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Research Article

Influence of Gliricidia (*Gliricidia sepium*) and Avocado (*Persea americana*) Leaf Meal on Performance, Carcass and Relative Organ Characteristics of Broiler Chickens

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Abstract

This study evaluates the effects of composite leaf meal from two leaves on the performance of broiler chickens when used as a supplement. Fresh *Gliricidia sepium* and *Persea americana* leaves were harvested, air-dried, and milled to produce leaf meals and then mixed in ratio 1:1 to form a composite leaf meal of Gliricidia–Avocado leaf meal (GALM). A basal diet was formulated and divided into four portions, the composite leaf meal was then added to these portions at 0, 4, 8, and 12g/kg and designated diets I, II, III, and IV, respectively. Two hundred (200) day-old broiler chicks of Arbor acre breed were randomly allotted to the four (4) dietary treatments replicated five (5) times with ten (10) chicks per replicate in a Completely Randomized Design. The respective diets were fed to the chicks *ad libitum* from 1 – 42 days. All data collected were subjected to analysis of variance using SPSS version 25 package. Results showed that final weight and total weight gain were significantly ($P < 0.05$) influence among the parameters measured. Birds fed the test diets were observed to be more improved for all parameters measured than those fed the control diet. All the carcass and relative organs parameters were not significantly ($P > 0.05$) affected except the spleen, which was significantly ($P < 0.05$) higher in birds fed diet III (1.28 ± 0.11g/kg) than those fed other diets. GALM supplemented up to 12g/kg level in broiler chicken diet improves the growth performance characteristics and muscle development.

Keywords: Composite Leaf Meal; Supplement; Carcass; Relative Organ Characteristics

Abbreviations

GALM: Gliricidia-Avocado Leaf Meal; FUTA: Federal University of Technology Akure

Introduction

Antibiotics had won worldwide recognition in livestock farming especially in the poultry industry for their ability to prevent poultry disease and improve productivity because they control the growth of both the Gram-positive and Gram-negative bacteria in the gut of host animals [13]. Gut microbial communities improve animal health through the synthesis of vitamins, food digestion, and immunity. However, with the concerns about their residue in food products [23], the unavoidable spread of bacterial resistance and cross-resistance [22] is observed in humans, the use of antibiotics has been considered hazardous to public health [2]. Due to the facts, the European Union placed a ban on the use of chemical antibiotics as growth promoters in livestock production [12]. This had led to recent investigations on many phytogenic sources for their effectiveness as alternatives to chemical antibiotics in livestock agriculture, especially in poultry production [9]. Several medicinal plants with numerous phytochemicals have been tested as growth promoters to avoid the excessive use of antibiotics in feeds while maintaining an efficient animal production to obtain safe edible food products [8,10].

Gliricidia sepium is a small to a medium-sized, thornless tree that usually grows up to a height of 10-12 m [19] is also rich in several nutrients, flavonoids, minerals that could be of great importance to broiler chickens [14]. The branching of the plant is usually from the base with a basal diameter ranging from 50-70 cm. The bark of

the plant is smooth and varies in colour from whitish-grey to deep red-brown. These plants have been explored in poultry production and reported to have anti-viral, anti-inflammatory and anti-oxidant properties [1,3]. It is a known fact that these beneficial biological properties may be related to the presence of polyphenolic compounds present in these medicinal plants. Studies have reported on the presence of phenolic acids, flavonoids, and procyanidins in some leaves which could be utilized to improve broiler production [11]. Avocado tree (*Persea americana*) on the other hand is native to Central America and Mexico, and now cultivated in several other parts of the world presents great commercial value because of the relevant nutritional utilization of its fruit [3]. Various parts of an avocado plant, such as peel, seed, and leaves, contain bioactive compounds which contribute to the development of avocado by-products for commercial purposes including broiler production [6,15,24].

Therefore, this study seeks to investigate the supplementary effects of a composite mix of Gliricidia and Avocado leaf meals on the growth parameters of broiler chickens.

Materials and Methods

Experimental site

The study was carried out at the Poultry Unit of the Teaching and Research Farms, The Federal University of Technology, Akure, Nigeria. The University is located on (Latitude $7^0$18''N and Longitude $5^0$10''E) Akure, Nigeria [18]. The altitude is about 350.52m above sea level, the annual humidity is 75% and that of temperature is 27^0C [3].

