
PERFORMANCE OF BROILER CHICKENS IN RESPONSE TO DIETS CONTAINING GRADED LEVELS OF ENERGY-PROTEIN CONCENTRATE

1Ayeni, A. O., *2Fasanmi, T. G., 3Adegbenro, M., 4Popoola, O. E., 5Odewole, K. H., 6Agbede, J. O

¹Department of Animal Production and Health, School of Agriculture and Agricultural Technology, Federal University of Technology, Akure

*Email: office.tolu@gmail.com

ABSTRACT

The 42-day study investigated the use of maize and local fish waste as components of an energy-protein concentrate (EPC) in broiler chicken diets, to address challenges in conventional feeding. Maize, used as the source of energy concentrate (ME), and local fish waste as the source of protein concentrate (CP) were mixed in the ratio 3:2 with maize containing 8.9% CP, and local fish waste containing 61.5% CP, while the energy content of maize and local fish waste were 3350kcal/kg and 2760kcal/kg, respectively. One hundred and fifty Arbor Acre broiler chickens of 5 replicates with 10 birds per replicate in a completely randomized design were fed diets with varying inclusion level of EPC at 0%, 50%, and 100% replacement of major energy and protein sources. Results revealed that for final weight (FWT), weight gain (WG) and feed intake (FI), birds fed diet with 0% and 50% EPC replacement performed similarly (710.76g, 668.46g, and 970.66g), (663.15g, 621.79g, and 944.57g) at 21 days. At 42 days, the FWT, WG and FI of those on 0% EPC were also similar to those on 50% EPC replacement (2.25kg, 2.21kg and 1.50kg), (2.21kg, 2.17kg and 3.60kg) respectively, but performed better than those fed 100% EPC replacement diet (356.08g, 314.66g, and 564.03g). However, the feed conversion ratio was not significantly affected. The study emphasized nutrient density of EPC and its efficient utilization for broiler performance. The findings support refining dietary formulations to optimize broiler performance and promote sustainable production practices.

Keywords: Energy-protein concentrate (EPC), maize, local fish waste, broiler performance, and sustainable poultry farming

INTRODUCTION

Poultry production is a vital component of global agriculture, contributing significantly to food security and economic development (FAO, 2019). However, conventional methods of feeding broiler chickens present challenges such as escalating production costs and environmental concerns (Jahanian & Rasouli, 2019). There is a growing need to explore sustainable and cost-effective dietary formulations that enhance broiler performance while reducing the environmental impact of poultry farming. The efficient utilization of energy and protein is crucial for optimizing broiler growth and development. Energy provides fuel for bodily functions, while protein is essential for tissue growth and development (Oliveira et al., 2015). Nutrient density plays a significant role in broiler performance, with varying energy and protein levels affecting feed intake, weight gain, and feed conversion efficiency (Onyimonyi et al., 2019). Adjusting dietary formulations to achieve an appropriate balance of energy and protein can enhance broiler performance and reduce production costs.

Maize is a widely used energy source in broiler diets but lacks sufficient protein and essential nutrients (FAO, 2019). On the other hand, local fish waste has the potential to serve as a sustainable protein source for broiler feed formulations (Adeola et al., 2019). Incorporating locally sourced ingredients like maize and fish waste in broiler diets offers a cost-effective and sustainable alternative to conventional feed components, benefiting broiler performance and reducing production costs (Onyimonyi et al., 2019; Adeola et al., 2019). This study aims to investigate the inclusion nuances of an energy-protein concentrate consisting of maize and local fish waste in broiler diets. By evaluating the performance and feed utilization efficiency of broiler chickens fed varying levels of this concentrate, the study seeks to optimize broiler growth and promote sustainable poultry production practices in Nigeria.

MATERIALS AND METHODS

Experimental Site

The research was carried out at the poultry unit of the Teaching and Research Farm of the Federal University of Technology, Akure, Ondo State, located between longitude 4.944055°E and 5.82864°E, and latitude 7.491780°N with annual rainfall ranging between 1300 and 1650 mm, and annual daily temperature ranging between 27 and 38 °C. The laboratory analyses of the experimental diets were done at the University Central Research Laboratory.

Sourcing of Experimental Ingredients

The maize (*Zea mays*) and local fish waste were sourced from a reputable vendor in Akure, Ondo State, Nigeria; and cleaned from foreign dirt like stones, wood and other contaminants before it was milled. Other feed ingredients were sourced from a reputable vendor.

