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Nutrient retention of broiler and layer chickens fed dietary treatment of neem leaf as a protein source

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ABSTRACTS: A study was conducted to investigate the inclusion of neem leaf (*Azadirachta indica*) as a protein source in the diet of broilers and layers. A total of one hundred and fifty broiler chicks and one hundred and fifty point-of-laying pullets were assigned to five dietary treatments in a completely randomised design. Five dietary treatments were formulated with varying levels of Neem Leaf Meal (NLM) inclusion. D1 (0% NLM), D2 (5% NLM), D3 (10% NLM), D4 (15% NLM) and D5 (20% NLM) with 30 birds per treatment, 10 birds per replicate and replicated thrice. The experimental trial for broiler chickens lasted for eight weeks, and the layers experimental trial lasted for twelve weeks, during which the nutrient retention of the birds was determined. There were no significant ($p>0.05$) differences in the nutrient retention of broilers fed the experimental diets. On laying birds' trial, the result showed that crude protein, ash, ether extract, crude fibre and dry matter were significantly ($p<0.05$) influenced by dietary treatments. It was concluded that dietary treatments significantly influenced nutrient retention in laying birds, with notable effects on crude protein, crude fibre, ether extract, ash, and dry matter. The results underscore the importance of optimizing dietary formulations to enhance nutrient utilization, reduce waste, and promote sustainable egg production. Therefore, 10% NLM inclusion is recommended for optimal performance in broiler and layer production.

Keyword: Broilers, layers, neem leaf, nutrient retention.

INTRODUCTION

The poultry industry has been rapidly expanding in recent years and is, therefore, one of the most commercialised subsectors of Nigerian Agriculture (Fadimula *et al.,* 2020). The popularity of poultry production can be explained by the fact that poultry has many advantages over other livestock, and it has been described as the fastest means of solving the problem of protein deficiency in Nigeria (Akpabio *et al.,* 2007). Poultry birds are good converters of feed into usable protein in meat and eggs. Therefore, poultry birds are one of the major sources of animal protein in Nigeria today. The significance of animal protein remains undisputed; animal protein supplies man with quality nourishment that aids growth, development, and tissue replacement. (Salami *et al.,* 2021). Poultry meat is very tender, and its acceptability to consumers is high, regardless of their religious beliefs. (Aboki *et al.,* 2013). Broiler birds are those kept and reared for meat production from day old to about eight weeks for good quality tender meat as a source of protein in the human diet. Chickens raised for eggs are usually called layers. on average, a laying hen produces one egg/day. All laying hens start to lay exactly when they are 21 weeks old (Bozkurt *et al.,* 2009). The appropriate nutrition provision to layers is a prerequisite for optimal egg production. Layer ration should be designed to meet the requirements for laying hens' energy, protein, minerals, and vitamins determined by maintenance, body weight, and level of egg production. Ingredient selection is determined by availability, price, and, if available, nutrient biological availability estimates to minimize the cost of the ration. Specific fats and cereal

Table 1. Gross composition of experimental diets for broilers.

Ingredients	Experimental diets				
	D1	D2	D3	D4	D5
Maize	60.00	60.00	60.00	60.00	60.00
Soybeans meal	25.00	22.00	19.00	16.00	13. 00
Neem leaf meal	0.00	3.00	6.00	9.00	12.00
Wheat Offal	5.45	5.45	5.45	5.45	5.45
Palm Kernel Cake	2.00	2.00	2.00	2.00	2.00
Fish meal	3.40	3.40	3.40	3.40	3.40
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	0.50	0.50	0.50	0.50	0.50
Premix	0.25	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.05	0.05	0.05	0.05	0.05
Total (%)	100	100	100	100	100
Calculated values					
Metabolizable energy Kcal/kg	2978	2978	2978	2978	2978
Crude protein (%)	20.23	20.23	20.23	20.23	20.23
Crude fibre (%)	3.56	3.56	3.56	3.56	3.56
Ether extract (%)	3.74	3.74	3.74	3.74	3.74
Calcium (%)	1.56	1.56	1.56	1.56	1.56
Available phosphorus (%)	0.77	0.77	0.77	0.77	0.77
Lysine (%)	1.11	1.11	1.11	1.11	1.11
Methionine (%)	0.43	0.43	0.43	0.43	0.43

