



INFLUENCE OF COCCICURE-H AS A DIETARY FEED ADDITIVE ON GROWTH PERFORMANCE, CARCASS CHARACTERISTICS, ORGAN DEVELOPMENT, AND ECONOMIC RETURNS IN BROILER PRODUCTION

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ABSTRACT

A 35-day feeding trial investigated the effects of coccicure-H, an herbal anticoccidial feed additive, on broiler chickens, using growth performance, carcass yield and cost benefits as response criteria. One hundred and eighty (180) day-old broiler chicks (Arbor-Acre+) were randomly assigned to three (3) dietary treatments. The dietary treatments were replicated six (6) times, with ten (10) chicks per replicate, in a Completely Randomised Design. The birds were kept in standard deep-litter management conditions with unlimited access to food and water. Weekly, feed intake, final weight and weight gain were recorded, and feed conversion ratio was calculated. At the end of the trial, two (2) birds per replicate were slaughtered for their carcass yield and relative organ measurements. The cost of feed per kg, the overall cost of production, and the average net profit per bird were all determined. All collected data were analysed using analysis of variance. The results show that only feed intake differed significantly ($P < 0.05$), while other performance parameters showed numerical but non-significant differences. The highest total feed intake (4667.46 ± 194.22 g/bird) was recorded in birds fed diet I, while the lowest total feed intake (4072.42 ± 147.75 g/bird) was recorded in birds fed diet II. Meanwhile, birds fed diet I recorded the highest final weight (2466.67 ± 152.75 g/bird) and the highest feed conversion ratio (1.92 ± 0.17), while birds fed diets II and III recorded the lowest final weight (2266.67 ± 57.74 g/bird) and the best feed conversion ratio, respectively. Birds fed diet III had the highest profit/dressed chicken (₦1133.76), while birds fed diet II had the lowest profit/dressed chicken (₦1061.36). The results suggest that Coccicure-H supported growth performance, carcass yield, and organ weight, and reduced the feed required per kg of dressed chicken as the inclusion level increased.

Keywords: Anticoccidial feed additive, Broiler chickens, Carcass yield, Coccisure-H, Growth, Cost

INTRODUCTION

Coccidiosis remains one of the most economically significant parasitic diseases affecting the poultry industry worldwide, particularly in broiler production systems (Blake and Tomley, 2017; Chapman, 2021). Protozoan parasites of the genus *Eimeria* cause the disease by infecting the intestinal epithelium of chickens, leading to impaired nutrient absorption, reduced growth performance, increased mortality, and substantial economic losses (Shirley *et al.*, 2023). Subclinical infections, although they do not always result in overt mortality, compromise feed efficiency and body weight gain, thereby affecting profitability (Tenget *et al.*, 2023). The global financial burden of coccidiosis has been estimated to exceed billions of dollars annually due to losses in feed conversion, growth retardation, and increased veterinary interventions (Blake *et al.*, 2023). Traditional control strategies for coccidiosis have relied heavily on synthetic anticoccidial drugs, including ionophores and chemical coccidiostats, administered either in feed or water. While these interventions are effective in reducing clinical disease, the intensive use of synthetic anticoccidials has led to the emergence of drug-resistant *Eimeria* strains, limiting long-term efficacy and prompting concerns over residues in poultry products (Chapman, 2021; Shirley *et al.*, 2023). Moreover, global consumer demand for antibiotic-free and naturally derived poultry products has increased, creating a market need for safe, natural alternatives to synthetic anticoccidials (Alagawany *et al.*, 2021).

