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Assessing the Nutritional Potential of *Samsorg-25* (*Sorghum Bicolor*) as Energy Source in Broiler Chicken Diets

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Abstract
This experiment was aimed to investigate growth performance and cost benefit of broiler chickens fed diets containing levels of samsorg-25 as replacement for red sorghum. Three-hundred-day-old broiler chickens were used in the study which was designed in a completely randomized designed. Feed and water were supplied *ad lib* and the trial lasted for 42 days. Results for experiment revealed a progressive significant ($P<0.05$) effect in favour of samsorg-25-based diets in terms of growth performance indices. Feed cost per kg gain decreased with increased level of dietary samsorg-25. It was concluded that samsorg-25 can completely replace red sorghum in broiler chicken diets without negative effect of growth performance and with concomitant reduction in feed cost.

Keywords: Growth, cost benefits, broiler chicken, sorghum bicolor

Introduction
Maize has been the major source of energy in poultry diets. However, inadequate production of this grain and the intense competition for it between man and livestock especially in the tropics, has made poultry rations to be expensive (Bala *et al.,* 2017 and Ndelekwute *et al.,* 2021). According to Amaza *et al.* (2020), the rising cost of poultry feeds have continued to be a major problem in developing countries as feed cost constitutes about 65 to 70% of the total cost of production while the energy component alone stands at about 70% of the feed cost (Cisse *et al.,* 2017). This scenario has indicated that to minimize feed cost with rapid growth at best feed conversion and to

maximize profit for the producer while making available cheaper poultry meat and products to the common man. This will invariably improve affordability and access to animal protein. Against this backdrop, the use of different varieties of sorghum as alternative energy source in poultry rations was advanced by many researchers.

Against this backdrop, the present study is designed to investigate the effects of complete replacement of *SAMSORG-25* with red sorghum variety on performance and cost-effectiveness of broiler chickens' production.

Objectives of the Study

The broad objective of this work is to assess the response of broiler chickens to dietary levels of *Samsorg-25* as replacement for white maize, yellow maize, yellow sorghum and red sorghum.

The specific objectives are to;

i. evaluate the productive performance of broiler chickens fed *Samsorg-25*-based diets.
ii. assess the cost-benefit of using *Samsorg-25* as dietary energy source for broiler chickens.

Justification

According to Indorama (2023), Nigeria is the second largest producer of sorghum, where it is produced on approximately 5.6 million ha of land and an average annual yield of 2.8 million tonnes. Sorghum requires a warm weather for good germination and growth which the study area is endowed with. Different varieties of sorghum, both local and improved are available. Samsorg-25 is an improved variety which is high-yielding, stiga-tolerant and does well on relatively poor soils (NSPI, 2023). It gives a yield of about 3.5 tonnes/ha. Generally, sorghum contains a crude protein level which is higher than that of maize (11.0 versus 9.0%). Although slightly lower than maize (85%) in metabolizable (ME) energy content (3270 kcal/kg) (McDonald *et al.*, 1987), sorghum can adequately provide the required ME in poultry rations. Therefore, considering the high cost of broiler rations formulation using maize whose production is being challenged by conditions brought about by climate change, high cost of inorganic fertilizer among others, and the positive results obtained from previous studies using different varieties of sorghum as replacement for dietary maize in poultry rations, the exploration of Samsorg-25 potentials as dietary energy source in broiler chickens would be well in place.

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).

Procurement, Processing of Feed Ingredients, and Chemical Analysis of Samsorg-25

The test ingredient, Samsorg-25 (sorghum variety), soya bean, red sorghum and wheat offal were purchased from Damaturu Sunday Market.

Experimental Birds and their Management

The total of 300-day-old broiler chicks, *Abor Acres* breed, were obtained from Agrited® Farm, Ibadan. Were randomly allocated into five dietary treatments of sixty birds each after one week of brooding. Each treatment was replicated four times with fifteen birds/replicate in a completely randomized designed with designated level of inclusion of both starter and finisher diets 0, 25, 50, 75 and 100% shown in Table 1 and 2.

