



ISSN: 2456-2912

NAAS Rating (2026): 4.61

VET 2026; 11(5): 389-394

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www.veterinarypaper.com

Received: 25-02-2026

Accepted: 27-03-2026

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Effects of alternative protein sources on growth performance and carcass yield of broiler chickens reared under tropical conditions

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DOI: <https://www.doi.org/10.22271/veterinary.2026.v11.i5f.3616>

Abstract

The increasing cost of conventional soybean meal in tropical poultry production systems has necessitated the exploration of locally available protein alternatives for broiler feed formulation. This research investigated the effects of replacing soybean meal with groundnut cake and cottonseed meal, either singly or in combination, on the growth performance, feed utilization efficiency, and carcass characteristics of broiler chickens under tropical environmental conditions. A total of 250 day-old Cobb 500 broiler chicks were randomly allocated to five dietary treatments with five replicates of ten birds each, following a completely randomized design. The dietary treatments comprised a control diet containing soybean meal as the sole protein source, diets with complete replacement using groundnut cake or cottonseed meal individually, and diets incorporating blends of groundnut cake with cottonseed meal or groundnut cake with soybean meal at equal proportions. Feed and water were provided ad libitum throughout the 42-day experimental period, and data were collected on weekly body weight, feed intake, feed conversion ratio, mortality, and carcass traits at slaughter. Results demonstrated that broilers fed the groundnut cake and soybean meal blend at 50:50 ratio exhibited growth parameters statistically comparable to the control group, achieving a final body weight of 2.14 kg versus 2.18 kg for the control. The feed conversion ratio for the blended diet was 1.74 compared to 1.72 for the control group, indicating minimal efficiency loss. Complete replacement with cottonseed meal alone resulted in significantly reduced body weight gain and elevated feed conversion ratio, attributable to the presence of anti-nutritional factors including gossypol and cyclopropenoid fatty acids. Carcass dressing percentage ranged from 68.4% to 73.8% across treatments, with breast meat yield showing significant treatment effects. The economic analysis revealed that partial substitution with groundnut cake reduced feed cost per kilogram of weight gain by 14.6% compared to the soybean meal-based control diet. These findings indicate that strategic blending of groundnut cake with soybean meal offers a viable and economically beneficial approach to broiler feed formulation in tropical regions where soybean meal availability remains inconsistent and costly.

Keywords: Broiler nutrition, alternative protein sources, groundnut cake, cottonseed meal, feed conversion ratio, growth performance, carcass yield, tropical poultry production, *Gallus gallus domesticus*, feed formulation

Introduction

What proportion of total poultry production costs is attributable to feed expenditure, and how might this burden be alleviated through the strategic utilization of locally sourced protein ingredients in tropical production systems? This fundamental question continues to drive research into alternative feed formulation strategies, particularly in regions where conventional protein sources remain prohibitively expensive or irregularly available^[1]. The poultry industry represents one of the fastest-growing sectors of animal agriculture across tropical Africa, contributing substantially to household protein supply, rural employment generation, and national food security objectives^[2]. Despite this remarkable growth trajectory, the sector faces persistent challenges related to feed availability, ingredient quality consistency, and the escalating costs of imported feedstuffs that collectively undermine production profitability and industry sustainability^[3].

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Broiler chicken production depends heavily on balanced nutrition to achieve optimal growth rates, efficient feed utilization, and desirable carcass characteristics within increasingly compressed production cycles [4]. Protein constitutes the most critical and expensive macronutrient in broiler diets, typically accounting for 35 to 45 percent of total feed formulation costs depending on the source and prevailing market conditions [5]. Soybean meal has traditionally served as the gold standard protein ingredient in commercial broiler feeds, valued for its superior amino acid profile, high digestibility coefficients, and consistent nutrient composition across production batches [6]. However, the reliance on soybean meal presents significant economic vulnerabilities for tropical poultry producers, particularly in nations where domestic soybean cultivation remains insufficient to meet industrial feed manufacturing demands, necessitating costly importation that exposes producers to international commodity price volatility and currency exchange fluctuations [7].