In response, recent research has focused on herbal and phytogenic feed additives with potential anticoccidial activity. These additives contain bioactive compounds such as flavonoids, saponins, alkaloids, and essential oils, which have been shown to exert antiparasitic, immunomodulatory, and antioxidant effects (Abd El-Hack *et al.*, 2022; Shahininejad *et al.*, 2024). By improving gut health and reducing oxidative stress, phytogenic additives can enhance nutrient utilisation and growth performance in broilers while mitigating the adverse effects of subclinical coccidiosis. Coccisure-H, a product from Veasure Animal Health, India, is an alternative, integrated and novel bio-control approach to control coccidiosis and to maintain a healthy gut in poultry. It is 100% natural and composed of a mixture of plants, such as *Aegle marmelos*, *Calotropis procera*, etc., which provide a range of active compounds (saponins, tannins and polyphenols) that act in a broad, complex and synergistic way. Coccisure is a novel herbal-based feed additive developed specifically as a natural anticoccidial for poultry. Coccisure-H is intended for use in both preventive and therapeutic contexts without leaving chemical residues in meat products. Similar herbal additives have shown promising effects on growth performance, immune modulation, and

gut morphology in broilers (Gao *et al.*, 2024; Shahininejad *et al.*, 2024). Therefore, this trial evaluated the dietary inclusion of Coccisure-H in broiler chicken diets, using growth, carcass yield and cost benefits as response criteria.

MATERIALS AND METHODS

Ethics

The Institutional Animal Care and Use Committee (IACUC), Centre for Research and Development, Federal University of Technology, Akure (FUTA), Nigeria, approved the experimental procedures for this study (approval number: FUTA/ETH/25/287). All animal handling and management procedures adhered strictly to established ethical guidelines for poultry production and welfare (Macer, 2019). Adequate measures were taken to minimise stress and discomfort throughout the experimental period. Birds were managed under hygienic conditions, and humane slaughter procedures were followed during carcass and organ evaluation.

Test Ingredient

Coccisure-H, an herbal anticoccidial feed additive, was manufactured by Veasure Animal Health, Gujarat, India, and imported to Nigeria by Peak Feed Limited, Ibadan, Nigeria. The product was stored in a sanitary facility within Peak Feed Limited's warehouse before use.

Diet Formulation and Production

The experimental diets were formulated and prepared in the Nutrition Laboratory of the Department of Animal Production and Health, Federal University of Technology, Akure, Nigeria, while feed production and packaging were carried out under hygienic conditions at Peak Feed Nigeria Limited, Ibadan, Nigeria. A basal diet was formulated to meet the nutrient requirements of broiler chickens during both the starter and finisher phases. The experimental starter diets were prepared by incorporating Coccisure-H as an additive at different inclusion levels. Diet I (100% synthetic anticoccidial) served as the control; Diet II had a blend of (50% synthetic anticoccidial + 50% Coccisure-H), and Diet III (100% Coccisure-H). The same procedure was adopted for the finisher phase. Table 1 presents the gross compositions of the basal starter and finisher diets.

Experimental Birds and Management

A total of one hundred and eighty (180) day-old Cobb 500® broiler chicks with an average initial body weight of 35.00 ± 0.00 g were obtained from a commercial hatchery. Upon arrival, the chicks were weighed and randomly assigned to three (3) dietary treatment groups in a

Completely Randomised Design (CRD). Each treatment had six (6) replicates, with ten (10) chicks per replicate.

Table 1: Gross composition of the basal experimental starter and finisher diets (%)

Ingredients	Starter (100%DL)	Finisher (100%DL)
Maize	52.00	55.50
Soy oil	0.50	0.50
Toxin binder	0.10	0.10
Wheat offal	4.00	3.00
Soybean meal	34.50	33.00
Lysine	0.45	0.45
Methionine	0.30	0.30
Limestone	0.30	0.30
Premix	0.40	0.40
Salt	0.30	0.30
Enerzyme	0.06	0.06
Corn bran	6.00	5.00
DCP	0.70	0.70
Enzyme	0.04	0.04
L-Threonine	0.10	0.10
Kingphos	0.02	0.02
Pellet binder	0.30	0.30
Total	100.00	100.00
Calculated		
Crude Protein (%)	23.00	19.80
Fat (%)	5.80	5.50
Crude fibre (%)	4.20	4.00
Calcium (%)	1.30	1.28
Av. Phosphorus (%)	0.50	0.48
Methionine (%)	0.55	0.50
Lysine (%)	1.30	1.23
Energy (Kcal/kg)	3050.00	3100.00

Chicks were raised in deep-litter pens equipped with standard feeders and drinkers. Feed and water were provided *ad libitum* throughout the six-week experimental period. Routine and occasional management practices, including daily feeding, changing of water, vaccination, medication, and strict biosecurity measures, were observed. The poultry house was adequately ventilated.

