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FINANCIAL BENEFIT OF BROILER CHICKENS PRODUCTION FED GRADED LEVELS OF SOYA BEANS BY-PRODUCT *(AWARA)* MEAL

[1]Dikko, I. M., [2]Doma, U. D., [1]Lakurbe, A. O., [3]Bah, U. J., [1]Inuwa, I. and [1]Abdullahi, B. A.
[1]Department of Animal Science, Federal University of Kashere, Gombe State, Nigeria
[2]Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi State, Nigeria
[3]Department of Animal Science, Yobe State University, Yobe State, Nigeria
Corresponding author: dikko005@yahoo.co.uk, +234 0803 451 6951

ABSTRACT
A feeding trial was conducted to investigate the effects of diets containing graded levels of soya bean by-product popularly known as awara residue as protein source. It was included at 0, 5, 10, 15, and 20% levels in the diet of broiler chickens. A total of 220 unsexed day old Marshall Broiler line were assigned to the five dietary treatments each replicated four times in a completely randomised design (CRD). Birds were provided with feed and water ad libitum and the experiment lasted for seven weeks. Data collected were daily feed intake, daily weight gain, cost per kilogram of each test diet, cost per kilogram of weight gain for each bird, total feed cost, and cost of feed /gain (₦/gain). The cost of feed intake per bird (₦/kg feed) which ranges as (560.00 vs 450.00) was decreased as the inclusion levels of the test diet increased, which led to the significant increase in the cost saving (₦132.32 vs 348.85). In conclusion, awara residue meal is a good protein source and broiler feeds could contain up to 20% level of its inclusion both during the starter and finisher phases with no adverse effect on growth performance. Also, there was reduction in feed cost.

Key words: Broiler, Soya beans, residue and cost

1.0 INTRODUCTION
Feeding has been recognised as an important single cost item as it accounts for 70 percent of the total cost of poultry production. Poultry convert feed into food products quickly and efficiently. Their high rate of productivity results in relatively high nutrient needs. Today's system of animal agricultural production put humans and animals in competition for protein. Residues generated by the food industries represent a potential resource to reduce this problem if properly utilized. The possibility of separation, collection and utilization of food residue as feedstuff for animals has been studied in many places around the world (Rajeh *et al*., 2021). The use of local, cheap and readily available material, particularly those that are not directly utilized by man has received particular attention as the only viable alternatives to the use of conventional feed stuffs. Soya bean meal serves as the world standard in regard to protein meals for livestock production (Singh and Krishnaswamy, 2022). It is palatable, nutrient dense, highly digestible, and cost effective. Similarly, Full Fat Soya Bean (FFSB) was said to possess the same features, but in addition, it is an excellent source of energy and fatty acids. Properly processed full fat soya bean may represent valuable material in diets used within the modern poultry industry because it may make a significant contribution to overall dietary energy level when incorporated with low quality ingredients in the diet of poultry (Obianwuna *et al*., 2022). Soybean is a legume which is well known for its high biological value, digestibility, and quality protein both for man and livestock feeding. Soybeans (*Glycine max* (L) Merril) have long been recognised as a valuable source of edible oil and protein for feeding both animals and man. (Peydayesh *et al*, 2022). Soybean meal has long been considered the best source of supplemental protein in diets for poultry. In fact, it is often referred to as the "gold standard" in that all other protein sources are generally compared to soybean meal (Singer, 2023). The same author reported that on a global basis, soybean meal accounts for approximately 63% of all protein sources used in animal feeds followed by rapeseed (canola) meal (12%), cottonseed meal (8%), sunflower meal (6%), fish meal (4%), and peanut meal (4%). Awara Residue (AR) or Okara is a by-product of soymilk or awara processing which contains pulp, shells and husk of ground soybean. It is beige in colour and has a light crumbly, fine grained texture

which makes it look like moist sawdust or grated coconut and taste similar to almond. Although AR is mostly treated as an industrial waste with little market value, it is a potentially nutritious product that is high in protein, carbohydrate, vitamins, minerals fibre and fat (Barretto *et al.,* 2021). Makkar (2014) reported that AR has high quality protein for feeding livestock. Consequently, Mujyambere (2022) observed that the use of AR as a replacer for soybean meal in broiler diet up to 60% did not adversely affect feed conversion and improve economic efficiency.