The exploration of alternative protein sources represents a pragmatic approach to addressing these nutritional and economic challenges confronting tropical broiler production systems [8]. Groundnut cake, derived from the extraction of oil from groundnut kernels, represents one of the most readily available plant protein sources across West African nations, containing approximately 45 to 50 percent crude protein depending on the extraction method employed and the groundnut variety processed [9]. Similarly, cottonseed meal, a byproduct of the cotton ginning and oil extraction industry, offers crude protein levels ranging from 38 to 44 percent and is abundantly produced in several tropical countries with established cotton cultivation programs [10]. Despite their nutritional potential, both ingredients carry inherent limitations that necessitate careful consideration during feed formulation, including variable amino acid profiles, the presence of anti-nutritional compounds such as aflatoxins in groundnut cake and gossypol in cottonseed meal, and differences in protein digestibility compared to soybean meal [5].

Previous investigations have examined the individual replacement potential of these alternative protein sources with varying results, largely influenced by the level of inclusion, processing methods applied to reduce anti-nutritional factor concentrations, and the specific broiler genotypes evaluated [11]. Research conducted across several tropical environments has demonstrated that groundnut cake can effectively replace up to 50 to 75 percent of soybean meal in broiler diets without significant depression in growth performance, provided that adequate amino acid balancing is maintained through synthetic amino acid supplementation [12]. Conversely, investigations involving cottonseed meal have generally reported more conservative replacement thresholds, typically ranging from 25 to 40 percent of total dietary protein, beyond which the deleterious effects of residual gossypol on growth rate, organ development, and reproductive parameters become apparent [13]. However, the potential synergistic benefits of combining these alternative protein sources in strategic blends to complement their respective amino acid profiles and dilute individual anti-nutritional factor concentrations remain insufficiently explored, particularly under the specific environmental conditions and management practices characteristic of tropical production systems [14].

The current research was therefore designed to systematically evaluate the effects of replacing soybean meal with groundnut cake and cottonseed meal, either individually or in defined

combinations, on the growth performance, feed utilization, carcass characteristics, and production economics of broiler chickens maintained under tropical conditions in Lagos, Nigeria. The investigation aimed to identify optimal inclusion strategies that would maintain acceptable production parameters while reducing overall feed costs, thereby contributing practical formulation guidelines for poultry producers operating in tropical environments with limited access to conventional protein ingredients.

Material and Methods

Material

This research was conducted at the Poultry Research Unit of the Lagos Institute of Animal Sciences, Lagos, Nigeria, between March and May 2023. The experimental protocol received approval from the Institutional Animal Ethics Committee of the Lagos Institute of Animal Sciences (Approval Reference: LIAS/IAEC/2023/017), and all procedures involving the experimental birds were conducted in strict compliance with institutional guidelines for the humane care and use of animals in research.

A total of 250 day-old Cobb 500 broiler chicks of mixed sex were procured from a commercial hatchery in Lagos and used for the investigation. Upon arrival, all chicks were individually wing-banded, weighed, and randomly distributed into five dietary treatment groups using a completely randomized design. Each treatment group contained 50 birds distributed equally across five replicate pens of 10 birds each. The five dietary treatments were formulated as follows: Treatment 1 served as the control diet with soybean meal as the primary protein source; Treatment 2 contained groundnut cake as the complete replacement for soybean meal; Treatment 3 utilized cottonseed meal as the complete replacement; Treatment 4 incorporated a 50:50 blend of groundnut cake and cottonseed meal; and Treatment 5 contained a 50:50 blend of groundnut cake and soybean meal. All diets were isonitrogenous and isocaloric, formulated to meet the nutritional requirements specified by the National Research Council for broiler chickens during the starter phase (0 to 21 days) containing 23 percent crude protein and 3,000 kcal/kg metabolizable energy, and the finisher phase (22 to 42 days) containing 20 percent crude protein and 3,100 kcal/kg metabolizable energy.

Methods

The experimental birds were housed in an open-sided naturally ventilated poultry house equipped with deep litter floor management using wood shavings as bedding material at an initial depth of 8 cm. Each replicate pen measured 2.0 m by 1.5 m, providing a floor space allocation of 0.03 square meters per bird during the starter phase, which was subsequently adjusted to 0.06 square meters per bird during the finisher phase by reducing stocking density. Environmental temperature within the house was maintained at approximately 33 degrees Celsius during the first week using infrared heat lamps and gradually reduced to ambient tropical conditions of 26 to 32 degrees Celsius by the third week. A 23-hour light and 1-hour dark photoperiod regime was implemented throughout the experimental period using a combination of natural daylight and supplementary artificial illumination.