Table 1: Ingredients and Composition (%) of Dietary Levels of SAMSORG-25 as Replacement for Red Sorghum Fed to Starter Broilers (1-4weeks)

	Diet				
Ingredients	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)	T_5 (100%)
Red Sorghum	44.75	33.56	22.37	11.19	0.00
SAMSORG-25	0.00	11.19	22.37	33.56	44.75
Full fat soya bean	35.75	35.75	35.75	35.75	35.75
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
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis (%)					
ME (kcal/kg)	2959.50	2959.50	2959.50	2959.50	2959.50
Crude Protein	23.00	23.00	23.00	23.00	23.00
Crude Fibre	3.76	3.76	3.76	3.76	3.76
Ether Extract	8.80	8.69	8.58	8.46	8.35
Calcium	1.68	1.69	1.69	1.69	1.70
Phosphorous	0.81	0.84	0.86	0.89	0.91
Methionine	0.69	0.68	0.67	0.66	0.65
Lysine	1.48	1.50	1.51	1.52	1.53

ME= Metabolizable Energy

Table: 2 Ingredients and Composition (%) of Dietary Levels of SAMSORG-25 as Replacement for Red Sorghum Fed to Finisher Broilers (4-7weeks)

	Diets				
Ingredients	**T_1 (0%)**	**T_2 (25%)**	**T_3 (50%)**	**T_4 (75%)**	**T_5 (100%)**
Red sorghum	44.85	33.64	22.43	11.21	0.00
SAMSORG-25	0.00	11.21	22.42	33.64	44.85
Palm oil	2.00	2.00	2.00	2.00	2.00
Full fat soya bean	33.65	33.65	33.65	33.65	33.65
Wheat offal	15.00	15.00	15.00	15.00	15.00
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
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis (%)					
ME (kcal/kg)	2990.50	2990.50	2990.50	2990.50	2990.50
Crude Protein	19.78	19.78	19.78	19.78	19.78
Crude Fibre	4.02	4.02	4.02	4.02	4.02
Ether Extract	10.34	10.22	10.11	10.00	9.89
Calcium	1.50	1.50	1.51	1.51	1.51
Phosphorous	0.66	0.69	0.71	0.74	0.77
Methionine	0.60	0.59	0.58	0.57	0.56
Lysine	1.25	1.27	1.28	1.29	1.30

ME = Metabolizable Energy

RESULTS AND DISCUSSION

Productive performance and Cost benefit of replacing *Samsorg-25* for Red Sorghum as Energy Source in Broiler Chickens Diets (3-8 weeks)

Initial weight of birds ranged from 200.81 g (T_2) to 208.01g (T_5). Body weight at 3 weeks indicated a significant ($P<0.05$) effect of diet with birds on T_5 (803.14g) outweighing those on other diets. These are followed by T_4 (762.59g), then T_3 (722.24 g), then T_1 (676.28g). However, birds on T_2 (698.83g) did not differ from T_1 and T_3. Final weight, which also revealed a significant effect of samsorg-25, was higher ($P<0.05$) in T_5 (1981.14g), followed by T_4 (1869.61g), T_3 (1708.56g) in that order. Diets T_2 (1611.18g) and T_1 (1548.47g) which gave the lowest final weights, were the same. Total weight gain also followed the same pattern as final weight in the order; T_5 (1773.12g), T_4 (1664.35g), T_3 (1504.18g) and T_2 (1410.36g) and T_1 (1340.79g) which were the same.

Daily feed intake revealed a significantly ($P<0.05$) higher effect of diet on T_4 (61.75g) which was similar to T_3 (60.58g), T_5 (61.30g) and T_1 (61.25g) which were the same. Birds fed diet T_2 (59.39g) had a comparable DFI with those on T_1, T_3, and T_5. Daily weight gain of broiler birds on T_5 outweighed those T_4 (26.53g), then T_3 (24.66g) and lastly T_1 (22.31g) in that order. However, those fed diet T_2 (23.71g) compared favourably with those on T_1 and T_3. Feed conversion ratio was better ($P<0.05$) in birds fed diet T_5 (2.16) which was similar to those on T_4 (2.33) followed by T_3 (2.46) and T_2 (2.50) which were the same. The lowest FCR was obtained on those fed the control diet (2.70). Only one (1) bird (T_4) died at the starter phase.