Experimental layout and design

Collection and Processing of leaves

Fresh *Gliricidia sepium* and *Persea americana* leaves were collected within Akure and identified by the Herbarium Curator of the Federal University of Technology Herbarium Centre and deposited for referral purposes with voucher specimen number allotted as Avocado (*Persea americana*) leaf (FUTA Herbarium Number: 0325) and Glyricidia (*Glyricida sepium*) leaf (FUTA Herbarium Number: 0327). The leaves were chopped, air-dried until crispy, milled, and stored in an air-tight container prior to use. Thereafter, the leaf meals were mixed in ratio 1:1 (weight: weight) to produce the composite leaf meal of Gliricidia–Avocado Leaf Meal (GALM).

Experimental diets

A straight basal diet of broiler chicks containing 21% Crude protein and 12.6MJ/kg Metabolizing energy was compounded for the chickens. The basal diet was thereafter divided into four (4) portions. The GALM was added to these portions at 0, 4, 8, and 12 g/kg and designated Diet I, II, III, and IV, respectively. The formulated basal diet was analyzed for the proximate composition according to AOAC, (2005) methods. The gross composition of the diets is presented in table 1.

Ingredients	Diet I	Diet II	Diet III	Diet IV
Maize	55.00	55.00	55.00	55.00
Groundnut cake	16.00	16.00	16.00	16.00
Soybean meal	17.45	17.45	17.45	17.45
Wheat offal	3.70	3.70	3.70	3.70
Fish meal	3.00	3.00	3.00	3.00
Premix	0.25	0.25	0.25	0.25
Dicalcium phosphate	1.00	1.00	1.00	1.00
Limestone	1.50	1.50	1.50	1.50
Methionine	0.15	0.15	0.15	0.15
Oil	1.50	1.50	1.50	1.50
Salt	0.30	0.30	0.30	0.30
Lysine	0.15	0.15	0.15	0.15
Total	100	100	100	100
Calculated Analysis				
Crude Protein	21.00	21.00	21.00	21.00
Metabolizable Energy	12.60	12.60	12.60	12.60
Calcium	1.10	1.10	1.10	1.10
Phosphorus	0.90	0.90	0.90	0.90
Analyzed composition (g/100gDM)				
Crude protein	22.53	22.90	22.80	22.60
Crude fat	8.03	7.90	7.51	7.74
Crude fiber	5.74	6.00	6.20	6.53
Ash	9.12	5.31	9.37	9.36
Carbohydrate	54.59	53.94	54.11	53.66

Table 1: Gross composition of the basal diet (g/100g) for the broiler chicken.

Experimental Layout and Feeding Trial

A total number of two hundred and fifty (250) day-old chicks of Abor-acre breed of broiler chicken were procured from AMO Farm Sieberer Hatchery Limited, Awe, Nigeria out of which two hundred (200) were assigned to four (4) dietary treatments of five (5) replicates and ten (10) chicks per replicate on the day of arrival. The weight of the groups was balanced (± 1g). The design of the experiment was Completely Randomized Design. The right to conduct the research was granted by the Research Committee of the Department of Animal Production and Health, The Federal University of Technology, Akure, Nigeria.

Growth performance

At the beginning of the experiment the broiler chicks were weighed and the initial weight of each group replicate was balanced (± 1g) thereafter each group was fed their respective diet *ad libitum* from 1-42 days during which weekly feed consumption and weight gained were measured, while the feed conversion ratio was calculated as the ratio of feed consumed to weight gain.

Carcass measurement

At the end of the trial, the birds were kept off feed for 12 hours to empty their crop to prevent carcass contamination. Three (3) birds were randomly selected per replicate and used to determine the carcass parameters. Slaughtering was done by severing the jugular veins, after stunning. The birds were bled and were scalded at 60°C in a water bath for about 30 seconds before de-feathering. Thereafter, the dressed and eviscerated weights were expressed as a percentage of the live weight. The following parts were weighed: head, breast, drumstick, thigh, neck, back, shank, and they were expressed in gram per kilogram (g/kg) body weight.

Organs measurement

For the organs, the following parts were taken and measured; liver, kidney, heart, lungs, pancreas, spleen, gizzard, and proventriculus, and they were expressed in gram per kilogram (g/kg) body weight.

Data analysis

All data collected were subjected to Analysis of Variance (ANOVA) using SPSS version 25 package and Duncan Multiple Range Test of the same package were used to separate the mean difference among treatments. The Experimental model is a Completely Randomized Design

$Y_{ij} = \mu + T_i + \sum_{ij}$

Where

- Yij = performance of the i^{th} broiler chickens in the j^{th} population
- μ = overall mean of the parameter
- T_i = fixed effect of composite leaf meal on the i^{th} broiler chickens
- $\sum_{ij}$ = residual error which is normally, independently, and randomly distributed with zero mean and common variance

Results

Growth performance

The growth performance of chickens fed the experiment diets is presented in table 2. From the table, highest final weight and total weight gained were observed in birds fed diet II (2210.12 ± 39.56g/birds) and (2165.55 ± 39.65g/birds), respectively while lowest final weight and total weight gained were observed in birds fed diet I (2042.50 ± 32.50g/birds) and (1999.72 ± 32.51g/birds), respectively. There were no significant (P > 0.05) differences in the final weight and total weight gained in birds fed diets II, III and IV. Meanwhile, best feed conversion ratio (2.00 ± 0.00) was recorded in bird fed diet III.