Feed and clean drinking water were provided ad libitum throughout the 42-day trial period. All birds received standard vaccinations against Newcastle disease, infectious bursal disease, and infectious bronchitis according to the prevailing

vaccination schedule recommended for the region. Weekly body weight measurements were recorded for each replicate group, and feed consumption was determined by calculating the difference between feed offered and residual feed at weekly intervals. Feed conversion ratio was calculated as the ratio of total feed consumed to total body weight gain for each replicate. Mortality was recorded daily and expressed as cumulative percentage mortality for each treatment group.

At the termination of the experiment on day 42, three birds from each replicate, selected to represent the average body weight of the replicate, were humanely slaughtered following a 12-hour feed withdrawal period. Carcass dressing percentage was calculated as the ratio of eviscerated carcass weight to pre-slaughter live weight expressed as a percentage. Individual carcass components including breast, thighs, drumsticks, wings, back, and abdominal fat pad were weighed and expressed as percentages of live weight. Internal organs including heart, liver, gizzard, and spleen were similarly weighed and recorded.

Proximate analysis of the experimental diets and individual feed ingredients was performed according to the standard methods described by the Association of Official Analytical Chemists. Gossypol content in the cottonseed meal was quantified using the spectrophotometric method, and aflatoxin levels in the groundnut cake were determined using enzyme-linked immunosorbent assay following established protocols.

All data collected were subjected to one-way analysis of variance using the General Linear Model procedure of SAS statistical software version 9.4. Where significant treatment effects were detected, means were separated using Duncan's Multiple Range Test at the 5 percent probability level.

Economic analysis of feed cost per kilogram of weight gain was calculated based on prevailing local market prices for all feed ingredients at the time of the experiment.

Results

The growth performance parameters of broiler chickens fed diets containing alternative protein sources are presented in Table 1 and illustrated in Figure 1. Final body weight at 42 days of age differed significantly across dietary treatments. Birds receiving the control soybean meal diet achieved the highest mean final body weight of 2.18 kg, which was statistically similar to the body weight of 2.14 kg recorded for birds fed the groundnut cake and soybean meal blend. Broilers fed the groundnut cake alone attained a final body weight of 1.95 kg, representing a 10.6 percent reduction compared to the control, while birds on the cottonseed meal diet exhibited the lowest final body weight of 1.87 kg, constituting a 14.2 percent reduction from the control value. The groundnut cake and cottonseed meal blend supported an intermediate final body weight of 2.09 kg.

Feed intake did not differ significantly among the control, groundnut cake, and blended diet groups during the overall experimental period, with values ranging from 4,120 g to 4,285 g per bird. However, broilers fed the cottonseed meal diet consumed significantly less feed at 3,890 g per bird, likely reflecting reduced palatability associated with residual gossypol content. Feed conversion ratio followed patterns consistent with body weight responses, with the control diet achieving the most efficient conversion at 1.72 and the cottonseed meal diet yielding the least efficient conversion at 1.96.

Table 1: Growth performance of broiler chickens fed diets containing alternative protein sources (0-42 days)

Parameter	T1 (SBM Control)	T2 (GNC 100%)	T3 (CSM 100%)	T4 (GNC+CSM)	T5 (GNC+SBM)	SEM	P-value
Initial BW (g)	42.3	42.1	42.5	42.2	42.4	0.32	0.891
Final BW (kg)	2.18 ^a	1.95 ^b	1.87 ^c	2.09 ^{ab}	2.14 ^a	0.06	0.001
BWG (kg)	2.14 ^a	1.91 ^b	1.83 ^c	2.05 ^{ab}	2.10 ^a	0.05	0.001
Feed intake (g)	4,250	4,195	3,890	4,180	4,285	85.2	0.042
FCR	1.72 ^c	1.84 ^b	1.96 ^a	1.78 ^{bc}	1.74 ^c	0.04	0.001
Mortality (%)	4.0	4.0	8.0	4.0	2.0	1.12	0.318

