



## PERFORMANCE AND COST-BENEFIT OF BROILER CHICKENS FED DIETARY LEVELS OF SAMSORG-25 SORGHUM (*Sorghum bicolor*) AS REPLACEMENT FOR WHITE MAIZE

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### ABSTRACT

This experiment was conducted to evaluate the response of broiler chickens to dietary levels of a sorghum variety, *samsorgh-25*, as replacement for maize. Five diets were formulated in which *samsorgh-25* replaced white maize at 0, 25, 50, 75 and 100% levels, designated as T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> respectively. Three hundred (300) two-weeks-old broiler chickens weighing 187.00 – 194.75g were randomly allotted to five diets in replicates of four (4) containing 15 birds each in a Completely Randomized Design. Feed and water were supplied *ad libitum* for 42 days. The results showed that except for feed conversion ratio (FCR) at the starter and overall phases, no parameter was significantly ( $P>0.05$ ) affected. At the starter phase, birds fed 100% (T<sub>5</sub>) replacement level of *samsorgh-25* for white maize had better FCR (1.98), which compared favourably with those on 25 -75% levels (2.12 – 2.23) and did not differ from the control (2.35). The trend was also the same at the overall phase where diet T<sub>5</sub> gave the best FCR which was similar to T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub>, while T<sub>1</sub> was the poorest. Feed cost per kg decreased continuously from N460.12 on T<sub>1</sub> to 365.71 on T<sub>5</sub>, while feed cost per kg gain was from N1114.21 (T<sub>1</sub>) to N802.95 (T<sub>5</sub>). Consequently, the highest cost saving of N311.28 was realized on T<sub>5</sub>. It was concluded that *samsorgh- 25* can completely replace white maize in broiler chicken diets without compromising performance and with a concomitant reduction in feed cost.

**Keywords:** Broiler chicken, Performance, Samsorgh-25, Cost-benefit

### INTRODUCTION

The rising cost of maize, a primary energy source in poultry diets, has prompted the search for alternative feed ingredients that can sustain or enhance broiler chicken performance while reducing feed costs. Sorghum has become a promising substitute due to its comparable nutritional profile and lower cost. Studies have shown that sorghum contains approximately 3256 kcal/kg of metabolizable energy and 11% crude protein, compared to maize's 3432 kcal/kg and 9% crude protein (Maidala & Sadiya, 2017). These attributes make sorghum a suitable alternative, especially in regions where maize is less accessible or expensive. Previous studies have demonstrated that sorghum can effectively replace maize in broiler diets without compromising growth performance or feed efficiency (Medugu *et al.*, 2018; Maidala *et al.*, 2021 and Daramola *et al.*, 2022). Several studies have demonstrated that broiler chickens fed sorghum-based diets exhibit comparable growth performance to those fed maize-based diets. Farahat *et al.* (2020) reported no significant effect on weight gain and feed conversion ratios (FCR) when broiler chickens were fed low-tannin sorghum as a replacement for maize. This confirms an earlier report by Seitz (2019) that including sorghum in broiler diets improves feed efficiency. Sorghum's resilience to drought and lower water requirements make it an attractive crop in semi-arid regions, where maize cultivation may be less viable (Liaqat *et al.*, 2024).



Furthermore, its reduced need for irrigation and stability in the face of climate variability contributes to its environmental sustainability.

Digestibility studies have highlighted that sorghum's nutrient absorption is slightly lower than that of maize due to the presence of anti-nutritional factors like tannins. However, advancements in sorghum processing, such as dehulling and enzyme supplementation, have mitigated these effects, improving nutrient utilization and overall digestibility (Foglia *et al.*, 2022). The impact of sorghum on meat quality has also been a focus of recent research. Studies have shown that broilers fed sorghum-based diets produce meat with similar tenderness, juiciness, and nutritional content as those fed maize-based diets. This suggests that sorghum does not adversely affect the sensory attributes of broiler meat (Ciurescu *et al.*, 2023). The economic benefits of using sorghum as a maize replacement are significant. Sorghum's lower market price and similar nutritional value can reduce feed costs, which constitute a major portion of poultry production expenses. A cost-benefit analysis revealed that incorporating sorghum into broiler diets could enhance profitability without compromising growth performance (Sanaa *et al.*, 2014). Although several varieties of sorghum have been explored as dietary energy sources in broiler chicken diets, available literature on the utilization of *Samsorgh 25* remains limited. Against this background, this study aims to evaluate the performance and cost benefits of starter broiler chickens fed dietary levels of *Samsorgh 25* as replacement for white maize.

