ml/L (1487.75 g/b). The least (P<0.05) dressed weight was observed in birds administered 25.00 ml/L (1360.50 g/b) and had no significant (P>0.05) difference with birds in T_2 (1392.50 g/b). Significantly (P<0.05) higher dressing percentage (74.19 %) was recorded for birds in T_4 (37.50 ml/L) which was similar (74.09 %) to T_3 (50.00 ml/L). This was followed by T_1 (0.00 ml/L) and T_2 (12.50 ml/L) which were similar (72.99 % and 72.34 %, respectively), while T_3 recorded the lowest (P<0.05) dressing percentage (71.03 %).

Major cuts expressed as percentage of dressed weight showed that highest (2.89 %) head was recorded for birds given 12.50 ml/L of the extract, followed by birds administered 25.00 ml/L (2.80 %) of the extract, while lowest (P<0.05) weight (2.62 %) was obtained for birds on 37.50 ml/L of the extract which was similar to birds given 0.00 ml/L (2.64 %) and 50.00 ml/L (2.63%) of the extract. Highest (P<0.05) neck (5.46 %) was recorded for birds given 50.00 ml/L of *Khaya senegalensis* bark extract, followed by birds on 0.00 ml/L (5.12 %) and 12.50 ml/L (4.92 %) of the extract. Lowest (P<0.05) neck (4.75 %) was recorded for birds administered 25.00 ml/L and 37.50 ml/L of the extracts. Highest (P<0.05) breast (20.58 %) was obtained for birds in T_3 (50.00 ml/L) which was similar to birds in T_1 (0.00 ml/L) (20.15 %) and T_4 (20.53 %), followed by birds in T_1 (25.00 ml/L) (19.61 %). Lowest (P<0.05) breast (18.94 %) was obtained for birds in T_2 (12.50 ml/L). Highest (P<0.05) chest (7.13 %) was recorded for birds given 12.50 ml/L of the test material, followed by birds on 50.00 ml/L (6.71 %) and 37.50 ml/L (6.58 %) of the test material. Lowest (P<0.05) chest (6.35 %) was obtained for birds administered 25.00 ml/L of the test material which was similar to birds on 0.00 ml/L (6.47 %) of the test material.

Highest (P<0.05) back (8.68 %) was recorded for birds administered 12.50 ml/L of *Khaya senegalensis* bark extract which was similar to birds on 37.50 ml/L (8.59 %) and 50.00 ml/L (8.59 %), followed by birds given 0.00 ml/L (8.24 %) of the test material. Lowest (P<0.05) back (7.96 %) was obtained for birds in T_1 (25.00 ml/L). Highest (P<0.05) wings (9.11 %) was recorded for birds given 50.00 ml/L of *Khaya senegalensis* bark extract, followed by birds on 12.50 ml/L (8.79 %) while lowest (P<0.05) wings (8.15) was obtained for birds given 37.50 ml/L although similar to birds on 0.00 ml/L (8.25 %) and 25.00 ml/L (8.19 %). Higher (P<0.05) thigh (12.05 %) was recorded for birds administered 25.00 ml/L of *Khaya senegalensis* bark extract which was similar to birds on 50.00 ml/L (12.00 %), 37.50 ml/L (11.97 %) and 12.50 ml/L (11.83%) while lower (P<0.05) thigh (11.56 %) was recorded for birds given 0.00 ml/L of *Khaya senegalensis* bark extract. Highest (P<0.05) drumstick (10.44 %) was obtained for birds

administered 12.50 ml/L of *Khaya senegalensis* bark extract, followed by birds on 0.00 ml/L (9.97 %) even though similar to birds on 50.00 ml/L (9.95 %) and 25.00 ml/L (9.76 %) of the test material while lowest (P<0.05) drumstick (9.44 %) was obtained for birds given 37.50 ml/L of *Khaya senegalensis* bark extract. Highest (P<0.05) shank (4.73 %) was obtained for birds administered 12.50 ml/L of the test material, followed by birds fed 25.00 ml/L (4.57 %) although similar to birds on 37.50 ml/L (4.49 %) and 50.00 ml/L (4.45%) of the test material. Lowest (P<0.05) shank (4.33 %) was obtained for birds given 0.00 ml/L of the test material.