2.0 MATERIALS AND METHODS

2.1 Study Area

This study was conducted at Gombe state poultry production unit of the state ministry of agriculture. Gombe State which lies between latitude 90^0 to 120^0 north and longitude 80^0 to 110^0east with an altitude of 407 meters above sea level. It has a mean maximum and mean minimum temperature of 38.8^0C and 18.3^0C respectively. The coldest months are from November to January while March to May is the hottest period. Gombe metropolis has a rainfall distribution which ranges from 970.7 mm to 1,142 mm annually, with a mean of 1,009.4 mm. The rain falls from the month of April to October. The vegetation of the area is savannah grassland (Gombe State Government, 2009).

2.2 Experimental Design.

The birds were randomly weigh and allocated to five (5) treatment groups of 44 birds each. Each treatment was replicated four times with 11 birds per replicate in a completely randomized design (CRD). The treatments diets were tagged $T_{1(0\%)}$, $T_{2(5\%)}$, $T_{3(10\%)}$, $T_{4(15\%)}$ and $T_{5(20\%)}$ level of inclusion of awara residues. The experiment lasted for 7 weeks.

2.3 Experimental Stock and Management

A total of two hundred and twenty (220) unsexed day old Marshall Broiler chicks were used in this experiment. The chicks were obtained at day-old from Sovet International Nig LTD, Kano State Nigeria. Before arrival of the chicks, the room was thoroughly swept, washed with detergent and then disinfected with disinfectant (IZAL) so as to eliminate any disease causing organism present that may be a source of infection to the chicks. After three days when the room was dried, wood shavings was spread on the cemented floor to a depth of about two centimetres (2cm) to serve as an insulator and also absorb moisture from droppings and then covered with old newspaper to avoid it been eaten by the chicks. All brooding equipment were cleaned, washed and disinfected. Flat feeding trays were placed on the litter materials (wood shaving) and plastic drinkers for the young chicks in the brooder room. On arrival, chicks were fed commercial broiler starter mash and water containing anti-stress to relieve them of transit stress. Subsequently as the birds grow, they were switched over to bigger cone-shape metal feeders and drinkers, similarly all the necessary brooding management practices were duly observed. These include spreading of old newspaper over the saw dust to prevent it been eaten by the chicks, provision of light and heat, thereby maintaining a temperature of 36 to 38^0c using charcoal, provision of adequate ventilation, cleaned water, and commercial broiler starter mash. All necessary animal welfare ethical standards were judiciously observed throughout the rearing period and there was no any conflict of interest concerning this research.

2.4 Awara Residue Collection and Preparation

The residue was obtained from locals who prepare and sale awara in Gombe metropolis, Gombe state and Yola, Adamawa state, Nigeria. The residue was boiled for 30 minutes in a large metallic pot and then sun dried to destroy the anti-nutritional factors in it, such as trypsin inhibitors, chymotrypsin inhibitors.

2.5 Experimental Diets

The experimental diets were compounded using the following ingredient. Maize, wheat offal, awara residue meal, soya bean, fishmeal, bone meal, min-vit premix, methionine and NaCl (common salt). Five starter and finisher experimental diets were formulated with different graded levels of inclusion of awara residue meal at 0, 5, 10, 15 and 20%. Both the experimental starter and finisher diets are presented in table 1 and 2 respectively. Water and Feed were provided *ad libitum* throughout the period of the research.