## MATERIALS AND METHODS

The experiment was conducted at the Poultry Unit, Teaching and Research Farm, Yobe State College of Agriculture, Damaturu Campus, Yobe State. Damaturu is within the GPS location of Latitude: 11° 44' 49.1856" N and Longitude: 11° 57' 58.2912" E. Situated in the semi-arid region of Nigeria, the area is characterized by a tropical continental climate with a short wet season (June – August) and a long dry season (October – May). The mean annual temperature varies from 14.4 to 43°C while the average annual rainfall is about 560mm. (Weather Spark, 2021).

The test ingredient, *SAMSORG-25*, was purchased at the Damaturu Sunday market, while other feed components were sourced from Damaturu and Potiskum towns in Yobe state. Three hundred (300) two-weeks-old broiler chickens were randomly allotted to five experimental diets in replicates of four (4) containing 15 birds each in a Completely Randomized Design. Feed and drinking water were served *ad libitum*. All recommended management practices, such as vaccination and sanitation, were strictly observed, and the study lasted for six weeks (42 days).

Five experimental starter and finisher diets were formulated with replacement levels of *Samsorgh-25* for white maize at 0, 25, 50, 75 and 100%, designated as T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub>, respectively (Tables 1 and 2).



**Table 1:** Ingredients and Composition of Experimental Diets Containing Dietary *Samsorg-25* as Replacement for White Maize Fed to Starter Broiler Chickens (3 – 5 weeks)

Ingredient	Diets				
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>
White Maize	43.00	32.25	21.50	10.75	0.00
<i>Samsorg-25</i>	0.00	10.75	21.50	32.25	43.00
Full Fat Soya bean	37.50	37.50	37.50	37.50	37.50
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	2.50	2.50	2.50	2.50	2.50
Limestone	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
<b>TOTAL</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>
<b>Chemical Analysis (%)</b>					
ME (kcal/kg)	2900.80	2898.12	2896.33	2880.26	2873.66
Crude Protein	23.00	22.85	22.76	22.63	22.57
Crude Fibre	3.87	4.48	4.16	4.19	4.22
Ether Extract	12.35	12.11	11.94	11.24	10.88
Calcium	1.69	1.69	1.69	1.70	1.70
Phosphorous	0.82	0.84	0.87	0.89	0.92
Methionine	0.69	0.69	0.68	0.67	0.66
Lysine	1.52	1.53	1.54	1.55	1.57



**Table 2:** Ingredients and Composition (%) of Experimental Diets Containing Dietary *Samsorg-25* as Replacement for White Maize Fed Finisher Broiler Chickens (6-8 weeks)

Diets					
Ingredient	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>
White Maize	48.90	36.68	24.45	12.22	0.00
<i>Samsorg-25</i>	0.00	12.22	24.45	36.68	48.90
Soya bean meal	29.60	29.60	29.60	29.60	29.60
Palm oil	2.00	2.00	2.00	2.00	2.00
Wheat Offal	15.00	15.00	15.00	15.00	15.00
Bone Meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
<b>TOTAL</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>
<b>Chemical Analysis (%)</b>					
ME (kcal/kg)	3086.65	3079.27	3047.32	3043.14	3037.99
Crude Protein	20.00	19.78	19.85	19.73	19.93
Crude Fibre	3.89	4.00	3.86	4.00	4.11
Ether Extract	14.42	14.28	14.33	14.21	14.11
Calcium	1.49	1.49	1.50	1.50	1.50
Phosphorous	0.64	0.67	0.70	0.73	0.75
Methionine	0.59	0.58	0.57	0.56	0.55
Lysine	1.17	1.18	1.19	1.20	1.22

Data for feed intake, weight gain, feed conversion ratio and mortality were collected. At the start of the experiment, the initial weight of the chickens was recorded, and thereafter, it was recorded every week. These records were used to calculate daily weight gain (DWG). Daily mean feed intake was determined by subtracting the weight of left-over feed from the quantity offered the previous day while feed conversion ratio was calculated from the relationship;

$$FCR = FI/WG$$

Where FCR= feed conversion ratio, FI= feed intake and WG= weight gain.