Growth Performance Measurements

Initial body weights of the experimental chicks were recorded at the commencement of the trial to establish baseline uniformity among treatment groups. Thereafter, body weight was measured

weekly throughout the experimental period to monitor growth patterns and assess changes over time. Feed was supplied to the birds *ad libitum*, and feed offered and leftover feed was recorded daily to estimate feed consumption. Using the recorded data, several growth performance indices were calculated to evaluate the birds' productive response to the dietary treatments. These included final body weight (the birds' body weight at the end of the feeding trial); daily feed intake (the average amount of feed consumed per bird per day); and total feed intake (the cumulative amount consumed during the experimental period).

Growth rate was assessed using daily and total weight gain, calculated as the difference between final and initial body weights over the trial period. Feed Conversion Ratio (FCR), defined as total feed intake divided by total weight gain, was calculated. This parameter estimated the efficiency with which the birds converted feed nutrients into body mass and served as an important indicator of broiler performance under the different dietary treatments.

Carcass and Organ Evaluation

At the end of the feeding trial, two (2) birds were randomly selected from each replicate after twelve (12) hours of feed withdrawal. Live weight was recorded prior to slaughter. Birds were humanely slaughtered by severing the jugular vein, allowed to bleed completely, defeathered, and eviscerated. Carcass parameters measured included slaughter weight, blood weight, plucked weight, feather weight, eviscerated weight, dressed weight, and primal cuts (breast, thigh, drumstick, wing, back, neck, shank, and head). Internal organs, including the liver, gizzard, spleen, heart, proventriculus, pancreas, and lungs, were carefully excised, cleaned of adhering tissues, and weighed using a sensitive digital scale.

Cost Benefit Analysis

An economic evaluation of the experimental diets was conducted to determine the cost-effectiveness of dietary Coccidure-H supplementation in broiler production. The cost of producing the experimental diets was estimated using prevailing market prices for feed ingredients at the time of the study. The final body weight (kg) used in the economic evaluation was obtained from the birds' recorded body weights at the end of the feeding trial. In contrast, total feed intake per bird was determined by subtracting the quantity of leftover feed from the total feed offered during the experimental period. The cost of day-old chicks and the expenses incurred for medication and vaccination were calculated using the prevailing purchase prices at the time of the experiment and were combined into the cost of seed (C_{Seed}). The cost of feed consumed per bird (C_{Feed}) was determined by multiplying the total feed intake per bird by the unit cost of the experimental diets. The total cost of production ($C_{Production}$) per bird was calculated as the sum of the cost of day-old chicks (C_{Seed}), the cost of feed consumed per bird (C_{Feed}), and the cost of management, including medication and vaccination ($C_{Management}$). Revenue per bird (C_{Bird})

was estimated using the prevailing market price of broiler chickens at the end of the trial, based on dressed weight. The average net profit per bird ($A_{\text{Net profit}}$) was then calculated as the difference between revenue per bird (C_{Bird}) and total production cost ($C_{\text{Production}}$).

Statistical Analysis

The data were subjected to a one-way analysis of variance (ANOVA) appropriate for a completely randomised design. Significant differences among treatment means were separated using Duncan’s Multiple Range Test. We declared statistical significance at $P < 0.05$, and presented results as mean $\pm$ standard error of the mean (SEM).

RESULTS

Growth performance of broiler chickens fed diets containing Coccisure-H.