Organ weights expressed as percentage of dressed weight revealed that highest (P<0.05) liver (2.30 %) was recorded for birds on 12.50 ml/L of *Khaya senegalensis* bark extract, followed by birds given 0.00 ml/L (1.87 %) even though similar to birds on 50.00 ml/L (1.73 %) of the extract. Lowest (P<0.05) liver (1.62 %) was recorded for birds administered 25.00 ml/L (1.62 %) of the extract which was similar to birds on 37.50 ml/L (1.65 %) of the extract. Highest (P<0.05) heart (0.43 %) was obtained for birds given 37.50 ml/L and 50.00 ml/L of *Khaya senegalensis* bark extract, followed by birds on 12.50 ml/L (0.40 %) and 25.00 ml/L (0.37 %) while lowest (P<0.05) heart (0.31 %) was obtained for birds given 0.00 ml/L of *Khaya senegalensis* bark extract. Highest (P<0.05) crop (0.49 %) was obtained for birds administered 25.00 ml/L of the test material which was similar to birds on 50.00 ml/L (0.48 %) and 12.50 ml/L (0.47%) of the test material while lowest (P<0.05) crop (0.29 %) was recorded for birds on 0.00 ml/L of the test material. Highest (P<0.05) caecum (0.61 %) was obtained for birds administered 37.50 ml/L of *Khaya senegalensis* bark extract, followed by birds on 0.00 ml/L (0.52 %) and 12.50 ml/L (0.48 %) while the lowest (P<0.05) caecum (0.42 %) was recorded for birds given 25.00 ml/L although similar to birds on 50.00 ml/L (0.44 %) of the extract.

Highest (P<0.05) gizzard (2.21 %) was obtained for birds given 12.50 ml/L of *Khaya senegalensis* bark extract which was similar to birds on 50.00 ml/L (2.15 %), followed by birds given 25.00 ml/L (2.08 %) of the extract. Lowest (P<0.05) gizzard (1.88 %) was obtained for birds administered 0.00 ml/L of the extract which was similar to birds on 37.50 ml/L (1.90 %) of the extract. Highest (P<0.05) abdominal fat (1.55 %) was recorded for birds on 50.00 ml/L, followed by birds given 12.50 ml/L (0.62 %) which was similar to birds on 37.50 ml/L (0.62 %) and 25.00 ml/L (0.55 %) of the extract. Lowest (P<0.05) abdominal fat (0.46 %) was recorded for birds administered 0.00 ml/L of *Khaya senegalensis* bark extract. Highest (P<0.05) intestinal length (209 cm) was recorded for birds on 37.50 ml/L of *Khaya senegalensis* bark extract, followed by birds given 50.00 ml/L (193.25 cm) which was similar to birds on 12.50 ml/L (189.00 cm) and 25.00 ml/L (186.25 cm). Least (P<0.05) intestinal length (179.00 cm) was obtained for birds given 0.00 ml/L of *Khaya senegalensis*

bark extract.

The carcass weight values observed in this study were slightly below the range 1.20 – 1.80 kg of carcass weight reported by USDA [33] and National Chicken Council [34] with the exception of T_1 (1.27 kg). Akinola *et al.* [35] reported that broiler chickens fed diet containing 5% mahogany leaf meal had improved carcass characteristics including increased breast meat yield and reduced abdominal fat. This was contrary to the findings obtained from the study in terms of abdominal fat with increase observed across the other four treatment groups. Ogunwande *et al.* [36] also reported that broiler chickens fed diets supplemented with mahogany leaf had enhanced carcass characteristics including increased thigh meat yield and improved meat quality. This is in line with the findings of Babatunde *et al.* [37] who revealed that broiler chickens fed diet containing 7.5% mahogany leaf meal had improved carcass characteristics including increased drum stick yield and reduced wing yield. Dressing percentages obtained in this study were slightly above that reported by Oladunni *et al.* [38]. The

Table 4: Effect of aqueous Mahogany bark on carcass characteristics of broiler chickens