Parameters	Diet I	Diet II	Diet III	Diet IV	p-value
Initial weight (g)	42.78 ± 1.62	44.57 ± 0.21	44.51 ± 0.34	43.68 ± 0.75	0.51
Final weight (g)	2042.50 ± 32.50^{b}	2210.12 ± 39.56^{a}	2110.71 ± 27.74^{ab}	2125.71 ± 70.82^{ab}	0.02
Total feed consumed (g)	4653.87 ± 588.55	5130.50 ± 200.58	4913.02 ± 207.97	5111.88 ± 154.28	0.73
Total weight gained (g)	1999.72 ± 32.51^{b}	2165.55 ± 39.65^{a}	2066.21 ± 27.42^{ab}	2082.04 ± 71.35^{ab}	0.04
Feed conversion ratio	2.33 ± 0.33	2.33 ± 0.33	2.00 ± 0.00	2.33 ± 0.33	0.80

Table 2: Performance of the broiler chickens.

^{a,b} Means in the same row with different superscripts were significantly different (P < 0.05).

Carcass measurement

Carcass measurement of broiler chickens fed GALM supplement in the diets indicated that all parameters measured were not significantly (P > 0.05) influenced by the dietary treatments as shown in table 3. Numerically, highest dressed weight (91.90 ± 0.99%) and highest eviscerated weight (86.18 ± 0.80%) were recorded in birds fed diet III, while lowest dressed weight (83.21 ± 3.16%) and lowest eviscerated weight (77.96 ± 3.05%) were recorded in birds fed diet I.

Organs measurement

Table 4 shows the influence of GALM supplement on organs measurement of broiler chickens fed the test diets. From the table, all parameters measured were not significantly (P > 0.05) influenced by the dietary treatments except spleen. The spleen of birds fed diet III (1.28 ± 0.11g/kg) was significantly (P < 0.05) higher than those fed other diets but was observed to be similar to that of the birds fed diet II (1.1 ± 0.09g/kg).

Discussion

The current study revealed that the final weight, total weight gained and feed conversion ratio of the birds fed the control diet were not significantly (P > 0.05) better than those fed the test diet. However, the best final weight, total weight gained and feed conversion ratio were recorded in birds fed the test diets which indicated that the birds fed the test diets utilized their feed better than those fed the control diet. In all, the growth performance of

Parameters	Diets I	Diet II	Diet III	Diet IV	p-value
Live weight (kg)	2.05 ± 0.06	2.10 ± 0.03	2.08 ± 0.05	2.10 ± 0.05	0.84
Dressed weight (%)	83.21 ± 3.16	90.69 ± 1.12	91.90 ± 0.99	84.98 ± 2.55	0.16
Eviscerated weight (%)	77.96 ± 3.05	80.66 ± 3.17	86.18 ± 0.80	81.91 ± 4.09	0.31
Drumstick (g/kg body weight)	96.48 ± 3.15	98.73 ± 6.52	102.84 ± 2.45	105.57 ± 7.62	0.64
Thigh (g/kg body weight)	103.86 ± 5.98	98.99 ± 6.77	102.59 ± 3.25	101.3 ± 4.05	0.92
Breast (g/kg body weight)	216.99 ± 11.94	232.04 ± 7.11	198.7 ± 36	231.92 ± 22.85	0.69
Wings (g/kg body weight)	73.37 ± 2.65	76.31 ± 3.41	77.84 ± 1.24	75.80 ± 2.64	0.68
Back (g/kg body weight)	142.20 ± 5.29	160.73 ± 7.56	154.54 ± 6.67	153.25 ± 7.95	0.32
Neck (g/kg body weight)	41.38 ± 2.87	42.29 ± 3.48	39.34 ± 2.23	49.11 ± 3.98	0.19
Head (g/kg body weight)	23.04 ± 0.8	23.06 ± 1.32	23.37 ± 0.99	23.62 ± 1.26	0.98
Shanks (g/kg body weight)	37.11 ± 1.39	36.95 ± 2.85	37.00 ± 2.24	36.55 ± 1.73	0.99
Muscles					
Pectoralis (g/kg body weight)	56 ± 7.5	63.62 ± 3.85	76.4 ± 4.29	79.22 ± 9.51	0.097
Musculus supra coracoids (g/kg body weight)	19.77 ± 2.53	16.49 ± 0.57	17.51 ± 0.96	18.85 ± 1.77	0.528
Gastrocnemeus (g/kg body weight)	41.19 ± 3.94	39.38 ± 2.25	42.96 ± 2.22	43.93 ± 3.14	0.718

Table 3: Carcass Traits of broiler chickens fed varying levels of Gliricidia-Avocado leaf meal.