Table 2 presents the effects of dietary Coccisure-H supplementation on broiler growth performance. The chicks had the same initial body weight across all treatments (35.00 g/chick), indicating that the birds were uniformly distributed at the start of the experiment. This ensured that any observed differences in performance parameters were due to dietary treatments rather than initial weight variation. From the table, only the feed intake was significantly ($P<0.05$) influenced by the dietary treatments. The highest total feed intake (4667.46 ± 194.22 g/bird) was observed in birds fed diet I, while the lowest total feed intake (4072.42 ± 147.75 g/bird) was observed in birds fed diet II. Numerical differences were observed but were not statistically significant, highest final weight (2466.67 ± 152.75 g/bird), highest weight gain (2431.67 ± 152.75 g/bird) and worst feed conversion ratio (1.92 ± 0.17) were recorded in bird fed diet I, while lowest final weight (2266.67 ± 57.74 g/bird), lowest weight gain (2231.67 ± 57.74 g/bird) were recorded in bird fed diet II and best feed conversion ratio (1.77 ± 0.01) was recorded in bird fed diet III.

Carcass characteristics of broiler chickens fed diets containing Coccisure-H.

Table 3 shows the effects of dietary Coccisure-H supplementation on carcass characteristics of broiler chickens. Among all parameters measured, only wing weight was significantly ($P<0.05$) influenced by the dietary treatments. The highest wing weight (189.03 ± 5.28 g/kg dressed weight) was observed in birds fed diet I, while the lowest wing weight (168.13 ± 2.02 g/bird) was observed in birds fed diet II. Meanwhile, highest slaughter weight (2.35 ± 0.16 kg/bird), highest plucked weight (2.25 ± 0.15 kg/bird), highest eviscerated weight (1.88 ± 0.14 kg/bird), highest dressed weight (1.67 ± 0.14 kg/bird), highest shank weight (94.03 ± 6.36 g/kg live weight), highest drumstick weight (239.33 ± 24.25 g/kg dressed weight), highest thigh weight (254.57 ± 31.37 g/kg

dressed weight), highest breast muscle weight (629.03±79.78 g/kg dressed weight), highest back weight (332.73±13.01 g/kg dressed weight) and highest neck weight (69.77±0.47 g/kg dressed weight) were recorded in bird fed diet I, while lowest slaughter weight (2.19±0.08 kg/bird), lowest plucked weight (2.10±0.06 kg/bird), lowest dressed weight (1.56±0.13 kg/bird), lowest thigh weight (233.30±11.43 g/kg dressed weight) and lowest breast muscle weight (585.50±107.86 g/kg dressed weight) were recorded in bird fed diet II. Lowest eviscerated weight (1.75±0.10 kg/bird), lowest shank weight (82.67±5.74 g/kg live weight), lowest drumstick weight (222.90±8.12 g/kg dressed weight), lowest back weight (319.27±14.85 g/kg dressed weight) and lowest neck weight (62.37±8.20 g/kg dressed weight) were recorded in birds fed diet III.

Table 2: Growth performance of broiler chickens fed diets containing Coccicure-H

Parameters	Diet II		
	Diet I (100%DL)	(50%DL:50%HB)	Diet III (100%HB)
Initial body weight (g)	35.00 ± 0.00	35.00 ± 0.00	35.00 ± 0.00
Final body weight (g)	2466.67 ± 152.75	2266.67 ± 57.74	2366.67 ± 57.74
Weight gain (g)	2431.67 ± 152.75	2231.67±57.74	2331.67 ± 57.74
Daily feed intake (g/day)	111.13 ± 4.62 ^a	96.96 ± 3.52 ^b	98.31 ± 3.05 ^b
Daily weight gain (g/day)	57.90 ± 3.64	53.13 ± 1.37	55.52 ± 1.37
Total feed intake (g)	4667.46±194.22 ^a	4072.42±147.75 ^b	4128.91±127.93 ^b
Feed conversion ratio (FCR)	1.92 ± 0.17	1.83 ± 0.06	1.77 ± 0.01

^{a, b,} means having different superscripts along the same row are significantly different (P< 0.05).

Relative organ characteristics of broiler chickens fed diets containing Coccicure-H

Table 4 presents the relative organ measurements of broiler chickens fed diets containing Coccicure-H. From the table, none of the measured parameters was significantly (P<0.05) influenced by the dietary treatments. Highest liver weight (65.07±4.43 g/kg body weight), highest heart weight (10.23±0.81 g/kg body weight) and highest lung weight (13.27±1.50 g/kg body weight) were recorded in bird fed diet I, while lowest liver weight (56.23±9.41 g/kg body weight), lowest heart weight (8.60±1.25 g/kg body weight) and lowest lung weight (11.63±2.50 g/kg body weight) were recorded in bird fed diet II.