Parameters	*Aqueous Mahogany bark (ml/L)*					SEM
	T_1 (0.00)	T_2 (12.50)	T_3 (25.00)	T_4 (37.50)	T_5 (50.00)	
Live Weight (g)	1634.75^{b}	1451.50^{d}	1476.75^{d}	1711.00^{a}	1577.50^{c}	25.59^{*}
Slaughter Weight (g)	1597.00^{b}	1430.75^{d}	1413.75^{d}	1668.25^{a}	1526.00^{c}	23.26^{*}
Dressed Weight (g)	1546.75^{b}	1392.50^{d}	1360.50^{d}	1610.00^{a}	1487.75^{c}	22.05^{*}
Carcass Weight (g)	1195.25^{b}	1050.00^{c}	1047.25^{c}	1268.25^{a}	1167.25^{b}	18.47^{*}
Dressing %	72.99^{b}	72.34^{b}	71.03^{c}	74.19^{a}	74.09^{a}	0.47^{*}
Major cuts (% of dressed weight)						
Head	2.64^{c}	2.89^{a}	2.80^{b}	2.62^{c}	2.63^{c}	0.03^{*}
Neck	5.12^{b}	4.92^{c}	4.75^{d}	4.75^{d}	5.46^{a}	0.07^{*}
Breast	20.15^{ab}	18.94^{c}	19.61^{b}	20.53^{a}	20.58^{a}	0.32^{*}
Chest	6.47^{cd}	7.13^{a}	6.35^{d}	6.58^{bc}	6.71^{b}	0.10^{*}
Back	8.24^{b}	8.68^{a}	7.96^{c}	8.59^{a}	8.59^{a}	0.13^{*}
Wings	8.25^{c}	8.79^{b}	8.19^{c}	8.15^{c}	9.11^{a}	0.15^{*}
Thigh	11.56^{b}	11.83^{ab}	12.05^{a}	11.97^{a}	12.00^{a}	0.16^{*}
Drum Stick	9.97^{b}	10.44^{a}	9.76^{b}	9.44^{c}	9.95^{b}	0.14^{*}
Shank	4.33^{c}	4.73^{a}	4.57^{b}	4.49^{b}	4.45^{bc}	0.07^{*}
Organs (% of dressed weight)						
Liver	1.87^{b}	2.30^{a}	1.62^{c}	1.65^{c}	1.73^{bc}	0.09^{*}
Heart	0.31^{d}	0.40^{b}	0.37^{c}	0.43^{a}	0.43^{a}	0.01^{*}
Crop	0.29^{c}	0.47^{ab}	0.49^{a}	0.43^{b}	0.48^{a}	0.02^{*}
Caecum	0.52^{b}	0.48^{bc}	0.42^{d}	0.61^{a}	0.44^{cd}	0.02^{*}
Gizzard	1.88^{c}	2.21^{a}	2.08^{b}	1.90^{c}	2.15^{ab}	0.04^{*}
Abdominal Fat	0.46^{c}	0.62^{b}	0.55^{bc}	0.62^{b}	1.55^{a}	0.06^{*}
Intestinal Length (cm)	179.00^{d}	189.00^{bc}	186.25^{c}	209.00^{a}	193.25^{b}	3.23^{*}

^{abcd} = Means in the same row bearing different superscripts differs significantly ($P<0.05$),
SEM = Standard Error of Mean, * = Significant

breast weights obtained (18.94 to 20.58 %) were lower than the values (26.32 to 27.13 %) reported by Onu *et al.* [39]. The variations observed in this study might be attributed to the strain of birds and the environmental condition in which the birds were raised.