Parameters	Diet I	Diet II	Diet III	Diet IV	p-value
Heart	4.66 ± 0.29	4.77 ± 0.47	4.68 ± 0.33	4.47 ± 0.08	0.926
Lungs	5.76 ± 0.23	6.49 ± 0.53	5.99 ± 0.47	5.79 ± 0.29	0.559
Spleen	0.86 ± 0.03^{b}	1.1 ± 0.09^{ab}	1.28 ± 0.11^{a}	0.85 ± 0.07^{b}	0.004
Liver	18.36 ± 1.13	18.92 ± 1.09	20.44 ± 0.85	18.84 ± 0.66	0.462
Gizzard	19.44 ± 1.05	20.58 ± 1.1	19.13 ± 0.47	20.21 ± 1.33	0.739
Proventriculus	4.13 ± 0.18	4.33 ± 0.26	3.52 ± 0.17	4.1 ± 0.3	0.125
Pancreas	2.54 ± 0.22	2.26 ± 0.05	2.58 ± 0.35	2.45 ± 0.38	0.849

Table 4: Relative organs of the broiler chickens fed varying levels of Gliricidia-Avocado leaf meal (g/kg body weight).

$^{a-b}$ means in the same row with different superscripts were significantly different ($P < 0.05$).

the birds fed the test diets supersede those fed the control diet thus suggested the nutritional adequacy of the GALM. This implies that the inclusion of medicinal plant extracts in poultry diets impacted the metabolism by reducing stress and microbial activity [17]. This could also suggest that the GALM increased the production and activities of digestive enzymes as well as improved the intestinal morphology (villi development) of broilers resulting in improved digestibility of nutrients as supported by previous studies [16], [17]. The improvement of the intestinal microbial ecosystem, immune responses, and physiological conditions of chickens may also be associated with the increased growth rate in broilers fed with a diet supplemented with composite leaf mix, confirming other studies on the use of medicinal plants in broiler diets [7,17]. The carcass characteristic parameter which includes the head, neck, drumstick, thigh, breast, wings, shank, back, live weight, dressed weight, eviscerated weight and the muscles of the birds in this study revealed that they were not affected by the variation of the dietary treatments. This conforms to the result of [5] who reported no significant difference in carcass yield and abdominal fat percentage of broiler when normal maize was replaced by quality protein maize. This implies that GALM inclusion could support the normal development of the muscle or the edible portion of the broiler chicken. Vital muscles in broiler include pectoralis thoracicus and musculu supracoracoideus [20]. It has been reported that malnutrition could result in protein degradation in chickens which would directly influence muscular growth. The weight of organ in broiler chickens according to [9] reflects the anatomical response of birds to the type of diet consumed. Organs are body parts composed of several tissues, capable of carrying out specialized functions [21]. All the organs measured in this study were comparable in all the dietary treatments except the spleen and this suggest that the diets were not detrimental even though leaves may have contained some

anti-nutritional factors. From this study, it revealed that the control diet and the test diets enhanced identical organs development.

Conclusions

Based on the result obtained for the performance, carcass, and relative organ characteristics of the broiler birds, it could be concluded that Gliricidia-Avocado leaf meal (GALM) supplemented at 12g/kg could enhance growth performance, carcass and organ development of broiler birds. Therefore, farmers could take advantage of the potential of the GALM in this study to provide additional protection to broiler chicken while improving the growth parameter for maximum benefits.

Ethics Approval and Consent to Participate

Not applicable.

Consent for Publication

All the authors agreed to publish the article.

Availability of Data and Materials

It is available from the corresponding author on reasonable request.

Competing Interest

The authors declare that they have no conflict of interest.

Funding

Not applicable.

Authors' Contributions

JOA, MA and AOA designed the study. All authors managed the activities of the experiment and interpreted the data collectively. OES, DOE and OIO prepared the proposal for the study. OES prepared the first draft of the Manuscript. AOA reviewed the first draft and MA reviewed the second draft while JOA reviewed the third draft. All authors read and approved the final manuscript.

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