At the finisher phase, daily feed intake did not differ significantly among diets and was between the range of 122.64g (T_2) and 126.13g (T_4). Daily weight gain was highest ($P<0.05$) for birds on diet T_5 (56.09g) followed by T_4 (52.71g), then T_3 (46.96g). Diets T_2 (43.44g) and T_1 (41.53g) which were the same, had the lowest DWG. Feed conversion ratio was better and the same in T_5 (2.24) and T_4 (2.40) followed by T_3 (2.64) which was similar to T_2 (2.83) and lowest in T_1 (2.98) which did not differ from T_2. Mortality at this phase was in the order 3, 2, 1, and 2 birds for T_1, T_2, T_3, and T_5 respectively.

Overall DFI was higher ($P<0.05$) in birds fed diets T_4 (93.94g) and T_5 (93.51g) which were the same and similar to T_3 (92.39g) and T_1 (92.33g) which were also the same. Birds fed diet T_2 (91.02g) which had a lower DFI did not differ from those in T_1 and T_3. Daily weight gain was highest ($P<0.05$) in birds fed diet T_5 (42.21g) followed by T_4 (39.63g), then T_3 (35.81g) and lowest T_2 33.58g) and T_1 (31.92g) which were the same. Feed conversion ratio was significantly ($P<0.05$) better in birds fed diet T_5 (2.21) than those on diet T_4 (2.37), then T_3 (2.58) & T_2 (2.71) which are the same, while those on T_1 (2.89) were the poorest. Overall mortality was 3, 2, 1, 1, and 2 birds on diets T_1, T_2, T_3, T_4 and T_5 respectively.

However the overall total feed intake was between 3.82kg (T2) and 3.95kg (T_4). Feed cost per kg was ₦539.77 across all diets while feed cost per kg gain ranged between ₦1198.47 on diet T_5 and ₦1596.92 on T_1. The highest cost saving was obtained on diet T_5 (₦364.45) while T_3 (₦99.56) was the lowest.

DISCUSSION

The results for productive performance of broiler chickens fed diets containing samsorg-25 as a replacement for red sorghum revealed a significant influence of diet in favour of birds on 50% level and above. Reason could be the reduction in the concentration of antinutritional factors with increased dietary level of samsorg-25 and reduced level of red sorghum which has been said to have higher levels of antinutritional factors, tannins, in particular, among all other varieties. Tannins typically reduce the availability of other compounds such as starches, proteins and minerals (Hidayat *et al.,* 2022). The activity (bioavailability reduction) correlates with the amount of tannin and the polymerization degree (Issa *et al.,* 2015).

At the starter phase, daily weight gain of birds increased significantly with increased replacement of samsorg-25 for red sorghum. However, DFI, which was also significantly affected, did not show a definite trend of variation among diets. Values for daily feed intake

obtained in the present study are lower than 74.94 – 78.70g reported by Abdullahi *et al.* (2023) in broiler chickens fed different commercial diets. Similarly, values for feed conversion ratio are poorer than 1.35-1.85 (Hafizu *et al.,* 2020) over the same study period.

Performance parameters at both the finisher and overall phases followed a similar trend with starter phase. This is in line with the findings of Lakurbe *et al.* (2018). However Findings for cost-benefit of broiler chickens fed dietary samsorg-25 as replacement for red sorghum revealed the same values for feed cost per kg at all three phases. This is due to the fact the prices for both red sorghum and samsorg-25 varieties were the same at the time of purchase. Feed cost per kg gain was lower on samsorg-25-based diets as a result higher weight gains were obtained in broiler chickens fed these diets. Consequently, the diets gave higher values for cost saving.

Table 3: Performance of Broiler Chickens Fed Diets containing *Samsorg-25* as Replacement for Red Sorghum

