Performance and carcass characteristics of Isa Brown cockerels fed graded levels of dried neem (*Azadirachta indica*) leaf and bark meal

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Abstract

The use of synthetic additives has some safety risks, residues, and consumer dissatisfaction. This has led Poultry farmers to prefer the rearing of healthy birds using natural growth and health-promoting natural feed additives. *Azadirachta indica* (neem leaf and bark) has good potential as feed additives. This study assessed the effect of graded levels of neem leaf and bark meal on the performance and carcass characteristics of ISA Brown cockerels. The study used two hundred and seventy (270) day-old ISA Brown strain cockerels. The birds were randomly allotted to nine dietary treatments of thirty birds each, replicated thrice with ten birds per replicate. The treatments were 0 g Neem leaf meal (NLM) and Neem bark meal (NBM) as control, 2.5 g, 5.0 g, 7.5 g, and 10.0 g NLM/kg feed^{-1}, 2.5 g, 5.0 g, 7.5 g and 10.0 g NBM/kg^{-1} feed in a Completely Randomized Design. Birds were fed the experimental diets from 1st week to 20th week of age. Daily feed intake (DFI), Daily Weight Gain (WG), Feed Conversion Ratio (FCR), and carcass weight were evaluated. Data were analyzed using the General Linear Model at p = 0.05. Cockerel chickens fed 2.5 g/kg^{-1} NLM exhibited significantly higher Final Weight (FW), DWG, and ADG during the starter phase compared to the control. In the grower phase, birds fed 5.0 g/kg^{-1} Neem Bark Meal (NBM) showed significantly heavier FW, DWG, and ADG. Carcass features like wings, thighs, drumsticks, back, breast, head, and neck were similarly affected. At the finisher phase, neem bark meal up to 5.0 g/kg^{-1} of feed enhanced growth performance. Based on the outcomes of this study, the following conclusions can be drawn: Feeding cockerels with neem bark meal at a rate of up to 5.0 g/kg^{-1} of feed improved final body weight and resulted in a better feed conversion ratio. However, supplementation with 7.5 g/kg^{-1} neem leaf meal enhanced carcass characteristics in cockerel chickens.

Keywords: poultry, neem leaf, neem bark, carcass, cockerel.

Desempenho e características de carcaça de galos *Isa Brown* alimentados com níveis graduados de folhas secas de nim (*Azadiractha indica*) e farinha de casca

Resumo

O uso de aditivos sintéticos apresenta alguns riscos de segurança, resíduos e insatisfação do consumidor. Isto levou os avicultores a preferirem a criação de aves saudáveis, utilizando crescimento natural e aditivos alimentares naturais que promovem a saúde. *Azadirachta indica* (folha e casca de nim) tem bom potencial como aditivo alimentar. Este estudo avaliou o efeito de níveis graduados de folhas e farinha de casca de nim no desempenho e nas características de carcaça de galos ISA Brown. O estudo utilizou duzentos e setenta (270) galos da linhagem ISA Brown com um dia de idade. As aves foram distribuídas aleatoriamente em nove tratamentos dietéticos de trinta aves cada, repetidos três vezes com dez aves por repetição. Os tratamentos foram 0 g de farinha de folha de Neem (NLM) e farinha de casca de Neem (NBM) como controle, 2,5 g, 5,0 g, 7,5 ge 10,0 g de NLM/kg de ração-1, 2,5 g, 5,0 g, 7,5 g e 10,0 g. Ração NBM/kg em um desenho completamente randomizado. As aves foram alimentadas com as dietas experimentais da 1ª semana até a 20ª semana de idade.

Foram avaliados o consumo diário de ração (CDR), o ganho de peso diário (GP), a taxa de conversão alimentar (CAA) e o peso de carcaça. Os dados foram analisados pelo Modelo Linear Geral com p = 0,05. Frangos galo alimentados com 2,5 g/kg^{-1} de NLM exibiram peso final (PF), GPD e GMD significativamente maiores durante a fase inicial em comparação ao controle. Na fase de crescimento, as aves alimentadas com 5,0 g/kg^{-1} de Farinha de Casca de Neem (NBM) apresentaram peso corporal, ganho de peso e ganho de peso significativamente maiores. Características da carcaça como asas, coxas, coxas, costas, peito, cabeça e pescoço foram afetadas de forma semelhante. Na fase final, a farinha de casca de nim até 5,0 g/kg^{-1} de ração melhorou o desempenho de crescimento. Com base nos resultados deste estudo, as seguintes conclusões podem ser tiradas: A alimentação de galos com farinha de casca de nim a uma taxa de até 5,0 g/kg^{-1} de ração melhorou o peso corporal final e resultou em uma melhor taxa de conversão alimentar. No entanto, a suplementação com 7,5 g/kg^{-1} de farinha de folhas de nim melhorou as características da carcaça em frangos galo.

