



PERFORMANCE AND COST BENEFIT OF REPLACING WHEAT OFFAL AT VARYING LEVELS WITH MAIZE OFFAL IN THE DIETS OF WEANER RABBIT

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ABSTRACT

The study was conducted to evaluate the performance and cost implications of replacing wheat offal at varying levels with maize offal in the diets of weaner rabbits. The experiment was carried out at the Rabbitry Unit of the Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria. Fifty (50) weaner rabbits were allotted in a Completely Randomized Design (CRD) to five dietary treatments (0, 25, 50, 75, and 100% maize offal inclusion) with three replicates of three rabbits each. The feeding trial lasted for eight weeks. Data were collected on feed intake, body weight gain, feed conversion ratio (FCR), mortality, and economic indices. Total feed intake ranged from 4.26 kg in diet 1 to 4.40 kg in diet 4, and daily feed intake from 76.06 g to 78.50 g. Daily weight gain ranged from 12.11 g in diet 5 to 13.36 g in diet 4, while FCR ranged between 5.50 in diet 3 and 6.71 in diet 1, showing no statistical differences (p value) among treatments. Mortality was very low, with only one death recorded in diet 1. cost analysis revealed that feed cost per kilogram ranged from ₦391.52 in diet 5 to ₦402.14 in diet 1, while total feed cost varied between ₦1,679.62 (diet 5) and ₦1,740.69 (diet 4). Total weight gain ranged from 0.68 kg (diets 2 and 5) to 0.75 kg (diet 4). Feed cost per kilogram gain was lowest in diet 4 (₦2,320.92) and highest in diet 2 (₦2,509.71), indicating better cost-effectiveness at higher maize offal inclusion. It was concluded that maize offal can completely replace wheat offal in the diets of weaner rabbits without adverse effects on growth performance while reducing feed cost per unit of weight gain. It is therefore recommended that maize offal be incorporated into rabbit diets as a cost-effective alternative to wheat offal, with potential to improve profitability and sustainability of rabbit production.

Keywords: Performance, Rabbits, Maize, Wheat, Offal, cost analysis

INTRODUCTION

The global demand for animal protein continues to rise due to rapid population growth, urbanization, and improved living standards. Meeting this demand requires sustainable intensification of livestock production, especially of species efficient in converting feed to meat. Rabbits (*Oryctolagus cuniculus*) are widely regarded as a promising source of animal protein in developing countries: they grow quickly, reproduce efficiently, have excellent feed conversion, and produce lean, tender, nutritious meat with lower fat and cholesterol levels (Siddiqui *et al.*, 2024). Despite those advantages, the profitability of rabbit production is often limited by the high cost of feed, which may account for 60 % to 75 % of total production cost (Gidenne *et al.*, 2017). The escalating prices of conventional feed ingredients (e.g. maize, soybean meal), driven by competition with human food and industrial uses, have motivated the search for alternative, lower-cost but nutritionally adequate feed resources (Jones *et al.*, 2024). Agro-industrial by-products represent one viable option. Maize offal, a residue from maize milling, is relatively abundant and cheaper than whole maize. It contains moderate levels of protein and energy and is relatively rich in fibre, making it suitable for non-ruminant diets. The utility of maize offal as a feedstuff in rabbit diets has been demonstrated (Adejinmi *et al.*, 2007). Wheat offal is another by-product often used in rabbit feeding, but in some systems it is costlier than maize offal. Thus, replacing wheat offal with maize offal may reduce feed costs without compromising performance. Accordingly, this study aimed to evaluate the growth performance and cost implications of feeding weaner rabbits diets with graded levels of maize offal as replacement for wheat offal, to identify an optimal balance between cost savings and animal productivity.



MATERIALS AND METHODS

The study was conducted at Bauchi State College of Agriculture Rabbitry Unit, located at Yelwan Makaranta along Bauchi – Dass Road

Management of Experimental Animals

The rabbits were placed on concentrate feed (grower's mash and groundnut haulms mixed together) for one week before assigning them to the experimental diets. Feed and water were provided *ad libitum*. Subsequently feed offered and left over were weighed and recorded on a daily basis. The rabbits were also be weighed weekly and what is obtained was recorded.

Experimental Design

The design for the experiment was a Completely Randomised Design. The study was carried out using fifty (50) weaner rabbits. The experiment lasted for a period of eight (8) weeks. The weaner rabbits were subjected to one week acclimation whereby they were treated against internal and external parasites by subcutaneous injection of Ivermectin. Broad spectrum antibiotic (Oxytetracycline) was administered and they were fed the same type of diet. Each experiment had five (5) treatments and three (3) replications with two (3) weaner rabbits per replication.

