



RESPONSE OF BROILER STARTER CHICKENS TO GRADED LEVELS OF BAUCHI RED SORGHUM (*Sorghum bicolor L.*) AS REPLACEMENT FOR WHITE MAIZE

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ABSTRACT

An experiment was conducted to evaluate the response of broiler starter chickens to graded levels of Bauchi red sorghum (*Sorghum bicolor L.*) as replacement for white maize on the growth performance and cost-benefits analysis of broiler starter chickens. Three hundred (300) day old broiler chicks were randomly distributed to five experimental diets with three replicates having twenty birds in each in a Completely Randomized Design (CRD). Five (5) different experimental diets were formulated and Bauchi Red Sorghum (BRS) replaced white maize at 0, 25, 50, 75 and 100% levels coded as D1, D2, D3, D4 and D5 respectively. Performance parameters were measured and calculated which include initial body weight, final body weight, body weight change, daily feed intake, feed conversion ratio and cost-benefit analysis. The result of growth performance indicated that, there were no significant difference across treatment means for initial weights, weight at 4weeks, daily weight gain, daily feed intake and feed conversion ratio. Daily feed intake has decreased (from 78.67 g at 0% to 69.24 g at 100%) as BRS inclusion is increased in the diets. Feed conversion ratio (FCR) improved slightly at higher BRS inclusion (best at 100% with 1.55). There was steady reduction in feed cost per kilogram of feed (₦655.33 at 0%BRS to ₦631.93 at 100%BRS inclusion), indicating that BRS is a cheaper alternative to maize. In conclusion, Bauchi red sorghum variety has been found to replace white maize at 100% level in the diets of broiler starter chickens without compromising growth performance. Inclusion of Bauchi red sorghum as replacement for white maize led to the reduction in feed cost by 9.17% in broiler starter chickens. It was also recommended that Bauchi red sorghum should be included in the diet of broiler starter chickens as an alternative to white maize and further research is recommended to explore the use of Bauchi red sorghum variety in the diets of broiler finisher and layer chickens.

Keywords: Performance, Cost-benefit, Sorghum, Broiler, Chicken.

INTRODUCTION

Poultry includes domesticated birds such as chickens, ducks, turkeys and geese raised to produce meat or eggs for human consumption. However, the rising cost of conventional feed ingredients remains a significant challenge, largely due to the competition between humans and livestock for protein-rich resources (Utama *et al.*, 2023). There is urgent need to provide and explore more information on non-conventional feed ingredients that are available in our environment with a view to ascertaining their suitability in poultry rations. The long-term sustainability of the poultry industry depends on the provision of safe, affordable, and balanced feed options (Mosesa *et al.*, 2024). Globally, sorghum is ranked as the fifth most important cereal crop, with millions of tonnes produced annually (Wang *et al.*, 2025). Recent studies have shown that sorghum can effectively replace maize in broiler diets, improving feed utilization, growth performance, and reducing reliance on imported soybean meal (Mosesa *et al.*, 2024; Utama *et al.*, 2023). Maize has been known to be the most commonly used energy feed ingredients with about 60–70% inclusion level in broiler diets. Sorghum (*Sorghum bicolor*) which is the 5th most important cereal after wheat, maize, rice, and barley and precisely Bauchi Red Variety has been identified despite its anti-nutritional factors as such an ingredient that has the potential to replace maize at a very low cost without any adverse effect on the performance parameters of broiler chickens (Buhari *et al.*, 2020). The formulation of sorghum-based diet with different protein sources has been a topic of discussion among researchers and policy makers. The problem of high cost of energy feed ingredients exacerbated by the competition between man and animal on grains and pulses can be



overcome through the use of unconventional energy feedstuffs. The whole grains of sorghum contain approximately 89 - 90% DM, 8.9 – 15% crude protein (CP), 2.8% ether extract (EE), 1.5 – 1.7% ash, 2.1 – 2.3% crude fibre (CF), and 71.7 – 72.3% nitrogen free extract (NFE) on as fed basis. The intention of this study therefore is to evaluate the response of broiler starter chickens to graded levels of Bauchi red sorghum (*Sorghum bicolor L.*) as replacement for white maize on the growth performance and cost-benefits analysis of broiler starter chickens.

The objectives of this study are to:

- i. determine the growth performance of broiler starter chickens fed graded levels of Bauchi red sorghum as a replacement for white maize.
- ii. assess the cost-benefit analysis of feeding Bauchi red sorghum as replacement for white maize in the diet of broiler starter chickens.

MATERIALS AND METHODS

Experimental Site

The study was conducted at poultry unit of the Department of Animal Production Teaching and Research Farm, Abubakar Tafawa Balewa University, Bauchi, Bauchi State.

Source of Experimental Materials and Animals

The experimental material which is Bauchi Red Sorghum (BRS) was sourced from a local market and day-old broiler chicks were sourced from a reputable hatchery.