Palavras-chave: aves, folha de nim, casca de nim, carcaça, galo.

1. Introduction

In recent decades, the poultry industry has undergone significant expansion, transitioning from traditional methods to a more scientifically driven commercial model. This progress is credited to the effective adoption of contemporary growth enhancement techniques and comprehensive disease prevention strategies (Angelakis et al., 2013).

Contemporary poultry producers encounter a pivotal challenge in ensuring the production of wholesome birds with high-quality meat and eggs, free from harmful residues. The utilization of synthetic compounds such as antibiotics and growth promoters poses economic burdens and potential health risks to poultry (Ojediran; Ojediran, 2024). Concerns regarding prolonged withdrawal periods and the accumulation of residues in poultry tissues and eggs, posing potential hazards to human health, have heightened (Jawad et al., 2014; Sarker et al., 2018). Consequently, there is a growing consumer preference for poultry products devoid of drug residues (Talukder et al., 2017). This increasing demand has spurred investigations into alternative methodologies for economically viable poultry production, emphasizing natural growth and health enhancement approaches (Sarker et al., 2020). Researchers are now delving into ancient medicinal systems to identify beneficial herbs that can augment production safely (Islam et al., 2018).

Plants inherently offer essential nutrients and valuable bioactive compounds (Cherkupally et al., 2017). Throughout history, herbs and spices have played crucial roles in addressing health challenges. Commonly utilized herbs such as neem fruit and leaves, nutmeg, cinnamon, and ginger serve diverse functions, acting as digestive stimulants, antidiarrheal agents, antiseptics, anti-inflammatories, antiparasitic, and appetite stimulants for both humans and animals (Agarwal, 2002).

Neem (*Azadirachta indica* A. Juss) is a tropical plant native to Nigeria, known as "Ogwu-iba" in Igbo and "Dogonyaro" in Hausa. Renowned for its medicinal properties, neem acts as an anti-coccidial agent in broilers and a natural pesticide (Tipu et al., 2002; Esonu et al., 2006; Islas et al., 2020). Recent studies have investigated the incorporation of neem leaf meal into the diets of broilers (Onyimonyi et al., 2009) and layers (Olabode et al., 2013), yet there is limited information regarding its application in cockerel production. Cockerels, valued for their resilience, active behavior, and cost-effectiveness, represent a significant source of poultry meat, particularly for small-scale farmers (Chukwuemeka, 2017; Ojediran et al., 2017) and those in rural settings.

Therefore, this study aims to assess the impact of varying levels of neem leaf and bark meal on the growth performance and carcass characteristics of cockerels.

2. Materials and Methods

2.1 Description of the experimental location

All procedures were certified by the University's Animal Use Committee under reference ANB/AP/2000297. The study was conducted at the Poultry Unit, Teaching and Research Farm of Ladoke Akintola University of Technology, situated in Ogbomoso, Nigeria. Ogbomoso falls within the derived Savanna Zone, positioned at a longitude of 4o101 East of the prime meridian and a latitude of 8o101 North of the equator. The elevation in this region ranges from 300 m to 600 m above sea level, with mean temperatures averaging 27 ºC and an annual rainfall of 1247 mm (Ojediran et al., 2022).

2.2 Collection and preparation of the test ingredient

Neem leaves and bark were collected from neem trees located within the vicinity of the experimental site in Ogbomoso, Oyo State, Nigeria. The neem tree bark was then diced using a sharp knife to achieve size reduction. Subsequently, both the leaves and bark were thoroughly rinsed under flowing tap water to eliminate any contaminants. Following this, they were placed in a shaded area to undergo air drying for 14 days and 21 days respectively during the month of November (during harmattan) until they reached a crisp texture. The dried neem leaf sample was pulverized into fine particles using a burr mill and stored in an airtight container, while the dried neem bark sample was crushed and ground into a powdery consistency using the same burr mill.