Premix provided to chicks with vitamin A: 1000 IU; vitamin D_3: 500 IU; vitamin E: 5.75 IU; vitamin K_3: 0.5 mg; vitamin B_1: 0.45 mg; vitamin B_2: 1.25 mg; vitamin B_6: 0.75 mg; vitamin B_{12}: 0.00375 mg; Niacin: 6.875 mg; Pantothenic acid: 1.875 mg; Folic acid 0.1875 mg; Biotin H_2: 0.015 mg; C Choline chloride: 75 mg; Cobalt: 0.05 mg; Copper: 0.75 mg; Iodine: 0.25 mg; Iron: 5 mg; Manganese: 10 mg; Selenium: 0.05 mg; Zinc: 7.5 mg and Antioxidant: 0.3125mg.

grains provide energy, content and digestibility of essential amino acids that determine the protein source (Zaheer, 2015). Neem is a tropical plant widely recognized for its medicinal, antimicrobial and insecticidal properties (Ogbuewu *et al.,* 2011). It also contained significant amounts of crude protein, fibre and bioactive phytochemicals, which suggests potential use for use in livestock nutrition (Shihab *et al.,* 2017). Researchers have reported the medicinal benefits of neem leaf, but little has been done about its nutritional benefits as a protein source in the diets of broilers and layers. This is the gap this study intends to fill. Therefore, this study was conducted to evaluate the effects of varying levels of neem leaf meal on the nutrient retention of broilers and layers.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Poultry Section of the Department of Animal Science, Osun State University, Ejigbo campus. The area is located within the forest zone of Nigeria on latitude 7° 54'N and longitude 4° 18'E. The average elevation is 426 meters (1,398ft) (MongaBay, 2011). It has an average annual rainfall of 1,330 mm. Usually; the rainy season lasts from April – October.

Housing

The birds were raised in colony cages for eight and twelve weeks, respectively. They were acclimatized for one week during which their basal diet was offered. Daily routine operations such as washing drinkers, changing water, offering feed, pen cleaning, and maintenance were observed.

Experimental animals, diets and design

A total of one hundred and fifty (150) day-old broiler chicks and (150) point-of-laying pullets were used for this study. The birds were randomly assigned to five (5) dietary treatments in a completely randomised design (CRD) at 30 birds per treatment, 10 birds per replicate and each treatment was replicated thrice. Five dietary treatments were formulated at varying inclusion levels of neem leaf meal (NLM). Diet 1 (control) without NLM, diet 2 contains 5% (NLM), diet 3 contains 10%(NLM), diet 4 contains 15% (NLM), diet 5 contains 20% (NLM) (see Tables 1 and 2). The birds were fed their dietary treatments for eight and twelve weeks, respectively.

Table 2. Gross composition of experimental diets for layers.

Ingredients	Experimental diets				
	D1	D2	D3	D4	D5
Maize	50.00	50.00	50.00	50.00	50.00
Soya Beans Meal	19.00	16.50	14.00	11.50	9.00
Neem Leaf Meal	0.00	2.50	5.00	7.50	10.00
Wheat Bran	15.00	15.00	15.00	15.00	15.00
Palm Kernel Meal	5.00	5.00	5.00	5.00	5.00
Fish Meal	2.00	2.00	2.00	2.00	2.00
Bone Meal	2.00	2.00	2.00	2.00	2.00
Oyster Shell	6.00	6.00	6.00	6.00	6.00
Premix	0.30	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total (%)	**100**	**100**	**100**	**100**	**100**
Calculated values					
M E (kcal/kg)	2676.45	2676.45	2676.45	2676.45	2676.45
Crude Protein	17.79	17.79	17.79	17.79	17.79
Lysine	1.09	1.09	1.09	1.09	1.09
Methionine	0.49	0.49	0.49	0.49	0.49
Calcium	3.21	3.21	3.21	3.21	3.21
Phosphorous	0.51	0.51	0.51	0.51	0.51

Premix provided to chicks with vitamin A: 1000 IU; vitamin D_3: 500 IU; vitamin E: 5.75 IU; vitamin K_3: 0.5 mg; vitamin B_1: 0.45 mg; vitamin B_2: 1.25 mg; vitamin B_6: 0.75 mg; vitamin B_{12}: 0.00375 mg; Niacin: 6.875 mg; Pantothenic acid: 1.875 mg; Folic acid 0.1875 mg; Biotin H_2: 0.015 mg; C Choline chloride: 75 mg; Cobalt: 0.05 mg; Copper: 0.75 mg; Iodine: 0.25 mg; Iron: 5 mg; Manganese: 10 mg; Selenium: 0.05 mg; Zinc: 7.5 mg and Antioxidant: 0.3125mg.