Table 3: Carcass characteristics of broiler chickens fed diets containing Coccicure-H

Parameters	Diet I (100%DL)	Diet II (50%DL:50%HB)	Diet III (100%HB)
Live weight (kg)	2.47 ± 0.15	2.27 ± 0.06	2.33 ± 0.06
Slaughter weight (kg)	2.35 ± 0.16	2.19 ± 0.08	2.21 ± 0.04
Blood weight (kg)	0.12 ± 0.07	0.08 ± 0.02	0.12 ± 0.03
Plucked weight (kg)	2.25 ± 0.15	2.10 ± 0.06	2.12 ± 0.02
Feather weight (kg)	0.09 ± 0.02	0.08 ± 0.03	0.09 ± 0.03
Eviscerated weight (kg)	1.88 ± 0.14	1.76 ± 0.12	1.75 ± 0.10
Dressed weight (kg)	1.67 ± 0.14	1.56 ± 0.13	1.58 ± 0.10
Head (g/kg live weight)	48.37 ± 2.39	52.63 ± 5.50	49.03 ± 4.95
Shank (g/kg live weight)	94.03 ± 6.36	89.97 ± 3.00	82.67 ± 5.74
Wing (g/kg dressed weight)	189.03 ± 5.28 ^a	168.13 ± 2.02 ^b	178.13 ± 10.04 ^{ab}
Drumstick (g/kg dressed weight)	239.33 ± 24.15	223.10 ± 4.42	222.90 ± 8.12
Thigh (g/kg dressed weight)	254.57 ± 31.37	233.30 ± 11.43	240.23 ± 21.55
Breast muscle (g/kg dressed weight)	629.03 ± 79.78	585.50 ± 107.86	603.07 ± 71.67
Back (g/kg dressed weight)	332.73 ± 13.01	321.93 ± 11.15	319.27 ± 14.85
Neck (g/kg dressed weight)	69.77 ± 0.47	65.80 ± 5.51	62.37 ± 8.20

^{a, b}, means having different superscripts along the same row are significantly different (P< 0.05).

Table 4: Relative organ measurement of broiler chickens fed diets containing Coccicure-H (g/kg body weight)

Parameters	Diet I (100%DL)	Diet II (50%DL:50%HB)	Diet III (100%HB)
Liver	65.07 ± 4.43	56.23 ± 9.41	61.83 ± 21.01
Gizzard	21.80 ± 2.98	26.03 ± 0.91	22.40 ± 6.33
Spleen	2.70 ± 0.87	1.70 ± 0.44	1.87 ± 0.15
Heart	10.23 ± 0.81	8.60 ± 1.25	8.83 ± 0.80
Proventriculus	14.07 ± 2.81	11.53 ± 0.96	13.27 ± 1.52
Pancreas	5.97 ± 0.98	5.87 ± 0.51	5.43 ± 0.97
Lungs	13.27 ± 1.50	11.63 ± 2.50	12.30 ± 1.78

Cost benefits of broiler chickens fed diets containing Coccicure-H

Table 5 presents the cost benefits of producing broiler chickens fed Coccicure-H as a feed additive. From the table, the highest cost of 1kg feed produced (N667.00), highest cost of feed intake (N3114.89), highest sale of dressed chicken (N7515.00) and highest profit/dressed chicken (N1100.11) were recorded in bird fed diet I, while the lowest cost of 1kg feed produced (N648.00) using the test ingredients was recorded in diet III. The lowest cost of feed intake (N2653.64), lowest sale of dressed chicken (N7020.00) and lowest profit/dressed chicken (N1061.36) were recorded in bird-fed diet II,

Table 5: Comparative cost benefits of broiler chickens fed diets containingCoccicure-H