2.3 Proximate analysis

The proximate analysis of the experimental ingredients was evaluated, following the methodology outlined in the AOAC (2000).

2.3.1 Experimental diets

Nine (9) diets were formulated for the study such that Diet 1 (T1) served as the control that neither contained neem (*Azadirachta indica*) leaf meal nor neem (Azadirachta indica) bark meal. Diets 2 (T2,), 3(T3), 4(T4), and 5(T5) contained 2.5 g, 5.0 g, 7.5 g, and 10.0 g NLM/kg^{-1} of feed respectively. Diets 6(T6), 7(T7), 8(T8), 9(T9) contained 2.5 g, 5.0 g, 7.5 g, and 10.0 g NBM/kg^{-1} of feed respectively. The gross composition of the experimental diets is shown in (Tables 1 and 2).

2.4 Preparation of experimental location

Before initiating the experiment, the experimental enclosure underwent maintenance procedures, including repair, cleaning, and disinfection utilizing Morigad®, Iodasteryl®, and Hypochlorite® dissolved in water. Electrical connections were established to provide heat and illumination for the chicks, while wood shavings were evenly distributed on the floor to function as litter material. The sides of the enclosure were insulated to conserve heat. Feeders, drinkers, and other equipment were thoroughly sanitized, and coal pots were prepared and set up to provide supplementary heat under standard operating conditions.

2.5 Experimental animals and management

Two hundred and seventy (270) 1-day-old cockerel chicks were acquired from Amo Sieberer Hatchery in Awe, Oyo State, Nigeria. Upon arrival, the chicks were unpacked, weighed individually, and then distributed randomly among nine dietary treatments. Each treatment was replicated three times, with ten birds per replicate, following a Completely Randomized Design (CRD). Vaccination and medication were administered solely to the control group (T1).

2.6 Experimental design

The experiment comprised two factors namely, neem leaf meal (NLM) and neem tree bark meal (NTBM). The levels of inclusion (2.5 g, 5.0 g, 7.5 g, and 10.0 g/kg^{-1} of feed were used during the experiment to have a two-by-four (2×4) factorial arrangement within a completely randomized design.

2.7 Data collection

Growth performance

The birds were weighed initially before the commencement of the experiment, weekly weight gains, feed intake, and feed conversion ratio were recorded during the experiment and were used as a measure of growth performance.

2.8 Feed intake

Weighed quantities of feed served to the birds and the left over were used to determine the feed intake of the experimental birds.

Feed intake (g/birds) = feed served – left over

Average Daily Feed Intake (ADFI)

ADFI (g/bird/day) = feed intake/ Number of birds

Weight Gain (WG)

WG = final body weight – initial weight

Average Daily Gain (ADG)

This is the total of the daily weight gain of the birds per replicate divided by several birds in that replicate.

ADG = Daily Weight Gain of birds in a replicate/ number of birds in that replicate

Feed Conversion Ratio (FCR) or Feed to gain Ratio

FCR = Average Daily Feed Intake / Average Daily Gain

Table 1. Gross composition of experimental diet at starter phase (0- 8 weeks).

Ingredient	T_1 (Control)	T_2 (2.5 g NLM)	T_3 (5.0 g NLM)	T_4 (7.5 g NLM)	T_5 (10 g NLM)	T_6 (2.5 g NBM)	T_7 (5.0 g NBM)	T_8 (7.5 g NBM)	T_9 (10 g NBM)
Maize	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00
Corn barn	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
Wheat offal	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50
GNC	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
SBM	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
NBM	-	-	-	-	-	+	++	+++	++++
Fish meal	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
PKC	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Limestone	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NLM	-	+	++	+++	++++	-	-	-	-
NBM	-	-	-	-	-	+	++	+++	++++
Total	100	100	100	100	100	100	100	100	100
Calculated nutrient									
Crude protein	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
Crude fiber	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18
Energy(k/cal/kg^{-1})	2650	2650	2650	2650	2650	2650	2650	2650	2650

Note: PKC = Palm Karnel Cake, SBM = Soya Bean Meal, GNC = Groundnut Cake, NLM = neem leaf meal, NBM = neem bark meal, + = 2.5 g/kg, ++ = 5.0 g/kg, +++ = 7.5 g/kg, ++++ = 8.5 g/kg. Source: Authors, 2024.