Experimental Diets

Five diets were formulated in which maize offal replaced wheat offal at 0, 25, 50, 75 and 100% levels coded as diets 1, 2, 3, 4 and 5 respectively (table 1).

Data Collection

The following parameters were recorded during the experimental trial:

Performance parameters

Feed Intake

A predetermined quantity of feed was offered daily to each replicate and carefully recorded. Leftover feed from each replicate was collected, weighed, and documented at the end of each day. Daily feed consumption was calculated as the difference between the feed offered and the residual.

$$\text{Total feed intake (g)} = \text{total feed given (g)} - \text{total feed left over (g)} - 1$$

$$\text{Average daily feed intake (g)} = \frac{\text{Total feed intake (g)}}{\text{Total number of days of the experiment}} - 2$$

Table 1: Composition of Experimental Diets Containing Dietary Levels of Maize Offal as a Replacement for Wheat Offal

	Diets				
Ingredients	1 (0%)	2 (25%)	3(50%)	4 (75%)	5 (100%)
Maize	32.40	31.17	29.90	28.07	27.40
Soya Beans	13.90	15.13	6.40	17.63	18.90
Wheat Offal	30.00	22.50	1.50	7.50	0.00
Maize Offal	0.00	7.5	15.0	22.5	30
Bone Meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Groundnuts haulms	20.00	20.00	20.00	20.00	20.00
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
TOTAL	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Crude Protein (%)	16.00	16.00	16.00	16.00	16.00
Crude Fibre (%)	10.23	12.85	13.14	14.66	16.15
Ether Extract (%)	3.49	3.47	3.47	3.46	3.46
Ash (%)	4.39	4.42	4.46	4.49	4.54
ME (Kcal/kg)	2213.01	2246.85	2258.72	2243.65	2380.62

Body Weight Gain

Rabbits from each replicate were weighed at the beginning of the experiment and subsequently at the end of every week for a 8-week period. Weekly body weight gain was computed



as the difference between the current and the previous week's weights. The final weight was measured at the close of the study.

$$\text{Total body weight gain (g)} = \text{Final body weight (g)} - \text{Initial body weight (g)} \quad -3$$

$$\text{Daily body weight gain (g)} = \frac{\text{Final body weight (g)} - \text{Initial body weight (g)}}{\text{Total number of days of the experiment}} \quad -4$$

Feed Conversion Ratio

FCR was determined as the ratio of feed consumed to body weight gained.

$$\text{Feed conversion ratio (FCR)} = \frac{\text{Total feed consumed (g)}}{\text{Total body weight gain (g)}} \quad -5$$

Cost Analysis

An economic evaluation was carried out to determine the cost-effectiveness of replacing wheat offal with maize offal in the diets of weaner rabbits. The analysis was based on the prevailing market prices of feed ingredients at the time of the experiment. The parameters evaluated included total feed intake (kg), feed cost per kilogram (₦/kg), total feed cost (₦), total weight gain (kg), and feed cost per kilogram gain (₦). These indices were used to determine the relative profitability of the different dietary treatments.

Data Analysis

Collected data were subjected to analysis of variance (ANOVA) using a Completely Randomized Design (CRD) in SPSS software. Differences among treatment means were separated using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Growth Performance of Weaner Rabbits Fed Diets Containing Graded Levels of Maize Offal

Total feed intake over the experimental period varied between 4,259.36 g (diet 3) and 4,396 g (diet 4), and daily feed intake ranged from 76.06 g to 78.50 g across treatments; again, these differences weren't significant. Hence, maize offal inclusion did not influence voluntary feed consumption. Rabbits are known to regulate intake based on diet energy density and palatability a phenomenon discussed by Onifade and Tewe (1993). Total weight gains ranged from 678.33 g (diet 5) to 745.33 g (diet 4), giving daily gains of 12.11–13.36 g. Although diet 4 had numerically higher gains, no significant differences were detected. This supports the idea that maize offal may replace wheat offal up to 100 % without compromising growth, consistent with reports that cereal by-products can substitute conventional ingredients when diets are nutritionally balanced (Jones *et al.* 2024). Also, in a related study, maize offal inclusion did not significantly affect growth performance in weaner rabbits (2022). Feed conversion ratio (FCR) ranged from 5.50 (diet 3) to 6.71 (diet 1). Rabbits on diets 3 and 4 had numerically better (lower) FCRs, though the differences were not statistically significant. This suggests that partial replacement (50 % and 75 %) of wheat offal with maize offal could modestly improve feed utilisation, potentially by supplying fermentable fibre that supports caecal microbial activity. The general potential of agro-industrial by-products to improve feed utilisation in rabbit production is discussed by Jones *et al.* (2024). Mortality was very low: only one rabbit died in diet 1, and none in the other groups, implying that maize offal inclusion did not harm rabbit health or survival. Ajimohun *et al.* (2021) similarly reported negligible mortality across treatments with maize offal diets.