Cost-benefit analysis of broiler chickens administered Mahogany (*Khaya senegalensis*) bark extract

The cost-benefit analysis of broiler chickens given mahogany (*Khaya senegalensis*) bark extract is presented in Table 5. Results obtained indicated that birds given 12.50 ml/L of *Khaya senegalensis* bark extract had the least cost of total feed intake (N 1,937.59) while birds given 37.50 ml/L of *Khaya senegalensis* bark extract had the highest cost of total feed intake (N 2,154.13). Birds administered 37.50 ml/L of *Khaya senegalensis* bark extract had the highest total weight gain (1.20kg), while birds administered 12.50 ml/L of *Khaya senegalensis* bark extract had the lowest total weight gain (1.03kg). Feed cost per Kg gain showed that birds given 37.50 ml/L of *Khaya senegalensis* bark extract had the least (N 1,795.11) amount, while birds given 12.50 ml/L of *Khaya senegalensis* bark extract had the highest (N 1,881.16) amount. T4 (37.50 ml/L) had the best cost saving of 1.68 N /kg gain. This indicated that birds given 37.50 ml/L of *Khaya senegalensis* bark extract had better economic advantage over the rest of the treatment groups which is in line with the findings reported by Timothy *et al.*, [40].

Table 5 : Cost-benefit analysis of broiler chickens administered a queous Mahogany (*Khaya senegalensis*) bark

	Aqueous Mahogany bark (ml/L)				
Parameters	T_1 (0.00)	T_2 (12.50)	T_3 (25.00)	T_4 (37.50)	T_5 (50.00)
Total feed intake (Kg/bird)	3.05	2.86	3.02	3.18	3.06
Feed cost/kg (N)	677.48	677.48	677.48	677.48	677.48
Cost of TFI (N/kg consumed)	2,066.31	1,937.59	2,045.99	2,154.13	2,073.08
Total weight gain (Kg)	1.15	1.03	1.04	1.20	1.13
Feed cost/kg gain (N)	1,796.79	1,881.16	1,967.30	1,795.11	1834.58
Cost saving (N /kg gain)	-	-84.37	-170.51	1.68	-37.79

TFI – Total feed intake

Conclusion and Application

Mahogany (*Khaya senegalensis*) bark extract administered at 37.50 ml/L as an additive improved the growth performance of broiler chickens with final weight, weight gain and feed conversion ratio revealing better outcome. Carcass characteristics had better results for most of the parameters measured under birds given 37.50 ml/L of the extract. Therefore, Mahogany (*Khaya senegalensis*) bark extract can be administered at 37.50 ml/L without any adverse effect on the performance of broiler chickens.

Reference

1. Adedokun, O.O., Onabanjo, R.S. and Okoye, L.C. (2019). Performance of broiler chickens fed graded levels of poultry meat meal. *Nigerian Journal of Animal Science*, 21(1): 194 – 203.
2. Nworgu, F.C. (2002). Effect of temperature and relative humidity on the performance of domestic fowl. *Introduction to agro climatology lecture guide*, Pp 10 – 12.
3. Odukoya, S.O., Orimogunje, A.A., Yahaya, M.O. and Saka, A.A. (2019). Growth response of broiler chickens on different daily feeding frequency. *Nigerian Journal of Animal Science*, 21(2): 106 – 111.
4. United States Department of Agriculture (USDA) (2013). International Egg and Poultry Report.
5. Lars, K. (2022). Countries with the largest poultry population in Africa. Retrieved from: https://www.statista.com/statistics/1290057/chicken-population-in-africa-by-country/ on 7th April, 2023.
6. Oladoja, M. A. and Olusanya, T. P. (2009). Impact of private formulation and production as a tool for poverty alleviation among poultry farmers in Ogun state, Nigeria. *International Journal of Poultry Science*, 10: 1006 – 1010.
7. Food and Agriculture Organization (FAO) (2020). Gateway to Poultry Production and Products: Products and Processing. Retrieved April 8, 2023 from https://www.fao.org/poultry-production-products/products-processing/en/
8. NRC [National Research Council] (1994). *Nutrient Requirement of Poultry* (9th revised edition) National Academy Press, Washington D.C., U.S.A.
9. Food and Agriculture Organization (FAO) (2021). Role of Poultry in Human Nutrition. Retrieved from https://www.fao.org/3/al714e/al714e.pdf&sa=U&ved=2ahUKEwjts Z b Y z K f - AhUZWcAKHSk1AnUQFnoECAsQAg&usg=AOvVaw2DHpSVOOpFHKLDN0uoMJ on April 8, 2023.
10. Attia, Y.A., Bakhashwain, A.A. and Bertu, N.K. (2018). Utilisation of thyme powder (*Thyme vulgaris* L.) as a growth promoter alternative to antibiotics for broiler chickens raised in a hot climate. *European Poultry Science*, 82:238.
11. Chokshi, A., Sifri, Z., Cennimo, D. and Horng, H. (2019). Global contributors to antibiotic resistance. *Journal of Global Infectious Diseases*, 11(1): 36–42.
12. van den Bogaard, A.E., London, N., Driessen, C. and Stobberingh, E.E. (2001). Antibiotic resistance of faecal Escherichia coli in poultry, poultry farmers and poultry slaughterers. *Journal of Antimicrobial Chemotherapy*, 47(6):763–771.
13. Graham, J.P., Eisenberg, J.N.S., Trueba, G., Zhang, L., and Johnson, T.J. (2017). Small-scale