Table 2. Gross composition of experimental diet at grower phase (9 weeks to 20 weeks).

Ingredient	T_1 (Control)	T_2 (2.5 g NLM)	T_3 (5.0 g NLM)	T_4 (7.5 g NLM)	T_5 (10.0 g)	T_6 (2.5 g NBM)	T_7 (5.0 g NBM)	T_8 (7.5 g NBM)	T_9 (10 g NBM)
Maize	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00
Corn barn	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
Wheat offal	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
GNC	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
SBM	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
PKC	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Limestone	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NLM	-	+	++	+++	++++	-	-	-	-
NBM	-	-	-	-	-	+	++	+++	++++
Total	100	100	100	100	100	100	100	100	100
Calculated nutrient									
Crude protein	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Crude fiber	6.24	6.24	6.24	6.24	6.24	6.24	6.24	6.24	6.24
Energy(kcal/kg^{-1})	2550	2550	2550	2550	2550	2550	2550	2550	2550

Note: PKC = Palm Karnel Cake, SBM = Soya Bean Meal, GNC = Groundnut Cake, NLM = neem leaf meal, NBM = neem bark meal, + = 2.5 g/kg, ++ = 5.0 g/kg, +++ = 7.5 g/kg, ++++ = 8.5 g/kg. Source: Authors, 2024.

3. Results and Discussion

The proximate composition of *A. indica* leaf meal (NLM) is detailed in (Table 3), indicating a moderate crude protein content of 24.53% and a high crude fiber content of 17.85%. Likewise, the proximate composition of neem (*Azadirachta indica*) bark powder demonstrated a crude protein content of 16.89% and a high crude fiber content of 7.29%.

Table 3. Proximate composition of neem leaf and bark powder.

Parameters	Test ingredients	Value
Dry matter (%)	Leaf	90.53
	Bark	91.10
Crude protein (%)	Leaf	24.53
	Bark	16.89
Crude fibre (%)	Leaf	17.85
	Bark	7.29
Ether extract (%)	Leaf	1.92
	Bark	2.25
Ash (%)	Leaf	3.72
	Bark	3.30
Nitrogen-free extract (%)	Leaf	51.98
	Bark	70.27
Gross energy (kcal/100 g^{-1})	Leaf	356.84
	Bark	320.88

Source: Authors, 2024.

Table 4 shows the main effect of varying levels of neem leaf meal (NLM) and neem bark meal (NBM) on the growth performance of ISA brown cockerels fed graded levels of neem leaf and bark meal at the starter phase (0-8 weeks). Final weight (FW), weight gain (WG), average daily gain (ADG), feed intake (FI), average daily feed intake (ADFI), and feed conversion ratio (FCR) were significantly ($p < 0.05$) affected by the levels of neem leaf and bark meal. The highest values for final weight, weight gain, and average daily gain were recorded among cockerels fed T2 (2.5 g NLP/1 kg of feed) while the highest values for feed intake and average daily feed intake were observed among cockerels fed T6, T7, T8 and T9 respectively. The highest value for feed conversion ratio was observed among cockerels fed T8 (7.5 g NBP/kg of feed) while the lowest feed conversion ratio was recorded among cockerels fed T2 (2.5 g NLP/kg^{-1} feed) respectively.

Table 4. Effect of varying levels of neem leaf and bark meal on growth performance of ISA brown cockerels at grower phase (0– 8 weeks).

TRT	T1	T2	T3	T4	T5	T6	T7	T8	T9	SEM
IW (g)	34.10	34.00	34.10	34.10	34.00	34.10	34.10	34.10	34.00	0.02
FW (g)	622.80^{cde}	684.96^{a}	664.36^{abc}	640.76^{bcd}	620.38^{de}	672.66^{ab}	635.00^{bcd}	586.66^{e}	650.00^{abcd}	5.62
WG (g)	588.46^{cd}	650.96^{a}	630.36^{ab}	606.76^{bc}	586.38^{cd}	642.00^{ab}	603.80^{bc}	555.53^{d}	618.60^{abc}	5.60
ADG (g/bird/day)	10.50^{cd}	11.62^{a}	11.25^{ab}	10.83^{bc}	10.47^{cd}	11.46^{ab}	10.78^{bc}	9.92^{d}	11.04^{abc}	0.10
FI (g)	1954.95^{c}	2046.79^{bc}	2113.23^{b}	2088.16^{bc}	2151.21^{b}	2410.26^{a}	2434.26^{a}	2523.10^{a}	2511.10^{a}	31.88
ADFI (g/bird/day)	34.91^{c}	36.54^{bc}	37.73^{b}	37.28^{bc}	38.41^{b}	43.04^{a}	43.46^{a}	45.05^{a}	44.84^{a}	0.56
FCR	3.32^{de}	3.14^{e}	3.35^{de}	3.44^{d}	3.67^{c}	3.75^{c}	4.03^{b}	4.56^{a}	4.06^{b}	0.06