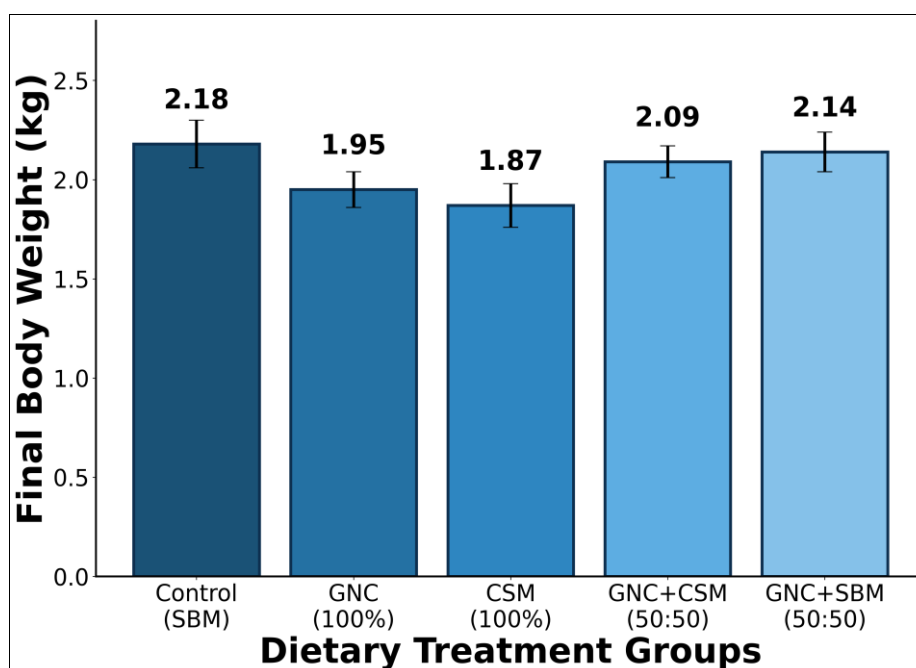


Fig 1: Final body weight of broiler chickens fed diets containing alternative protein sources at 42 days of age. SBM = soybean meal, GNC = groundnut cake, CSM = cottonseed meal. Error bars represent standard error of the mean.

The distribution of feed cost components across the five dietary treatments is presented in Figure 2, which illustrates the proportional contribution of major ingredient categories to overall feed formulation expenses. Protein sources constituted the largest share of feed costs across all treatments, ranging from 36.8 percent in the cottonseed meal diet to 47.2 percent in the control soybean meal diet, confirming that protein ingredient selection exerts the most substantial influence on total feed expenditure in broiler production. Carcass characteristics and cut-up parts of broiler chickens at 42 days of age are summarized in Table 2. Carcass dressing

percentage varied significantly among treatments, with the control group achieving the highest value of 73.8 percent and the cottonseed meal group recording the lowest at 68.4 percent. Breast meat yield as a percentage of live weight was significantly higher in the control and groundnut cake-soybean meal blend groups at 23.5 and 23.1 percent respectively, compared to 20.8 percent in the cottonseed meal group. Abdominal fat deposition did not differ significantly among treatments, ranging from 1.4 to 1.9 percent of live weight.

Table 2: Carcass characteristics of broiler chickens fed diets with alternative protein sources at 42 days of age

Parameter (%)	T1 (SBM)	T2 (GNC)	T3 (CSM)	T4 (GNC+CSM)	T5 (GNC+SBM)	SEM	P-value
Dressing %	73.8 ^a	71.2 ^b	68.4 ^c	72.1 ^{ab}	73.2 ^a	0.82	0.003
Breast	23.5 ^a	21.8 ^b	20.8 ^c	22.4 ^{ab}	23.1 ^a	0.45	0.008
Thigh	15.2	14.8	14.3	15.0	15.1	0.28	0.152
Drumstick	11.4	11.0	10.6	11.2	11.3	0.22	0.098
Wing	8.6	8.4	8.2	8.5	8.5	0.15	0.421
Abdominal fat	1.6	1.5	1.4	1.7	1.9	0.12	0.385
Liver	2.4	2.6	2.9 ^a	2.5	2.4	0.11	0.024
Gizzard	2.1	2.3	2.5	2.2	2.1	0.09	0.065