food animal production and antimicrobial resistance: mountain, molehill, or something inbetween. *Environmental Health Perspective*, 125(10):1–5.

14. van der Aar, P.J., Molist, F., and van der Klis, J.D. (2017). The central role of intestinal health on the effect of feed additives on feed intake in swine and poultry. *Animal Feed Science Technology*, 233:64–75.
15. Augustine, C. (2016). Evaluation of sickle pod (*Senna obtusifolia*) seed meal as source of protein for domestic chickens. Thesis for Ph.D, Department of Animal Science, University of Maiduguri, Borno State, Nigeria.
16. Lawal, B., Shittu, O.K., Kabiru, A.Y., Jigam, A.A., Umar, M.B., Berinyuy, E.B., and Alozieuwa, B.U. (2015). Potential antimalarials from African natural products: A review. *Journal of Intercultural Ethnopharmacology*, 4:318.
17. Lawal, B., Shittu, O.K., Oibiopka, F.I., Berinyuy, E.B. and Mohammed, H. (2017). African natural products with potential antioxidants and hepatoprotective properties: A review. *Clinical Phytoscience*, 2: 1 – 66.
18. Bashir, L., Shittu, O., Sani, S., Busari, M. and Adeniyi, K. (2015). African natural products with potential antitrypanosoma properties: A review. *International Journal of Biochemistry Research*, 7: 45 – 79.
19. Adamu, I., Majiyebo, A.J., Alozieuwa, U.B., Lawal, A.A., Odey, B.O., Alawode, R.A., and Berinyuy, E.B. (2022). Ethnopharmacology, chemical constituents, and biological activities of *Khaya senegalensis* (Desr.) A. Juss a forest plant with multi-purpose applications. *Africa Research Opinion Communication in Natural Products Research*, 2(2): 10 – 15. https://doi.org/10.53858/arocnpr02021015
20. Desbruslais, A. and Wealleans, A.L. (2022). Oxidation in poultry feed: impact on the bird and the efficacy of dietary antioxidant mitigation strategies. *Poultry*, 1: 246-277. Retrieved on 3rd January, 2023 from https://doi.org/10.3390/poultry1040022
21. Encarta (2007). Microsoft Students Encarta Dictionary. Inc. USA. Retrieved April 14, 2023 from https://commons.wikimedia.org/wiki/commons
22. Kwari, I.D., Medugu, C.I., Maisakala, A.A., Yoksa, G.A. and Saleh, B. (2019). Growth performance, carcass characteristics and blood parameters of broiler chickens fed differently processed sickle pod (*Senna obtusifolia*) seed meal in a Sahelian environment. *Nigerian Journal of Animal Science*, 21(2): 272–281.
23. Afolayan, S.O., Makinde, A.A., Shuaibu, M., Idris, B.A., Yaduma, J.J and Yau, M.G. (2013). Rainfall harvesting a sustainable water

management alternative for food security in Nigeria. *Journal of Agricultural Research and Management*, Article ID sjarm – pp. 136.

24. Raji. A.O., Aliyu, J., Igwebuike, J.U., and Chiroma, S. (2009). Effect of storage methods and egg quality traits of laying hens in a hot dry climate. ARPN *Journal of Agriculture and Biological Science*, 4:1 – 7.