Note: abc = means within the same row with different superscripts differ significantly, SEM = standard error of mean, IW = Initial weight, FW = Final weight, WG = Weight gain, ADG = Average Daily Gain, FI = Feed intake,

ADFI = Average daily feed intake, FCR = Feed conversion ratio. Source: Authors, 2024.

Table 5 shows the effect of varying levels of neem leaf meal (NLM) and neem bark meal (NBM) on the growth performance of ISA Brown cockerels fed graded levels of neem leaf and bark meal at the grower phase (9-20 weeks). Initial weight (IW), final weight (FW), weight gain (WG), average daily gain (ADG), feed intake (FI), average daily feed intake (ADFI) and feed conversion ratio (FCR) were significantly ($p < 0.05$) affected by the levels of neem leaf and bark meal. The highest values for final weight, weight gain, and average daily gain were recorded among cockerels fed T7 (5.0 g NBP/1 kg of feed) while the highest values for feed intake and average daily feed intake were observed among cockerels fed T1, T2, and T3 respectively. The highest value for feed conversion ratio was observed among cockerels fed T4 (7.5 g NLP/kg^{-1} of feed) while the lowest feed conversion ratio was recorded among cockerels fed T6, T7, T8, and T9 respectively.

Table 5. Effect of varying levels of neem leaf and bark meal on growth performance of ISA brown cockerels at grower phase (9 – 20 weeks).

TRT	T1	T2	T3	T4	T5	T6	T7	T8	T9	SEM
IW (g)	622.80^{de}	684.96^{a}	664.36^{abc}	640.76^{bcd}	620.38^{de}	672.66^{ab}	635.00^{bcd}	586.66^{e}	650.00^{abcd}	5.62
FW (g)	2028.40^{ab}	1846.03^{bc}	1759.46^{bcd}	1433.90^{d}	1541.60^{cd}	2076.88^{ab}	2386.20^{a}	2107.09^{ab}	2095.65^{ab}	54.88
WG (g)	1405.60^{abc}	1161.06^{bcd}	1095.10^{cd}	793.13^{d}	921.21^{d}	1404.22^{abc}	1751.20^{a}	1520.42^{ab}	1445.65^{abc}	54.83
ADG (g/bird/day)	16.73^{abc}	13.82^{bcd}	13.03^{cd}	9.44^{d}	10.96^{d}	16.71^{abc}	20.84^{a}	18.10^{ab}	17.21^{abc}	0.65
FI (g)	10126.93^{a}	9885.29^{a}	10082.42^{a}	9644.13^{ab}	9977.20^{a}	8722.77^{c}	8881.82^{c}	9196.64^{bc}	8818.02^{c}	97.36
ADFI (g/bird/day)	120.55^{a}	117.68^{a}	120.02^{a}	114.81^{ab}	118.77^{a}	103.84^{c}	105.73^{c}	109.48^{bc}	104.97^{c}	1.15
FCR	9.03^{b}	8.66^{b}	9.33^{b}	12.40^{a}	10.84^{ab}	6.34^{c}	5.19^{c}	6.08^{c}	6.09^{c}	0.38

Note: abc =means within the same row with different superscripts differ significantly, SEM= standard error of mean, IW = Initial weight, FW = Final weight, WG = Weight gain, ADG = Average Daily Gain, FI = Feed intake, ADFI = Average daily feed intake, FCR = Feed conversion ratio. Source: Authors, 2024.