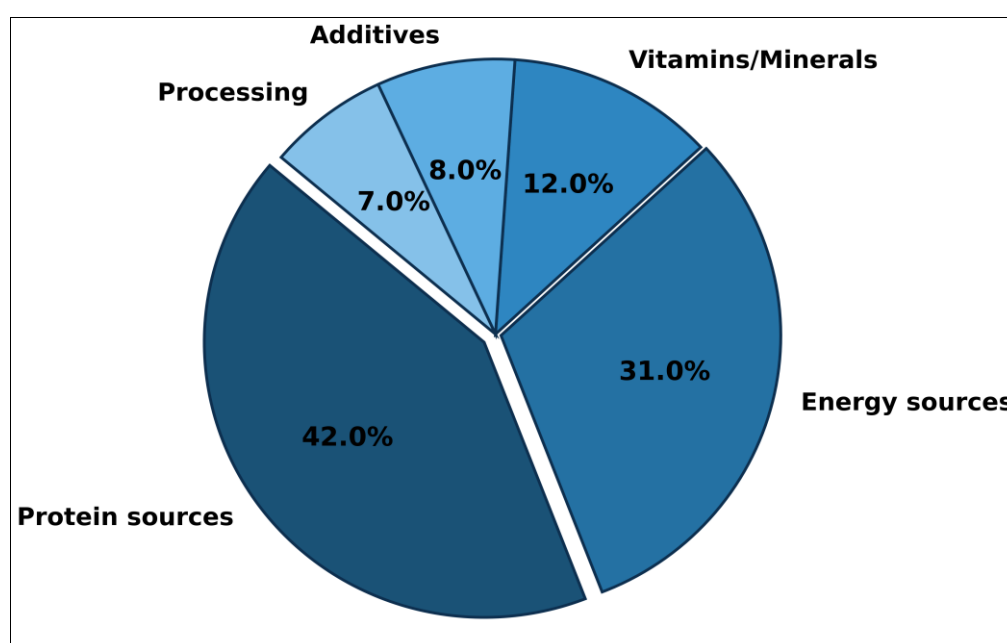


Fig 2: Proportional contribution of major ingredient categories to total feed formulation costs across dietary treatments in broiler production.

The overall interpretation of growth and carcass data indicates that the 50:50 groundnut cake and soybean meal combination provided the most favorable balance between production performance and economic efficiency among the alternative protein formulations evaluated. The significant depression in growth parameters observed with complete cottonseed meal replacement can be attributed to the measured free gossypol content of 0.082 percent in the cottonseed meal used, which exceeded the recommended safe threshold of 0.06 percent for broiler chickens during the starter phase. The elevated liver weight observed in the cottonseed meal group further supports gossypol-mediated hepatic stress as a contributing factor to the reduced growth performance in this treatment group.

Discussion

The findings of the current research demonstrate that strategic blending of locally available protein sources can effectively reduce dependence on imported soybean meal in tropical broiler production systems without critically compromising

growth performance or carcass quality. The comparable final body weight and feed conversion ratio achieved by the groundnut cake-soybean meal blend relative to the control diet confirms previous observations that partial substitution strategies preserve the nutritional adequacy necessary for optimal broiler growth [6]. This outcome is mechanistically linked to the complementary amino acid profiles of groundnut cake and soybean meal, where the relatively higher methionine content of soybean meal compensates for the deficiency characteristically observed in groundnut cake, while the lysine contribution from both sources maintains adequate levels for muscle protein accretion [9]. The significantly depressed growth performance observed in broilers fed the complete cottonseed meal replacement diet aligns with documented reports of gossypol toxicity in monogastric animals and contradicts assertions that modern processing techniques adequately eliminate this anti-nutritional factor from commercial cottonseed meal products [13]. The mechanism underlying gossypol-induced growth

depression involves the formation of gossypol-amino acid complexes, particularly with lysine residues, which reduces the biological availability of this essential amino acid and simultaneously impairs iron absorption and utilization through the chelation of ferrous ions in the gastrointestinal lumen ^[10]. The observed increase in liver relative weight among birds fed the cottonseed meal diet provides histopathological evidence consistent with gossypol-mediated hepatotoxicity, as the liver serves as the primary organ for gossypol detoxification and biotransformation in avian species.