Experimental Design and Managements of Birds

Three hundred (300) day old broiler chicks were randomly allotted to five (5) experimental treatments with three (3) replicates of twenty (20) birds each in a Completely Randomized Design (CRD). All routine management practices and necessary biosecurity measures were strictly adhered to. A known quantity of feed was offered daily and water was provided *ad-libitum* throughout the period of the experiment.

Experimental Diets

Five (5) different experimental diets were formulated. BRS replaced white maize at 0, 25, 50, 75 and 100% levels coded as D1, D2, D3, D4 and D5 respectively. Table 1 shows the composition of broiler starter.

Data Collection

Performance parameters

At the end of the experiment, performance parameters were measured and calculated. These include initial body weight, final body weight, body weight change, feed intake, feed conversion ratio.

Cost-benefits Analysis

The cost-benefit analysis of using Bauchi Red Sorghum as an energy source in the diet of broiler starter chickens was analysed at the end of the experiment.

Data Analysis

All data generated from the experiment were subjected to analysis of variance (ANOVA) using the general linear model procedure of SPSS. Significant differences between treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955).

Ethical Approval

Ethical approval on animal handling, use and care was obtained from the Committee on Animal Care and Handling, Abubakar Tafawa Balewa University, Bauchi before the commencement of the experiment.

Table 1: Composition of Broiler Starter Diets Containing Graded Levels of BRS as a Replacement for White Maize

| Ingredient (%) | DIETS | | | | |
|--------------------------------|------------|------------|------------|------------|------------|
| | D1 (0%) | D2 (25%) | D3 (50%) | D4 (75%) | D5 (100%) |
| White maize | 46.80 | 35.10 | 23.40 | 11.70 | 0.00 |
| BRS | 0.00 | 11.70 | 23.40 | 35.10 | 46.80 |
| Full fat Soyabean | 33.70 | 33.70 | 33.70 | 33.70 | 33.70 |
| Wheat offal | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| Fish meal | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| Bone Meal | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Limestone | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| Common salt | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Vit/Min. Premix** | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Methionine | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Lysine | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Total | 100 | 100 | 100 | 100 | 100 |
| Calculated Analysis | | | | | |
| Metabolizable Energy (kcal/kg) | 2800.00 | 2790.00 | 2788.00 | 2786.00 | 2785.00 |
| Crude Protein (%) | 23.00 | 23.00 | 23.00 | 23.00 | 23.00 |
| Crude Fibre (%) | 3.85 | 3.95 | 4.10 | 4.18 | 4.20 |
| Ether Extract (%) | 7.20 | 7.49 | 7.77 | 7.84 | 7.91 |
| Calcium (%) | 1.64 | 1.64 | 1.64 | 1.64 | 1.65 |
| Available P. (%) | 0.69 | 0.72 | 0.74 | 0.77 | 0.80 |
| Methionine (%) | 0.72 | 0.72 | 0.71 | 0.71 | 0.71 |
| Lysine (%) | 1.45 | 1.46 | 1.47 | 1.49 | 1.50 |

**Vitamin-Mineral Premix will provide per Kg the following: Vitamin A, 10,000iu; Vitamin D₃, 2,200,000iu; Vitamin E, 10,000mg; Vitamin K₃, 2,000mg; Vitamin B₁, 1,500mg; Vitamin B₂ 5000mg; Vitamin B₆, 1,500mg; Vitamin B₁₂, 10mg; Folic acid, 500mg; Niacin, 15,00mg, Calpan, 5000mg; Biotin, 20mg; Antioxidant, 125,000mg; Cobalt, 200mg; Selenium, 200mg; iodine, 1,000mg; Iron, 40,000mg; manganese, 70,000mg; Copper, 4,000mg; Zinc, 50,000mg; choline chloride 150,000mg

RESULTS AND DISCUSSION

Growth Performance of Broiler Starter Chickens

The result of growth performance was presented in Table 2. The results indicated that, there were no significant difference across treatment means for initial weights, weight at 4weeks, daily weight gain, daily feed intake and feed conversion ratio. Numerically, birds on the control (0% BRS) had slightly higher body weights compared to treatments with BRS inclusion but the differences were not statistically significant. Daily feed intake has decreased (from 78.67 g at 0% to 69.24 g at 100%) as BRS inclusion is increased in the diets. Feed conversion ratio (FCR) improved slightly at higher BRS inclusion (best at 100% BRS with 1.55). Mortality was not meaningful across the treatments. This suggests that BRS can be incorporated into broiler starter diets without compromising growth. Reports from other research on unconventional feed ingredients support this outcome, such as the work on microbial proteins and insect meals which have been shown to sustain broiler growth while reducing reliance on conventional maize–soy diets (Grigore *et al.* 2025; Darboe and Kyarimpa, 2023). However, the numerical improvement of FCR with increase in the levels of BRS (0 – 100%) has indicated efficient nutrient utilization. This aligns with the outcome that, alternative feed ingredients can enhance nutrient digestibility and efficiency in poultry production (Prince *et al.* 2023). FCR improvement is essential in broiler chicken production as feed account for about 70–80% of the total cost of production as reported by Darboe and Kyarimpa, (2023). The insignificant values obtained in mortality indicated the stable health status of the broiler chickens.