Table 6 shows the effect of neem leaf and neem bark meal on the carcass characteristics of ISA Brown cockerel chicken. Live weight, slaughter weight, dressed weight, wings, thigh, drumstick, back, breast, head and neck were significantly ($p < 0.05$) influenced by the dietary treatments. The highest live weight was observed in T1 and T2 while the least live weight was observed in T6 and T9. The slaughter weight was highest across all the inclusion levels except T5 which had the least value. Dressed weight was observed to be highest among birds fed T6 and least across all other inclusion levels.

The highest value for wings was recorded in T9 while the least values were recorded among other inclusion levels. The highest value for thigh was observed among birds fed T1 while the least values were observed among birds fed T6 and T8. The highest value for drumsticks was observed among birds fed T1 and T5 but the lowest value was observed among birds fed T9. Birds fed T1 and T5 had the highest values observed for the back while the least value was observed among birds fed T3. The highest values for breast were observed among birds fed T2, T3, T4, and T7 while the lowest value was observed among birds fed T1 and T9. The highest value for head was observed among birds fed T5 while the least value was observed in T7. The highest value for neck weight was recorded among birds fed T8 while the least value was observed among birds fed T3.

Table 6. Effect of neem leaf and bark meal on the relative carcass characteristics of ISA brown cockerel chicken.

Parameters (%)	T1	T2	T3	T4	T5	T6	T7	T8	T9	SEM
Live W (g)	2091.330^{a}	1984.000^{ab}	1824.670^{c}	1927.000^{bc}	1997.670^{ab}	1674.330^{d}	2118.670^{a}	1902.000^{bc}	1683.000^{d}	25.19
Slaughter	96.75^{a}	96.17^{a}	94.61^{a}	95.96^{a}	75.12^{b}	96.07^{a}	90.94^{a}	95.58^{a}	96.40^{a}	1.16
Dressed W	78.03^{b}	78.74^{b}	80.54^{b}	80.64^{b}	81.04^{b}	87.14^{a}	79.28^{b}	81.87^{b}	80.14^{b}	0.57
Wings	9.55^{b}	10.03^{b}	9.93^{b}	9.33^{b}	9.61^{b}	10.19^{b}	9.53^{b}	9.92^{b}	11.45^{a}	0.13
Thigh	12.27^{a}	11.64^{abc}	10.90^{cd}	11.81^{ab}	11.07^{bcd}	10.49^{d}	11.75^{ab}	10.34^{d}	10.64^{d}	0.12
Drumstick	11.90^{a}	11.33^{ab}	11.58^{ab}	12.28^{a}	11.88^{a}	11.32^{ab}	11.55^{ab}	10.67^{bc}	9.99^{c}	0.12
Back	16.57^{a}	15.04^{ab}	13.19^{b}	14.59^{ab}	16.23^{a}	15.31^{ab}	15.30^{ab}	14.47^{ab}	15.07^{ab}	0.25
Breast	12.79^{b}	14.95^{a}	15.02^{a}	16.08^{a}	14.41^{ab}	14.04^{ab}	15.85^{a}	14.10^{ab}	12.65^{b}	0.25
Head	4.08^{ab}	4.43^{ab}	3.90^{bc}	4.16^{ab}	4.70^{a}	4.13^{ab}	3.32^{c}	3.86^{bc}	3.89^{bc}	0.07
Neck	6.25^{ab}	6.74^{ab}	5.11^{c}	5.81^{b}	6.97^{ab}	5.13^{b}	5.51^{b}	7.87^{a}	5.69^{b}	0.21

Note: abc = means within the same row with different superscripts differ significantly, SEM = standard error of the mean, Live W = live weight, Slaughter = slaughter weight, Dressed W = dressed weight. Source: Authors, 2024.

4. Discussion

The proximate analysis of neem leaf conducted in this investigation revealed decreased dry matter (90.53%), ether extract (1.92%), ash (3.72%), and nitrogen-free extract (51.98%) compared to values documented by Esonu et al. (2006). Conversely, the experiment indicated a slightly elevated crude protein content of 24.5%, contrasting Esonu et al (2006) observation of 20.69% but aligning with Onyimonyi et al. (2009) finding of 24.06%. The crude fiber value (17.85%) in this study exceeded Esonu et al. (2006) result of 16.60% and Onyimonyi et al (2009) report of 12.00%. Discrepancies may stem from divergent drying methodologies; while Esonu et al. (2006) sun-dried neem leaves, this study utilized air drying. Moreover, geographical disparities, encompassing soil composition, fertility, and climatic conditions, may contribute to observed discrepancies. The age of the neem leaves is also a significant determinant, as it is established that crude protein decreases and crude fiber increases with leaf maturity.