Experimental Diets

A straight basal diet was formulated to contain maize as a source of energy (ME), soybean and foreign fish meal as a source of protein (CP) with the diet having 21.5% CP and 2900kcal/kg of ME. Thereafter, the energy and protein sources were replaced by energy-protein concentrate (EPC) at 0%, 50%, and 100%, and designated as diets 1, 2, and 3 respectively. The gross and calculated composition of the 3 experimental diets fed to broiler chickens is as shown in Table 1 and 2 respectively.

Table 1: Gross Composition (%) of the Experimental Diet

INGREDIENT	QUANTITY (KG)		
	D1	D2	D3
Maize	47.0	23.5	-
Soybean Meal	40.0	20.0	-
Local Fish Meal	3.0	1.5	-
Energy-Protein Concentrate	-	45.0	90.0
Wheat Offal	4.3	4.3	4.3
Bone Meal	1.5	1.5	1.5
Limestone	1.4	1.4	1.4
Premix	0.25	0.25	0.25
Methionine	0.2	0.2	0.2
Lysine	0.1	0.1	0.1
Salt	0.25	0.25	0.25
Vegetable Oil	2.0	2.0	2.0
TOTAL	100.00	100.00	100.00

Table 2: Calculated Composition of the Experimental Diet

COMPOSITION	Unit	D1	D2	D3
Crude Protein	%	21.70	22.20	22.50
Metabolizable Energy	%	2903.70	2909.08	2914.48
Ether Extract	%	4.09	4.01	3.98
Crude Fibre	%	22.24	23.20	23.65
Available Phosphorus	%	0.71	0.60	0.59
Calcium	%	1.45	1.37	1.35

Production of Energy-Protein Concentrates (EPCs)

Maize, the source of energy concentrate (ME), and local fish waste, the source of protein concentrate (CP), were mixed in a ratio of 3:2 with maize containing 8.9% CP, and local fish waste containing 61.5% CP, while the energy content of maize was 3350kcal/kg, and that of local fish waste was 2760kcal/kg.

Experimental Animals and Management

The experiment involved 150 unsexed day-old Abor Acre broiler birds, lasting for 42 days (6 weeks). The birds were provided with *ad libitum* access to feed and water. They were divided into 3

experimental diets, with 5 replicates per treatment and 10 birds per replicate, in a completely randomized design (CRD) experiment. The study ensured sanitation, routine medication, and vaccination to prevent disease outbreaks. The birds' body weight was measured weekly using a digital weighing scale to track weight changes. Performance criteria such as feed intake and feed conversion ratio (FCR) were recorded along with the initial and final body weights of the birds.

Data Analysis

Data underwent one-way analysis of variance (ANOVA) using the statistical software SPSS (2015). Mean values were compared using the Duncan Multiple Range Test, with statistical significance set at $P < 0.05$.

RESULTS AND DISCUSSION

The performance characteristic of broiler chickens fed diets containing graded levels of EPC reared to 21 days is shown in Table 3. It was observed that all the parameters evaluated for birds fed 0% and 50 % EPC replacement diets were similar, but more significant ($P < 0.05$) than the parameters evaluated for birds fed with 100% EPC replacement, except for the feed conversion ratio. The final weight, weight gain and feed intake decreased as the EPC replacement level increased in the test diets. The final weight and weight gain at 0% and 50% EPC replacements promoted broiler performance similarly at the same level, while there is a sharp decrease with EPC replacement above 50%. However, the feed intake were also similar, but decreased, and this correlates with the study of Adedokun *et al.*, (2019) which observed that the feed intake of broiler chickens was affected by the feed composition, the age, the balance of energy and protein level in the feed.

Table 3: Performance Characteristics (1-21 Days) of Broiler Chickens Fed Diets Containing Graded Levels of Energy-Protein Concentrate

Parameters	Unit	D1	D2	D3	±SEM	P Value
Initial Weight	g	42.30	41.37	41.42	0.37	0.56
Final Weight	g	710.76 ^a	663.15 ^a	356.08 ^b	48.94	0.001
Weight Gain	g	668.46 ^a	621.79 ^a	314.66 ^b	48.82	0.001
Feed Intake	g	970.66 ^a	944.57 ^b	564.03 ^a	57.95	0.001
Feed Conversion Ratio		1.45 ^a	1.52 ^a	1.80 ^b	0.06	0.006

SEM: Standard Error of Mean; Mean with different superscript along the same row are significantly ($P < 0.05$) different.