Mortalities were recorded for each treatment throughout the feeding trial period.

The cost-benefit of broiler chickens fed dietary levels of *SAMSORG-25* as a replacement for white maize was computed based on the prevailing prices of feed ingredients at the time of the study. Analysis of *Samsorgh-25* and experimental diets for proximate composition was carried out at the Yobe State University, Animal Nutrition Laboratory according to the methods of AOAC (2000).

All data obtained were analysed using one-way analysis of variance (ANOVA) of the statistical package SPSS version 23. Differences between treatment means were separated using Duncan's Post Hoc method (Duncan, 1955).



## RESULTS AND DISCUSSION

### Proximate Composition

The proximate composition of *Samsorgh* - 25 is presented in Table 3. The results showed that the variety has a crude protein content of 9.59%, ether extract 3.13%, crude fibre 4.06%, ash 3.57%, NFE 71.91%, and 3077.71kcal/kg. These values are within the ranges of 6.23 – 13.81% CP, 65.57 – 76.28% NFE, 3.60 – 10.54% ether extract, 1.65 – 7.94% crude fibre and 1.12 – 1.68 ash reported by Jimoh and Abdullahi (2017) for six different local varieties of sorghum.

**Table 3:** Proximate Composition (%) of *SAMSORG-25*

Nutrient	Level
Crude protein	9.59
Fat/Ether Extract	3.13
Moisture	7.74
Crude fibre	4.06
Ash	3.57
Nitrogen-free extract (NFE)	71.91
ME (kcal/kg)	3077.71

ME = Metabolizable Energy

### Performance of Broilers Fed Diets Containing *Samsorgh-25*

Growth performance of broiler chickens fed dietary levels of *Samsorgh-25* is presented in Table 4. Except for feed conversion ratio at the starter and overall phases, no parameter was significantly ( $P>0.05$ ) affected. This supports the findings of Ciurescu *et al.* (2023) and Moses *et al.* (2024). Initial weight of birds ranged between 187.00 and 194.75g on T<sub>1</sub> and T<sub>3</sub>, final weight was between 2227.17g (T<sub>1</sub>) and 2435.32g (T<sub>4</sub>). At the starter phase, daily feed intake ranged between 46.79 and 51.11g on T<sub>5</sub> and T<sub>2</sub> respectively. Daily weight gain was within the range of 21.66g (T<sub>1</sub>) and 24.12g (T<sub>4</sub>). Feed conversion ratio was best on T<sub>5</sub> (1.98) and poorest on T<sub>1</sub>. However, all other diets were comparable with T<sub>5</sub> and T<sub>1</sub>. This disagrees with Farahat *et al.* (2020) who reported a decreased daily weight gain and increased FCR when sorghum replaced maize above 50% level in broiler chicken diets.

At the finisher phase, daily feed intake ranged between 138.75g (T<sub>4</sub>) and 141.91g (T<sub>2</sub>), DWG from 56.62g (T<sub>1</sub>) to 62.48g (T<sub>5</sub>), while feed conversion ratio was between 2.37 (T<sub>4</sub> & T<sub>5</sub>) and 2.51 (T<sub>1</sub>). Overall total feed intake ranged from 4940.10g (T<sub>1</sub> & T<sub>5</sub>) to 5046.81g (T<sub>2</sub>), daily feed intake, 94.07g (T<sub>5</sub>) to 96.51g (T<sub>2</sub>), and daily weight gain, 39.13g (T<sub>1</sub>) to 43.11g (T<sub>5</sub>). Feed conversion ratio was best on T<sub>5</sub> (2.12) which was similar to 2.24 (T<sub>4</sub>) – 2.31 (T<sub>3</sub>). Overall mortality recorded was for only one (1) bird on diet T<sub>1</sub>.