Parameters	Diet I (100%DL)	Diet II (50%DL:50%HB)	Diet III (100%HB)
Cost of Day-Old Chick (₦)	1800.00	1800.00	1800.00
Final Weight (Kg)	2.47	2.27	2.37
Weight Gain (Kg)	2.43	2.23	2.33
Total Feed Intake (Kg)	4.67	4.07	4.13
Cost of 1kg Feed (₦)	667.00	652.00	648.00
Cost of Feed Intake (₦)	3114.89	2653.64	2676.24
Feed Cost/Kg Weight Gain (₦/Kg)	1281.85	1189.97	1148.60
Other Expenses (₦)	1500.00	1500.00	1500.00
Total Cost of Production (₦)	6414.89	5958.64	5976.24
Dressed Weight (Kg)	1.67	1.56	1.58
Price/Kg Dressed Weight (₦)	4500.00	4500.00	4500.00
Sale of Dressed Chicken (₦)	7515.00	7020.00	7110.00
Profit/Dressed Chicken (₦)	1100.11	1061.36	1133.76
Dollar (\$) @ \$1 = N1359	0.81	0.78	0.83

DISCUSSION

The growth performance trend indicated that final body weight, total weight gain, and daily weight gain of broilers were not affected by dietary treatment, suggesting no negative impact of the additive on growth performance. Importantly, feed intake and feed conversion ratio (FCR) did not differ across treatments, although birds fed diet III (100% Coccicure-H) had a lower FCR, indicating improved feed utilisation. Coccicure-H produced comparable performance to the control, with no significant differences in weight gain or feed conversion ratio. Anticoccidial feed additives like Coccicure-H are designed to mitigate subclinical coccidial infections, which can damage the intestinal mucosa and impair nutrient absorption, reducing growth efficiency (Blake *et al.*, 2023). By controlling coccidial infection, the additive likely helped preserve intestinal integrity, allowing consistent feed intake and weight gain even under potential pathogen pressure. Similar observations have been reported with herbal and phytogenic anticoccidial feed additives, which maintain growth performance without adversely affecting feed efficiency (Teng *et al.*, 2023; Shahininejad *et al.*, 2024).

The evaluation of carcass yield revealed that live weight, slaughter weight, plucked weight, eviscerated weight, dressed weight, and most carcass cut-up parts were not affected by Coccicure-H supplementation in the diets. This indicates that the additive did not negatively affect carcass yield or composition. The isolated effect on wing weight, without corresponding changes in other major cuts (breast, thigh, drumstick), likely reflects normal biological variability rather than a direct dietary effect. The carcass yield results suggest that anticoccidial and phytogenic additives do not alter carcass yield in broiler chickens raised under standard husbandry conditions (Gao *et al.*, 2024; Olusiyi *et al.*, 2024). Maintaining carcass characteristics

while potentially improving gut health is important in commercial poultry production, as it ensures that feed additives do not compromise meat yield or marketable parts, which are the primary drivers of profitability.

Internal organ weights are widely used as indicators of physiological stress, toxicity, and immune response (Abd El-Hack *et al.*, 2022). Similar liver weights suggest the additive did not induce hepatic stress or metabolic imbalance, while stable gizzard and proventriculus weights indicate normal digestive function and mechanical digestion. The spleen, as a key immune organ, maintained consistent weights across treatments, suggesting that test ingredient (Coccicure-H) did not compromise immune development or provoke abnormal immunostimulation. Likewise, heart and lung weights were similar, indicating that the cardiovascular and respiratory systems were not adversely impacted. The pancreas, which plays a central role in enzyme production and nutrient digestion, was not affected by the dietary treatments. Collectively, these findings demonstrate that Coccicure-H is physiologically safe at the inclusion levels tested and does not impose stress on vital organs in broiler chickens. Similar results have been reported with other anticoccidial feed additives and herbal supplements in broiler chickens, where internal organ development remained normal (Iwuji *et al.*, 2022; Amao *et al.*, 2025).

Broiler poultry farmers aim to maximise profit by reducing feed costs, which accounts for about 60–75% of production costs under intensive systems (Adegbenro *et al.*, 2017; Adetunji *et al.*, 2020). The results of this study accurately reflect the benefits of alternative feed resources in feed production for broiler chickens. The cost of 1 kg of feed (₦) decreased progressively as the inclusion of Coccicure-H increased. The decrease in feed cost per kg as Coccicure-H increased in the diets reflects its lower price.