Birds that received T2 (2.5 g NLM) demonstrated the highest final weight, weight gain, and average daily gain compared to those on the control diet. This contradicts the findings of Olabode et al. (2013), who observed reduced body weight in birds fed a diet containing NLM. The increased weight gain observed in this study suggests minimal presence of toxic factors such as terpenes and limonoids, which may potentially promote bird growth with NLM and NBM. Tipu et al. (2002) similarly reported positive outcomes with neem as a feed additive in broilers. These results underscore neem leaf and bark as viable nutrient sources and growth promoters, contrasting with the findings of Durrani et al. (2008), possibly attributable to variations in processing methods; they employed oven-drying in their study, whereas air-drying was utilized in the present investigation.

Variations in feed conversion ratio observed among the treatments suggest an influence of neem leaf and bark meal (NLM) on nutrient availability, digestion, absorption, and utilization. Suboptimal utilization of diets containing elevated levels of neem leaf and bark meal during the starter phase may stem from challenges encountered by bird enzymes in breaking down active components and potential metabolic disruptions associated with neem leaf, as documented by Esonu et al. (2005). This Ojediran et al., (2014a, b; 2016; 2018) and Oladunjoye et al., (2014) attributed to the age and maturity of the GIT of starter chicks.

In the finisher phase, the inclusion of Azadirachta indica leaf and bark meal in the diet of cockerels in this investigation significantly impacted initial weight, final weight, weight gain, average daily gain, feed intake, average daily feed intake, and feed conversion ratio. Birds receiving T7 exhibited the highest weight gain compared to both the control and other dietary treatments. Elevated levels of neem leaf corresponded to reduced weight gain and average daily gain, consistent with the findings of Bonsu et al. (2012), who noted a significant influence of neem leaf meal on weight gain and final weight in broiler chickens.

Feed intake and average daily feed intake were observed to be highest in birds fed the control diet and those supplemented with neem leaf meal, whereas birds receiving neem bark meal exhibited the lowest values,

potentially attributed to the presence of coumarins in neem bark. Neem bark meal-fed birds displayed the highest feed conversion ratio, followed by those on the control diet, while birds receiving neem leaf meal had the lowest. The presence of coumarins in neem bark may contribute to these observations, consistent with findings reported by El-Far et al. (2016). Studies by Kale et al. (2003), Bishnu et al. (2009), and Sarker et al. (2014) similarly documented increased body weight and weekly weight gain in birds supplemented with neem leaf extract, attributed to the antimicrobial and anti-protozoal properties of neem leaves. Discrepancies among studies may arise from differences in the form of the test ingredient (extract vs. leaf meal) and the mode of administration.

The evaluation of slaughtered chickens extends beyond whole carcasses to encompass smaller cuts, warranting consideration of the impact of phytogenic additives. Notably, premium commercial cuts from chickens include the breast, thigh, and drumstick (Adeyemi et al., 2008). Neem leaf and bark meal influenced carcass yield, as indicated by significant disparities in live weight, slaughter weight, dressed weight, wings, thighs, drumsticks, back, breast, head, and neck measurements. However, these findings contrast with the conclusions of Bonsu et al. (2012) and Ubua et al. (2019), who reported no notable variations in carcass characteristics among broilers fed neem leaf meal.

5. Conclusions

Based on the outcomes of this study, the following conclusions can be drawn: Feeding cockerels with neem bark meal at a rate of up to 5.0 g/kg^{-1} of feed improved final body weight and resulted in a better feed conversion ratio. However, supplementation with 7.5 g/kg^{-1} neem leaf meal enhanced carcass characteristics in cockerel chickens.

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6. Authors' Contributions

Oyetoro Blessing Abiola: conceptualize the study and write the article. *Adedeji Olusegun Stephen*: designed the study. *Ojediran Taiwo Kayode*: proofread the writing. *Rom-Kalilu Fiwasade Adejoke*: carried out the experiment. *Daniel Modupe Blessing*: carried out the experiment.

7. Conflicts of Interest

No conflicts of interest.

8. Ethics Approval

All procedures were certified by the University's Animal Use and Ethics Committee under reference ANB/AP/2000297.

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