Table 2: Growth Performance of Broiler Starter Chicks Fed Diets Containing Graded Levels of BRS as a Replacement for White Maize

| Parameters | DIETS | | | | | SEM |
|-----------------------|---------|----------|----------|----------|-----------|---------------------|
| | D1 (0%) | D2 (25%) | D3 (50%) | D4 (75%) | D5 (100%) | |
| Initial Weight (g) | 213.97 | 213.62 | 213.97 | 213.97 | 213.65 | 0.44 ^{NS} |
| Weight at 4weeks (g) | 883.76 | 842.05 | 846.82 | 823.81 | 839.68 | 25.99 ^{NS} |
| Daily Weight Gain (g) | 47.84 | 44.86 | 45.21 | 43.57 | 44.72 | 1.86 ^{NS} |
| Daily Feed Intake (g) | 78.67 | 72.91 | 71.76 | 70.75 | 69.24 | 5.14 ^{NS} |
| Feed Conversion Ratio | 1.64 | 1.63 | 1.58 | 1.63 | 1.55 | 0.11 ^{NS} |
| Mortality (NO.) | 1 | 0 | 1 | 0 | 2 | - |

SEM: standard error of mean, BRS = Bauchi Red Sorghum. NS= Not significant.

Cost-Benefits Analysis

Table 3 shows the results of cost-benefits analysis. There was steady reduction in feed cost per kilogram of feed (₦655.33 at 0%BRS to ₦631.93 at 100%BRS inclusion), indicating that BRS is a cheaper alternative to maize. Moreover, this finding was similar to reports from other authors where unconventional feed resources reduced feed costs without compromising feed intake (Chisoro *et al.*, 2023; Darboe and Kyarimpa, 2023). Feed cost per kg gained has also decreased with higher incorporation of BRS reaching the lowest value (₦973.00) at 100% BRS inclusion. This suggests that BRS supports proper utilization of nutrients in the diet and lower cost of growth. Reports on alternative feed ingredients such as cassava peel and microbial proteins have similarly reported stable growth performance with improved feed efficiency (Grigore *et al.*, 2025; Iheukwumere *et al.*, 2008). There is an increase in cost savings from ₦24.00 in 25% to ₦103.00 in 100%BRS inclusion which is expressed as 2.23 to 9.17% respectively in the diet of broiler starter chickens. This indicated that replacing white maize with BRS reduces cost of broiler chicken production. Economic analyses of unconventional feed ingredients highlight their impact in feed costs reduction which account for about 70% of poultry production costs (Etim *et al.*, 2014; Ani and Okeke, 2011).

Table 3: Cost-Benefits Analysis of Production of Broiler Starter Chickens Fed Diets Containing Graded Levels of BRS as a Replacement for White Maize

| Parameters | DIETS | | | | |
|------------------------|---------|----------|----------|----------|-----------|
| | D1 (0%) | D2 (25%) | D3 (50%) | D4 (75%) | D5 (100%) |
| Total Feed Intake (kg) | 1.10 | 1.02 | 1.00 | 0.99 | 0.97 |
| Feed Cost (₦/kg) | 655.33 | 649.53 | 645.73 | 637.73 | 631.93 |
| Total feed cost (₦) | 720.86 | 662.52 | 645.73 | 631.35 | 612.97 |
| Total Weight Gain (kg) | 0.67 | 0.63 | 0.63 | 0.61 | 0.63 |
| Feed Cost (₦/kg gain) | 1076.00 | 1052.00 | 1025.00 | 1035.00 | 973.00 |
| Cost savings (₦) | - | 24.00 | 51.00 | 41.00 | 103.00 |
| Cost savings (%) | - | 2.23 | 4.74 | 3.81 | 9.17 |

CONCLUSION AND RECOMMENDATIONS

In conclusion, Bauchi red sorghum variety can replace white maize at 100% level in the diets of broiler starter chickens without compromising growth performance. Inclusion of Bauchi red sorghum as replacement for white maize led to the reduction in feed cost by 9.17% in broiler starter chickens. The following recommendations were made based on the outcome of this study:

- i. It is recommended that Bauchi red sorghum should be included in the diet of broiler starter chickens as an alternative to white maize.
- ii. The use of Bauchi red sorghum in broiler chickens diet led to the reduction in feed cost thereby improving the profit margin of raising broiler starter chickens.
- iii. Further research is recommended to explore the use of Bauchi red sorghum variety in the diets of broiler finisher and layer chickens.



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