CONCLUSION

Overall, the findings suggest that replacing coccidiostat with Coccicure-H at 50% and 100% inclusion levels supports good growth performance, a better feed conversion ratio, and favourable carcass yield and relative organ measurements compared with birds fed the control diet (100% coccidiostat). Also, as the inclusion levels of Coccicure-H increased progressively, feed cost per kilogram reduced, suggesting the potential of Coccicure-H as a cost-effective alternative to coccidiostat in broiler chicken diets.

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REFERENCES

- Abd El-Hack, M. E., El-Saadony, M. T., Shafi, M. E., Zabermawi, N. M., Arif, M., Batiha, G. E., Khafaga, A. F., and Abdel-Moneim, A. M. (2022). Probiotics in poultry feed: A comprehensive review. *Animal Biotechnology*, 33(2), 219–236.
- Adegbenro M., Ayeni, A. O., Agbede J. O., Onibi G. E. and Aletor, V. A. (2017). Performance characteristics of broiler chickens fed composite leaf meal as alternative premix. *Animal Research International* 14(3): 2883 - 2891.
- Adetunji, M. A., Adegbenro, M., Ojambati, O. G. and Aletor, V. A. (2020). Growth performance and cost implication of broiler chickens fed fortified composite cassava stump meal based diets. *Animal Research International* 17(2): 3631 – 3639.
- Alagawany, M., Abd El-Hack, M. E., Farag, M. R., Sachan, S., Karthik, K., and Dhama, K. (2021). The use of probiotics as eco-friendly alternatives for antibiotics in poultry nutrition. *Environmental Science and Pollution Research*, 28, 14686–14706.
- Amao, S. R., Falohun, I. A, Ademola, B., Bamidele, B. J., Folawiyo, M. O., Adedokun, M. S. and Agbaye, F. P. (2025). Growth performance, carcass and organ characteristics of broiler chickens administered aqueous pawpaw leaf extract. *Greener Journal of Agricultural Sciences*, Vol. 15(1): 120 – 125.
- Blake, D. P., Knox, J., Dehaeck, B., Huntington, B., Rathinam, T., Ravipati, V., Ayoade, S., Gilbert, W., Adebambo, A. O., and Jatau, I. D. (2023). Re-calculation of the global burden of coccidiosis in chickens. *Veterinary Research*, 54, 33.
- Chapman, H. D. (2021). Coccidiosis in the chicken: A review of control strategies. *Poultry Science*, 100(3), 101–109.
- Gao, Y., Wang, C., and Li, J. (2024). Effects of dietary additives on organ development and metabolic health in broiler chickens. *Frontiers in Veterinary Science*, 11, 128334.
- Iwuji, T. C., Iheanacho, G. C., Ogamba, M. C., and Odunfa, O. A. (2022). Relationship between live weight, internal organs, and body part weights of broiler chickens. *Malaysian Animal Husbandry Journal*, 2(2), 64–66.
- Macer, D. (2019). Ethical poultry and the bioethics of poultry production. *The Journal of Poultry Science*, 56(2): 79 – 83.
- Olusiya, J. A. and Igila, T. T. (2024). Effect of varying levels of Acha husk as a substitute for wheat offal on the growth performance and carcass characteristics of broiler chicken. . *Nigerian Journal of Animal Science*, 26(2), 221–228.
- Shahininejad, H., Rahimi, S., KarimiTorshizi, M. A., Arabkhazaeli, F., Ayyari, M., Behnamifar, A., Abuali, M., and Grimes, J. (2024). Comparing the effect of phytobiotic, coccidiostat, toltrazuril, and vaccine on the prevention and treatment of coccidiosis in broilers. *Poultry Science*, 103(5), 103596
- Teng, P. Y., Kim, W. K., and Applegate, T. J. (2023). Gut health and nutrient utilization in poultry: Mechanisms and implications. *Animals*, 13(4), 672.