Nutrient retention

In the eleventh week, six birds were taken from each treatment and placed in metabolic cages for the collection of faeces for nutrient retention studies. Fresh excreta were collected in the morning, weighed, and oven-dried at 40°C for a period of 3 days. The oven-dried excreta were analysed using AOAC (2004).

Statistical analysis

Data obtained from this study were subjected to a one-way analysis of variance (ANOVA). Significant means were separated using the Duncan New Multiple Range Test as contained in the SAS (2020) package.

RESULT AND DISCUSSION

Table 3 shows the proximate composition of the broiler finisher diets. Crude protein, ash content, crude fibre, ether extract, dry matter, moisture content and nitrogen-free extracts were not significantly ($p>0.05$) different.

The proximate composition of the layer diets is shown in Table 4. There were no significant ($p>0.05$) differences observed across the treatment means on crude protein, ash content, crude fibre, ether extract, dry matter, moisture content and nitrogen-free extract.

The nutrient retention of broiler chickens fed neem leaf meal is shown in Table 5. There were no significant ($p>0.05$) differences in the nutrient retention of broilers fed the experimental diets. Table 6 presents the effect of feeding neem leaf meal as a protein source on the nutrient retention of laying birds. The result showed that crude protein, ash, ether extract, crude fibre and dry matter nutrient retention were significantly ($p<0.05$) influenced by dietary treatments. The crude protein (CP) nutrient retention was significantly highest in laying birds fed diet 1 (14.00%), indicating a high proportion of unutilized crude protein, while laying birds fed diet 2 had the lowest (12.37%) crude protein nutrient retention. The crude fibre nutrient retention was significantly ($p<0.05$) higher among laying birds fed the control diet, while the lowest crude fibre nutrient retention (60.85%) was recorded in birds fed diet 4. The highest ether extract retention (42.80%) was

Table 3. Proximate composition of broiler diets

Parameters (%)	Experimental diets					SEM
	D1	D2	D3	D4	D5	
Crude protein	20.83	19.96	19.85	18.97	18.13	1.64
Ash content	9.93	10.41	10.76	12.35	12.85	1.77
Crude fibre	6.18	5.91	6.81	7.03	7.54	1.71
Ether extract	8.03	7.06	6.91	6.05	5.80	1.68
Dry matter	93.93	92.86	92.89	92.74	91.34	996.42
Moisture content	7.53	6.96	7.23	7.76	8.30	1.68
Nitrogen free extract	49.58	50.66	51.32	60.33	52.83	1.76

SEM = Standard Error of Mean.

Table 4. Proximate composition of layer diets.

Parameters (%)	Experimental diets					SEM
	D1	D2	D3	D4	D5	
Crude protein	18.25	16.88	17.82	17.41	17.38	0.045
Ash content	9.33	8.68	10.13	9.08	8.79	0.617
Crude fibre	5.57	5.97	5.60	5.59	6.02	0.330
Ether extract	7.58	7.18	7.40	7.44	6.95	0.072
Dry matter	93.20	93.25	93.61	93.02	93.34	0.266
Moisture content	7.29	7.24	6.88	7.22	7.15	0.035
Nitrogen free extract	52.32	54.29	52.28	52.48	53.95	0.609

SEM = Standard error of mean.

Table 5. Nutrient retention of broiler chickens fed dietary neem leaf meal.

Parameters (%)	Experimental diets					SEM
	D1	D2	D3	D4	D5	
Crude protein	45.31	43.37	41.5	40.45	40.95	0.08
Ash	35.2	33.03	31.26	30.4	31.58	0.05
Ether extract	56.38	55.83	53.31	51.38	50.13	0.05
Fibre	32.38	35.18	36.45	36.7	38.17	0.06
Dry matter	89.28	89.96	90.4	90.53	91.3	0.07

SEM = Standard error of mean.