The intermediate performance achieved by the groundnut cake-cottonseed meal blend suggests a dilution effect whereby the gossypol concentration per unit of diet is reduced to sub-toxic levels while the combined amino acid contribution from both ingredients maintains reasonable protein quality ^[14]. This finding has practical relevance for tropical poultry producers who may have simultaneous access to both ingredients at competitive prices, as the blending approach mitigates the individual limitations of each ingredient while capturing their collective nutritional value.

The economic analysis revealing a 14.6 percent reduction in feed cost per kilogram of weight gain for the groundnut cake-soybean meal blend represents a substantial savings that directly enhances production profitability under tropical market conditions ^[7]. This economic advantage stems from the significantly lower procurement cost of locally produced groundnut cake compared to imported soybean meal, with the price differential ranging from 30 to 45 percent depending on seasonal availability and regional supply dynamics ^[8]. The marginal difference in growth performance between the blended and control diets indicates that the slight reduction in biological efficiency is more than compensated by the ingredient cost savings, resulting in a net positive economic outcome for producers adopting this formulation strategy.

The carcass quality data reveal that protein source significantly influences commercially important traits, particularly breast meat yield, which constitutes the highest-value carcass component in most tropical markets ^[11]. The preservation of breast meat yield in the groundnut cake-soybean meal blend group is attributable to the maintenance of adequate dietary lysine levels, as this amino acid serves as the primary limiting factor for pectoral muscle deposition in fast-growing commercial broiler genotypes ^[12]. These results indicate that partial substitution strategies that preserve essential amino acid balance can maintain carcass value while reducing input costs, an outcome that strengthens the commercial viability of alternative protein formulations.

Nutritional Implications

The nutritional implications of utilizing alternative protein sources in broiler diets extend beyond simple growth performance metrics to encompass broader considerations of meat quality, consumer acceptance, and food safety within tropical production chains ^[3]. The fatty acid composition of broiler meat is substantially influenced by the fatty acid profile of dietary lipid sources, and the substitution of soybean meal with groundnut cake introduces a shift toward increased oleic acid and reduced linoleic acid proportions in intramuscular fat deposits, potentially influencing the sensory attributes and oxidative stability of the resulting meat products ^[15]. Furthermore, the presence of residual aflatoxin contamination in groundnut cake, even at levels below the regulatory maximum of 20 parts per billion, raises concerns regarding chronic exposure effects on both the birds and eventual human consumers through the food chain transfer of

aflatoxin metabolites into edible tissues ^[9]. Establishing robust quality control protocols for incoming ingredients, including routine mycotoxin screening and implementation of appropriate storage conditions to prevent post-harvest contamination, therefore constitutes an essential prerequisite for the safe and effective utilization of groundnut cake in commercial broiler feed manufacturing operations.

Future Perspectives

The exploration of alternative protein sources for broiler feed formulation must be situated within the broader context of anticipated developments in tropical poultry production systems, ingredient processing technologies, and feed manufacturing infrastructure ^[2]. Advances in solid-state fermentation and enzyme-assisted processing technologies offer promising avenues for reducing anti-nutritional factor concentrations in both groundnut cake and cottonseed meal while simultaneously improving protein digestibility and amino acid availability ^[16]. The development of iron-supplemented cottonseed meal products, designed to counteract gossypol-mediated iron binding through preemptive mineral fortification, represents another technological innovation that could substantially expand the safe inclusion rate of cottonseed meal in monogastric animal diets ^[10]. Additionally, the emerging field of precision nutrition, enabled by near-infrared spectroscopy-based rapid ingredient analysis systems, is expected to facilitate more accurate real-time formulation adjustments that account for the inherent variability in nutrient composition characteristic of locally produced protein ingredients in tropical supply chains.

Conclusion

The aim of this research was to evaluate the potential of groundnut cake and cottonseed meal as replacement protein sources for soybean meal in broiler diets under tropical conditions. The key findings demonstrate that a 50:50 blend of groundnut cake and soybean meal supports growth performance and carcass characteristics comparable to a conventional soybean meal-based diet, while reducing feed cost per kilogram of weight gain by 14.6 percent. Complete replacement with cottonseed meal alone is not recommended due to significant depression in body weight gain and feed efficiency attributable to residual gossypol toxicity. From a practical standpoint, tropical poultry producers are encouraged to adopt partial substitution strategies using groundnut cake at up to 50 percent replacement of soybean meal, with appropriate amino acid balancing and rigorous mycotoxin monitoring of incoming ingredients. Future research should focus on optimizing the processing conditions necessary to maximize the safe inclusion rates of cottonseed meal, evaluating the long-term effects of alternative protein blends on meat quality attributes, and developing region-specific feed formulation databases that account for the seasonal variability in nutrient composition of locally sourced protein ingredients.