The performance characteristic of broiler chickens fed diets containing graded levels of EPC reared to 42 days is shown in Table 4. It was observed that all the parameters evaluated for birds fed 0% and 50% EPC replacement diets were similar but more significant ($P < 0.05$) than the parameters evaluated for birds fed 100% of EPC except for the feed conversion ratio of the birds. The final weight, weight gain, and feed intake were similarly higher in birds fed diet with 0% and 50% EPC inclusion, than in birds fed 100% EPC replacement level. The results of birds fed EPC replacement indicate that the feed composition affect feed intake, feed conversion, and weight gain for the poultry. The final weight and weight gain at 0% and 50% EPC replacements promoted broiler performance while there is a sharp decrease with EPC replacement above 50%. However, the feed intake showed decreased, consistent with the findings of Faria-Filho *et al.* (2002), which suggest that feed conversion is influenced by factors such as nutrient balance, body size, ambient temperature, the ability to digest nutrients, and the metabolic process impacting the availability of nutrients in the feed.

Table 4: Performance Characteristics (1-42 Days) of Broiler Chickens Fed Diets Containing Graded Levels of Energy-Protein Concentrate

Parameters	Unit	D1	D2	D3	±SEM	P-Value
Initial Weight	g	42.30	41.37	41.42	0.37	0.560
Final Weight	kg	2.25 ^a	2.21 ^a	1.50 ^b	0.11	0.001
Weight Gain	kg	2.21 ^a	2.17 ^a	1.45 ^b	0.11	0.001
Feed Intake	kg	3.59 ^b	3.60 ^b	2.45 ^a	0.17	0.001
Feed Conversion Ratio		1.63	1.66	1.68	0.03	0.783

SEM: Standard Error of Mean; Mean with different superscript along the same row are significantly ($P < 0.05$) different.

CONCLUSION

This study showed that the utilization of maize and local fish waste as components of EPC and its incorporation in feed has the potential to enhance broiler performance, providing a balance between energy and protein while minimizing the environmental impact associated with conventional feed sources. The observed trends in performance characteristics highlight the potential benefits of incorporating percentage of EPC substitution for major feed ingredients rather than a complete substitution of other nutritional ingredients with EPC. Further research and fine-tuning of these dietary formulations will enhance performance outcomes and promote sustainable practices in poultry production.

REFERENCES

- Adedokun, O. O., Onabanjo, R. S. and Okoye, L. C. (2019). Performance of broiler chickens fed graded levels of poultry meat meal. *Nigerian Journal of Animal Science*, 21(1), 194-203.
- Adeola, O., Akinola, O. O., & Agunbiade, J. A. (2019). Evaluation of the nutritional value of street-vended fish wastes for animal feeding in Nigeria. *Journal of Applied Animal Research*, 47(1), 358-363.
- FAO. (2019). World Livestock: Transforming the livestock sector through the Sustainable Development Goals. Food and Agriculture Organization of the United Nations.
- Faria Filho, D. E., Faria, D. E., Junqueira, O. M., Rizzo, M. F., Araújo, L. F., Araújo, C. S. S. (2002). Avaliação da Farinha de Carne e Ossos na Alimentação de Frangos de Corte. *Brazilian Journal of Poultry Science*, 4(1), 1-9.
- Jahanian, R., & Rasouli, E. (2019). Sustainable poultry nutrition approaches for efficient broiler production. *Frontiers in Veterinary Science*, 6, 1-16.
- Nawaz, H., Mushtaq, T. and Yaqoob, M. (2006). Effect of varying levels of energy and protein on live performance and carcass characteristics of broiler chicks. *The Journal of Poultry Science*, 43(4), 388-393.
- Oliveira, S. F., Bisker, G., Bakh, N., Gibbs, S. L., Landry, M. P., & Strano, M. S. (2015). Protein functionalized carbon nanomaterials for biomedical applications. *Carbon*, 95, 767–779.
- Onyimonyi, A. E., Udedibie, A. B. I., & Okeudo, N. J. (2019). Nutrient composition and recommended inclusion levels of fishmeal in broiler diets in Nigeria. *Journal of Animal Production Research*, 31(2), 25-37.
- SPSS (2015). IBM SPSS Scientist Statistics for Windows, Version 23.0. IBM SPSS Corporation, Armonk, New York, USA.