**Table 4:** Performance of Broiler Chickens Fed Diets Containing *Samsorg-25* as Replacement for White Maize (3 -7 weeks)

Parameter	Diets					SEM
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	
<b>Productive Performance</b>						
Initial wt. (g)	187.00	189.50	194.75	189.75	187.50	6.19 <sup>NS</sup>
Final wt. (g)	2227.17	2339.51	2332.31	2344.33	2435.32	72.69 <sup>NS</sup>
Week 3 wt.(g)	641.88	686.13	670.38	696.25	686.00	20.92 <sup>NS</sup>
TWG (g)	2040.17	2150.01	2137.56	2154.58	2247.87	71.44 <sup>NS</sup>
<b>Starter Phase (3-5 weeks)</b>						
TFI (g)	1062.66	1073.29	1060.6	1072.92	982.62	37.71 <sup>NS</sup>
DFI (g)	50.60	51.11	50.50	51.09	46.79	1.79 <sup>NS</sup>
DWG (g)	21.66	23.65	22.65	24.12	23.74	0.86 <sup>NS</sup>
FCR	2.35 <sup>a</sup>	2.17 <sup>ab</sup>	2.23 <sup>ab</sup>	2.12 <sup>ab</sup>	1.98 <sup>b</sup>	0.29
Mortality rate (No.)	1	0	0	0	0	-
<b>Finisher Phase (6-8 weeks)</b>						
TFI (g)	3969.88	3973.52	3954.93	3884.93	3957.57	36.44 <sup>NS</sup>
DFI (g)	141.78	141.91	141.25	138.75	141.34	1.30 <sup>NS</sup>
DWG (g)	56.62	59.04	59.34	58.86	62.48	2.14 <sup>NS</sup>
FCR	2.51	2.41	2.39	2.37	2.37	0.27 <sup>NS</sup>
Mortality (No.)	0	0	0	0	0	-
<b>Overall phase (3-8 wks.)</b>						
TFI (g)	4940.19	5046.81	5015.54	4957.84	4940.19	48.58 <sup>NS</sup>
DFI (g)	96.19	96.51	95.88	94.92	94.07	1.03 <sup>NS</sup>
DWG (g)	39.13	41.35	41.00	41.49	43.11	1.35 <sup>NS</sup>
FCR	2.43 <sup>a</sup>	2.29 <sup>ab</sup>	2.31 <sup>ab</sup>	2.24 <sup>ab</sup>	2.12 <sup>b</sup>	0.26
Mortality (No.)	1	0	0	0	0	-

a, b = Means in the same row with different superscripts differ significantly @ P<0.05, NS = Not significant, TWG = Total weight gain, DWG = Daily weight gain, DFI = Daily feed intake, TFI = Total feed intake, FCR = Feed conversion ratio, SEM = Standard Error of Means.

### Cost-benefit of Broiler Chickens fed Dietary Levels of *Samsorgh-25*

Results for cost-benefit of broiler chickens fed dietary *Samsorgh-25* as replacement for white maize are presented in Table 4. Total feed intake was lowest on T<sub>1</sub> and T<sub>5</sub> (4.94kg) and highest on T<sub>2</sub> (5.05kg). Feed cost (₦/kg) decreased continuously with increased dietary replacement of samsorgh-25 for white maize. Diet T<sub>1</sub> (₦460.12) had the highest value, while T<sub>5</sub> (₦365.71) was the lowest. Feed cost per kg gain declined from ₦1114.21 on T<sub>1</sub> to ₦802.94 (T<sub>5</sub>), while the highest cost saving of ₦311.28 was realized on T<sub>5</sub>. By ranking, cost-saving assumed a reverse trend from T<sub>5</sub> to T<sub>1</sub>. These findings agree with Medugu *et al.* (2023).

**Table 5:** Cost Benefit Analysis of Replacing *Samsorgh-25* for White Maize as Energy Source in Broiler Chicken Diets (3-8 weeks)

Parameter	Diets				
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>
Total feed intake (kg)	4.94	5.05	5.02	4.96	4.94
Feed cost (₦/kg)	460.12	436.91	413.54	391.03	365.71
Total feed cost (₦)/bird	2272.99	2206.4	2075.97	1939.51	1806.61
Total weight gain (kg)	2.04	2.15	2.14	2.15	2.25
Feed cost ₦/kg gain	1114.21	1026.23	970.08	902.1	802.94
Cost saving (₦)	-	87.98	144.13	212.12	311.28
Ranking	5	4	3	2	1



## CONCLUSION AND RECOMMENDATION

Based on the findings of this study, it was concluded that *Samsorgh-25* could completely replace white maize as the main energy source in broiler diets without a negative effect on growth performance and with a concomitant reduction in feed cost. Consequently, *Samsorgh-25* is recommended as replacement for white maize in broiler chicken diets. Similarly, further research on the use of the test ingredient in other types of poultry such as guinea fowl, turkeys and layer chickens is hereby recommended.

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