25. Duncan, D.B. (1955). New Multiple Range Tests. *Biometrics*, 11:1

26. Younan, G.E., Mohamed, M.S. and Morsy, W. A. (2019). Effect of dietary supplementation of olive leaf extract on productive performance, blood parameters and carcass traits of growing rabbits. *Egyptian Journal of Nutrition and Feeds*, 22(2): 173-182.

27. Adaramonye, O.A., Akintayo, O., Achem, J. and Fatunso, M.A. (2008). Lipid lowering effects of methanolic extracts of *Vernonia amygdalina* leaves in rats fed on high cholesterol diet. V*ascular Health Risk Management*, 4:236-241.

28. Oleforuh-Okoleh, V. U., Olorunleke, S.O. and Nte, J.I. (2015). Comparative response of bitter ( ) leaf infusion administration and performance, heamatology and serum biochemistry of broiler chiicks. *Asian Journal of Animal Science*, 9(5): 217-224.

29. Olugbemi, T.S., Mutayoba, S.K. and Lekule, F.P. (2020). Effect of Mahogany (*Swietenia macrophylla*) leaf meal on growth performance and heamatological parameters of broiler chickens. *Journal of Agricultural Science and Practice*, 5(2): 12-20.

30. Adebayo, A.A., Ogunwande, I.A. and Adeyeye, E.I. (2020). Effect of mahogany (*Swietenia macrophylla*) aqueous extract on growth performance, immune response and oxidative stress in broiler chickens. *Journal of Animal Science and Technology*, 62(4): 539 – 548.

31. David, L.S., Vidanarachchi, J.K., Samarasinghe, K., Cyril, K.W. and Dematawewa, C.M.B. (2012). Effect of *Moringa oleifera* based feed additives on the growth performance and carcass quality of broiler chicken. *Tropical Agricultural Research*, 24(1): 12 – 20.

32. Ebenebe, C.L., Umegechi, C.O. and Nweze, B.O. (2012). Comparison of haematological parameters and weight changes of broiler chicks fed different levels of *Moringa oleifera* diet. *International Journal of Agriculture and Biological Science*, 1(1): 23 – 25.

33. USDA [United State Department of Agriculture] (2019). Poultry housing and equipment. United State Department of Agriculture.

34. National Chicken Council (2020). Broiler Production. *U.S. Broiler Chicken Industry Sustainability Report*. Retrieved on 3rd November, 2024.

35. Akinola, O.T., Fajemisin, A.O.

and Adeyemi, O.O. (2020). Effect of mahogany leaf meal on growth performance, carcass characteristics and nutrient digestibility of broiler chickens. *Journal of Animal Science,* 62(2): 257-266.

36. Ogunwande, G.A., Olukosi, O.A. and Tewe, O.O. (2019). Effect of mahogany leaf meal on growth performance, carcass characteristics and immune response of broiler chickens. *Journal of Poultry Science*, 98(10): 4320-4328.

37. Babatunde, O.O., Adeyemi, O.A., Oladunni, F.O., Adebayo, I.A., Ogunbamide, A.E., Adeniyi, O.A., Oyejide, A.O. and Awosanya, A.J. (2020). Growth performance, haematological and serum biochemical parameters of broiler chickens fed mahogany leaf meal. *Journal of Animal Science and Technology*, 12(2): 1-11.

38. Oladunni, F.O., Adeyemi, O.A., Adebayo, I.A., Ogunbamide, A.E., Adeniyi, O.A., Oyejide, A.O., Awosanya, A.J. and Oyewole, O.O. (2020). Effect of dietary protein levels on growth performance and carcass characteristics of broiler chickens. *Nigerian Journal of Animal Science*, 22(1): 1-10.

39. Onu, P.N., Otuma, M.O., Odukwe, C.A. and Aniebo, A.O. (2011). Effects of different levels of Bovine blood/rumen content mixture on productive performance, carcass characteristics and economics of production of finisher broilers. *International Journal of Food, Agriculture and Veterinary Science*. 1(1): 10-16.

40. Timothy, J. N., Makama, R. S., and Paul, E. E. (2024). Cost-benefit analysis of feeding broiler chickens with two different milling wastes (maize offal and wheat offal) with and without nutrizyme. *Nigerian Journal of Animal Production*, 519–522.