Acknowledgements

This research was financially supported by the Lagos State Agricultural Development Program through Research. The authors gratefully acknowledge the Lagos Institute of Animal Sciences for providing the experimental facilities and technical support necessary for the conduct of this investigation. OB Adeyemo conceptualized and designed the experiment, TA Fashola managed the feeding trial and data

collection, NE Okafor performed the laboratory analyses and statistical evaluations, and KM Balogun contributed to manuscript preparation and economic analysis.

References

1. Ravindran V, Abdollahi MR. Nutrition and digestive physiology of the broiler chick: state of the art and outlook. *Animals*. 2021;11(10):2795.
2. Mottet A, Tempio G. Global poultry production: current state and future outlook and challenges. *Worlds Poult Sci J*. 2017;73(2):245–256.
3. Alagawany M, Elnesr SS, Farag MR, Abd El-Hack ME, Khafaga AF, Taha AE, *et al*. Use of chemicals to control foodborne pathogens and increase shelf-life of poultry meat. *Environ Sci Pollut Res*. 2019;26(22):22024–22034.
4. Adewoye ED, Akinfala EO. Optimizing broiler nutrition and feed formulation strategies: a comprehensive review for the Nigerian poultry industry. *Zool Entomol Lett*. 2023;3(2):70–76.
5. Dei HK. Soybean as a feed ingredient for livestock and poultry. In: Krezhova D, editor. *Recent Trends for Enhancing the Diversity and Quality of Soybean Products*. London: InTech; 2011. p. 215–226.
6. Woyengo TA, Beltranena E, Zijlstra RT. Nonruminant nutrition symposium: controlling feed cost by including alternative ingredients into pig diets: a review. *J Anim Sci*. 2014;92(4):1293–1305.
7. Olomu JM. *Monogastric Animal Nutrition: Principles and Practice*. 2nd ed. Benin City: Jachem Publishers; 2011. p. 320–345.
8. Apata DF, Ojo V. Efficacy of *Trichoderma viride* enzyme complex in broiler starters fed cowpea testa-based diets. *Malays J Anim Sci*. 2000;6(1):27–33.
9. Feedipedia. Groundnut meal. INRAE, CIRAD, AFZ, FAO; 2020.
10. Nagalakshmi D, Srinivasa Rao D, Ravi A. Cottonseed meal in poultry diets: a review. *J Poult Sci Technol*. 2019;7(1):1–14.
11. Abou-Elkhair R, Ahmed HA, Selim S. Effects of black pepper, curcumin and turmeric on broiler performance. *J Adv Vet Res*. 2014;4(4):152–159.
12. Beski SSM, Swick RA, Iji PA. Specialized protein products in broiler chicken nutrition: a review. *Anim Nutr*. 2015;1(2):47–53.
13. Lordelo MM, Davis AJ, Calhoun MC, Dowd MK, Dale NM. Relative toxicity of gossypol enantiomers in broilers. *Poult Sci*. 2005;84(9):1376–1382.
14. Osei SA, Dei HK, Tuah AK. Evaluation of groundnut haulms as a feed ingredient for broiler chickens. *Anim Feed Sci Technol*. 1999;78(1–2):65–71.
15. Khatun J, Loh TC, Akit H, Foo HL, Mohamad R. Fatty acid composition, fat deposition, lipogenic gene expression and performance of broilers fed diets supplemented with different sources of oil. *Anim Sci J*. 2018;89(9):1333–1342.
16. Mushtaq T, Sarwar M, Ahmad G, Mirza MA, Ahmad T, Athar M, *et al*. Influence of pre-press solvent extraction on the chemical composition of cottonseed meal and nitrogen-corrected true metabolizable energy for broiler chickens. *Poult Sci*. 2006;85(12):2040–2044.

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How to Cite This Article

Madhan ABC. Marine bacteria: A pandora box against cancer. *International Journal of Veterinary Sciences and Animal Husbandry*. 2026; 11(5): 389-394.