Parameter	**T_1(0%)**	**T_2(25%)**	**T_3(50%)**	**T_4(75%)**	**T_5(100%)**	**SEM**
Productive performance						
Initial weight (g)	207.67	200.81	204.38	204.26	208.01	4.39^{NS}
3rd week body wt. (g)	676.28^{d}	698.83^{cd}	722.24^{c}	762.59^{b}	803.14^{a}	9.04^{*}
Final weight (g)	1548.47^{d}	1611.18^{d}	1708.56^{c}	1869.61^{b}	1981.14^{a}	23.19^{*}
Total weight gain (g)	1340.79^{d}	1410.36^{d}	1504.18^{c}	1664.35^{b}	1773.12^{a}	25.73^{*}
Starter phase (3 - 5 wks.)						
Daily feed intake (g)	61.25^{ab}	59.39^{b}	60.58^{ab}	61.75^{a}	61.30^{ab}	0.64^{*}
Daily weight gain (g)	22.31^{d}	23.71^{cd}	24.66^{c}	26.53^{b}	28.34^{a}	0.51^{*}
Feed conversion ratio	2.70^{a}	2.50^{b}	2.46^{b}	2.33^{bc}	2.16^{c}	0.22^{*}
Mortality (Number)	0	0	0	1	0	
Finisher phase (6 – 8 wks.)						
Daily feed intake (g)	123.41	122.64	124.2	126.13	125.7	1.23^{NS}
Daily weight gain (g)	41.53^{d}	43.44^{d}	46.96^{c}	52.71^{b}	56.09^{a}	1.09^{*}
Feed conversion ratio	2.98^{a}	2.83^{ab}	2.64^{b}	2.40^{c}	2.24^{c}	0.30^{*}
Mortality (Number)	3	2	1	0	2	
Overall phase (3- 8 wks.)						
Daily feed intake (g)	92.33^{ab}	91.02^{b}	92.39^{ab}	93.94^{a}	93.51^{a}	0.51^{*}
Daily weight gain (g)	31.92^{d}	33.58^{d}	35.81^{c}	39.63^{b}	42.21^{a}	0.61*
Feed conversion ratio	2.89^{a}	2.71^{b}	2.58^{b}	2.37^{c}	2.21^{d}	0.04*
Mortality (Number)	3	2	1	1	2	

$^{a,b,\ c,\ d}$ = Means bearing different superscripts within the same row differ. * = ($P<0.05$),

NS = Not Significant,

SEM = Standard Error of Means.

Table 4: Cost Benefit Analysis of Replacing *Samsorg-25* for Red Sorghum as Energy Source in Broiler Chickens Diets (3-8 weeks)

	Diets				
Parameters	**T_1(0%)**	**T_2(25%)**	**T_3(50%)**	**T_4(75%)**	**T_5(100%)**
Starter phase (3 - 5 wks)					
Total feed intake (kg)	1.29	1.25	1.27	1.30	1.29
Feed cost (₦/kg)	536.83	536.83	536.83	536.83	536.83
Total feed cost (₦)/bird	692.51	671.04	681.77	697.88	692.51
Total weight gain (kg)	0.49	0.50	0.52	0.56	0.60
Feed cost ₦/kg gain	1413.29	1342.08	1311.09	1246.21	1154.18
Cost saving (₦)	-	71.21	102.20	167.08	259.11
Cost saving (%)	-	5.04	7.23	11.82	18.33
Finisher phase (6 - 8 wks.)					
Total feed intake (kg)	2.59	2.58	2.61	2.65	2.64
Feed cost (₦/kg)	542.71	542.71	542.71	542.71	542.71
Total feed cost (₦)/bird	1405.62	1400.19	1416.47	1438.18	1432.75
Total weight gain (kg)	0.87	0.91	0.99	1.11	1.18
Feed cost ₦/kg gain	1615.65	1538.67	1430.78	1295.66	1214.20
Cost saving (₦)	-	76.98	184.87	319.99	401.45
Cost saving (%)	-	4.77	11.44	19.81	24.85
Overall phase (3 - 8 wks.)					
Total feed intake (kg)	3.88	3.82	3.88	3.95	3.93
Feed cost (₦/kg)	539.77	539.77	539.77	539.77	539.77
Total feed cost (₦)/bird	2094.31	2061.92	2094.31	2132.09	2121.30
Total weight gain (kg)	1.34	1.41	1.50	1.66	1.77
Feed cost ₦/kg gain	1562.92	1462.36	1396.22	1284.39	1198.47
Cost saving (₦)	-	99.56	166.70	278.53	364.45
Cost saving (%)	-	6.37	10.67	17.82	23.32

CONCLUSION

Based on the results of this study, the following conclusions was made:

Samsorg-25 can completely (100%) replace red sorghum in broiler chicken diets without any negative effects on growth performance, parameters and with concomitant reduction in feed cost

RECOMMENDATIONS

Based on the results of this study, and the conclusions made therefrom, the following recommendations were made.

i. Samsorg-25 is recommended as a suitable substitute for red sorghum in broiler chicken diets.
ii. Further studies on its utilization in the diets of other monogastric species like layers, rabbits, quails, turkeys, and guinea fowl is hereby recommended.

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