Table 2: Response of Weaner Rabbits Fed Diets Containing Dietary Levels of Maize Offal as a Replacement for Wheat Offal

Parameters	Diets					SEM
	1(0%)	2(25%)	3(50%)	4(75%)	5(100%)	
Initial weight (g)	544.67	538.00	516.67	525.00	521.67	15.12 ^{NS}
Final weight (g)	1233.03	1216.67	1233.00	1273.33	1200.00	120.63 ^{NS}
Total feed intake (g)	4262.53	4283.07	4259.36	4396.00	4294.27	194.49 ^{NS}
Daily feed intake (g)	76.12	76.48	76.06	78.50	76.68	3.47 ^{NS}
Total weight gain (g)	688.67	678.67	716.60	745.33	678.33	128.57 ^{NS}
Daily weight gain (g)	12.30	12.12	12.80	13.36	12.11	2.30 ^{NS}
Feed conversion ratio	6.71	6.59	5.50	5.84	6.47	1.14 ^{NS}
Mortality (number)	1.00	0.00	0.00	0.00	0.00	-

SEM - Standard error of means NS -Not significant

Financial Benefits of Weaner Rabbits Fed Diets Containing Graded Levels of Maize Offal

Table 3 presents the economic returns of feeding weaner rabbits diets in which maize offal replaced wheat offal in graded levels. Economic efficiency is crucial in rabbit production because feed costs often account for up to 70 % of total production costs (Farinu and Akinlade, 2007). Total feed intake per rabbit ranged from about 4.26 kg (in diets 1 and 3) to 4.40 kg (in diet 4), with no significant difference between treatments. However, the cost per kilogram of feed declined steadily from ₦402.14 in the control diet (0 % maize offal) down to ₦391.52 in the diet with 100 % maize offal inclusion. This descending trend indicates that maize offal is less expensive than wheat offal, so its use directly reduces feed compounding costs. This result is consistent with data showing that inclusion of leaf-byproduct mixtures significantly decreases per-kg feed cost (Olabanji *et al.*, 2007). Total feed cost per rabbit ranged from ₦1,679.62 (diet 5) to ₦1,740.69 (diet 4). Although rabbits on diet 4 consumed slightly more feed (thus incurring a higher total feed cost), they also achieved the highest weight gain (0.75 kg). Because weight gains were similar across treatments (0.68–0.75 kg), these data imply that replacing wheat offal with maize offal did not impair productivity. A key metric of economic efficiency is feed cost per kilogram of weight gain. In the experiment, costs per kg gain ranged from ₦2,320.92 (diet 4) to ₦2,509.71 (diet 2). Rabbits fed diet 4 (75 % maize offal replacement) showed the most favorable cost per unit gain, while those on diet 2 (25 % maize offal) had the least efficient cost–gain ratio. Diet 3 (50 % maize offal) also performed well, with a cost per kg gain of ₦2,363.83 better than diets 1 and 5. These results suggest that intermediate replacement levels (50–75 %) optimize economic returns by balancing reduction in feed cost while maintaining performance. This notion echoes the general observation in livestock nutrition that partial, not full, inclusion of unconventional feedstuffs often yields the best trade-off between cost and performance as seen in Ajimohun *et al.* (2024) for millet offal substitution in rabbits).

Table 3: Cost Benefits of Weaner Rabbits Fed Diets Containing Dietary Levels of Maize Offal as a Replacement for Wheat Offal

Parameters	Diets				
	1(0%)	2(25%)	3(50%)	4(75%)	5(100%)
Total feed intake (kg)	4.26	4.28	4.26	4.40	4.29
Feed cost (kg/N)	402.14	400.61	399.52	395.61	391.52
Total feed cost (N)	1713.12	1706.60	1701.96	1740.69	1679.62
Total weight gain(kg)	0.69	0.68	0.72	0.75	0.68
Feed cost /kg gain(N)	2482.78	2509.71	2363.83	2320.92	2470.03

CONCLUSION AND RECOMMENDATIONS

The study concluded that maize offal can effectively replace wheat offal in the diets of weaner rabbits without adverse effects on growth performance. Rabbits fed diets containing varying



levels of maize offal recorded comparable feed intake, weight gain, and feed conversion efficiency across treatments. The cost analysis further revealed that higher inclusion levels of maize offal reduced feed cost per kilogram gain, thereby improving profitability. These findings indicate that maize offal is not only a nutritionally viable alternative but also a cost-effective feedstuff for rabbit production. It is recommended that maize offal be adopted as a replacement for wheat offal in weaner rabbit diets, particularly in regions where it is abundant and affordable, to reduce feed costs and enhance the profitability of rabbit production.

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