Table 6. Nutrient retention of layer chickens fed dietary neem leaf meal

Parameter (%)	D1	D2	D3	D4	D5	SEM
Crude protein	56.85^{a}	54.72^{c}	56.55^{b}	54.55^{c}	50.25^{d}	0.017
Ash	42.50^{a}	40.30^{c}	41.92^{b}	39.80^{e}	40.01^{d}	0.034
Ether extract	40.21^{c}	42.70^{a}	40.80^{b}	42.80^{a}	40.05^{bc}	0.061
Crude fibre	65.37^{a}	64.30^{b}	62.65^{ab}	60.85^{c}	64.36^{b}	0.092
Dry matter	90.93^{ab}	90.47^{c}	90.99^{ab}	90.66^{bc}	91.10^{a}	0.11

^{abcd}: Means on the same row with different superscripts differ significantly ($p<0.05$), SEM = Standard error of mean.

recorded in birds fed diet 4, which is closely similar to the value (42.70%) obtained in diet 2, while laying birds fed diet 5 had the lowest (40.05%) ether extract retention. The ash content was significantly observed to be highest in birds fed the control diet, while the least significant value was observed in birds fed diet 4. The dry matter content was significantly influenced by the dietary group. Birds fed diet 5 had the highest dry matter content, while the birds fed diet 2 had the least dry matter content.

Nutrient retention is a critical factor in poultry nutrition, particularly for layer chickens, as it directly influences their health, egg production, and overall productivity. Efficient nutrient utilization ensures that layers receive adequate amounts of essential nutrients, such as proteins, fats, vitamins, and minerals, required for optimal physiological function and sustained egg production (Leeson and Summers, 2005). Evaluating nutrient retention also has broader implications for feed efficiency, cost-effectiveness, and environmental sustainability by minimizing nutrient waste (Adeola and Cowieson, 2011). The retention of nutrients in poultry is influenced by various factors, including feed composition, enzyme supplementation, bird age, and management practices (Adeola and Cowieson, 2011).

The crude protein (CP) retention results, where diet 1 exhibited the highest retention (56.85%), suggest inefficiencies in protein utilization in this group, as a high CP retention often indicates an increased proportion of unutilized protein (Ravindran *et al*., 2000). Conversely, the lowest CP retention observed in birds fed diet 5 (50.25%) may indicate more efficient protein utilization, possibly due to a more balanced amino acid profile or improved digestibility in this diet (Adeola and Cowieson, 2011). Crude fibre retention was significantly higher in birds fed the control diet, suggesting that the fibre composition in the control group might have been more conducive to digestion or that the other diets contained fibre sources that were less degradable. The lowest crude fibre retention in birds fed diet 4 (60.85%) may point to dietary components that limited fibre digestibility or promoted rapid passage through the gastrointestinal tract (Mateos *et al*., 2012).

The ether extract retention results, where diet 4 showed the highest value (42.80%), indicate improved lipid utilisation in this group, potentially due to dietary fat source or enhanced lipid absorption facilitated by feed additives or specific ingredients. In contrast, the lowest ether extract retention in birds fed diet 5 (40.05%) suggests lower lipid digestibility, which could be related to the absence of digestibility-enhancing components or less bioavailable fat sources in the diet (Leeson and Summers, 2005).

Ash content retention, being significantly highest in birds fed the control diet, reflects the utilisation of essential minerals in the control group. The lowest ash retention observed in birds fed diet 5 could indicate good absorption of the essential minerals in this group (NRC, 1994).

The significant differences in dry matter retention, with diet 5 showing the highest retention, emphasised the role of dietary composition in determining overall nutrient absorption. Higher dry matter retention in diet 5 suggests a more balanced and digestible nutrient profile, whereas the lower retention in diet 2 could imply suboptimal nutrient formulation or less digestible feed ingredients (Swick *et al.,* 2014).

Conclusion and Recommendation

This study demonstrated that dietary treatments significantly influenced nutrient retention in laying birds, with notable effects on crude protein, crude fibre, ether extract, ash, and dry matter, while the broiler birds were not significantly influenced. Therefore 5% inclusion level was recommended in broiler production, and a 10% inclusion level was recommended in layers 'production.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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