Table 1: Composition and Calculated Analysis of Experimental Starter Diets (1-4wks)

	Treatment/Diets				
Ingredients	**T1(0%)**	**T2(5%)**	**T3(10%)**	**T4(15%)**	**T5(20%)**
Maize	46.97	42.63	38.30	43.97	42.97
Soybean	33.63	32.97	27.30	21.63	17.63
Wheat Offal	10.0	10.0	10.0	10.0	10.0
Awara Residue Meal	0.0	5.0	10.0	15.0	20
Fish Meal	5.0	5.0	5.0	5.0	5.0
Bone Meal	2.0	2.0	2.0	2.0	2.0
Limestone	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25
Min-vit-Premix*	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total	100%	100%	100%	100%	100%
Calculated analysis					
Crude Protein(%)	23	23	23	23	23
Met.energy (Kcal/kg)	2890.61	2891.26	2919.87	2935.89	2950.93
Crude Fibre (%)	4.02	4.99	4.93	5.56	5.91
Ca (%)	1.31	1.31	1.31	1.31	1.31
P (%)	0.68	0.68	0.68	0.68	0.68
Lysine (%)	1.23	1.38	1.30	1.24	1.21
Methionine (%)	1.34	1.34	1.34	1.34	1.34

Key: P = phosphorus, **Ca =** calcium,

2.6 DATA COLLECTION

2.6.1 Measure of Growth Performance

Feed consumption from each replicates were measured on daily basis by subtracting left over from feed served per group and adequate measures were also taken to safeguard against spillage and related wastages, such as avoidance of pouring too much feeds in the feeders, hanging the feeders above the ground level and at the height of the broilers neck as well as careful removal of any foreign materials from the left over feeds. The mean daily feed intake was calculated on weekly basis by dividing the amount consumed by the number of birds and days in the group. Weekly weight gain measurements of each bird in a replicate were conducted and divided by seven and number of birds in that group to obtain the mean daily weight gain. The mean daily feed intake and weight gain were used to estimate the feed conversion as follow:

Feed conversion ratio = $\frac{\text{Mean feed intake}}{\text{Mean body weight gain}}$

Table 2: Composition and Calculated Analysis of Experimental Finisher Diets (4-7wks)

	Treatment/Diets				
Ingredients	**T1(0%)**	**T2(5%)**	**T3(1)0%**	**T4(15%)**	**T5(20%)**
Maize	50.47	49.47	50.77	47.47	46.47
Soybean	28.13	24.13	19.33	16.13	12.13
Wheat Offal	15.0	15.0	15.0	15.0	15.0
Awara Residue Meal	0.0	5.0	10.0	15.0	20.0
Fish Meal	2.0	2.0	2.0	2.0	2.0
Bone Meal	2.0	2.0	2.0	2.0	2.0
Limestone	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25
Min-vit-Premix*	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total	100%	100%	100%	100%	100%
Calculated analysis					
Crude Protein(%)	20.0	20.0	20.0	20.0	20.0
Met.energy (Kcal/kg)	2822.07	2837.15	2907.17	2867.31	2882.39
Crude Fibre (%)	4.72	5.05	5.47	5.77	6.11
Ca (%)	1.31	1.31	1.31	1.31	1.31
P (%)	0.68	0.68	0.68	0.68	0.68
Lysine (%)	1.10	1.07	1.02	1.01	0.99
Methionine (%)	1.33	1.34	1.33	1.31	1.34

Key: P = Phosphorous Ca = Calcium

2.6.2 Proximate Analysis

Raw and processed awara residue meals as well as test diets were analysed to determine their proximate composition. Metabolizable energy (ME.Kcal/Kg) of awara residue and experimental diets were estimated using the method of Pauzenga (1985) as follows: ME = 35 * CP% + 81.8 * EE% + 35.5 * NFE%.

2.6.3 Economics Analysis

The economic significance of replacing soya bean meal with awara residue meal was calculated as follows

i. Cost per Kilogram of each test diet.
ii. Cost per Kilogram of weight gain by the production of each bird
iii. Cost of feeding birds on their respective test diet throughout the period of experiment.
iv. Cost of feed /gain (₦/gain)

3.0 RESULTS AND DISCUSSION

3.1 Proximate Composition of Experimental Diets and Test Ingredients

The result of the proximate composition of the experimental diets is presented on Table 3. The results showed 93.63 - 96.30 range of percent dry matter content, 23.75 - 30.0% crude protein (CP), 8.33 - 9.64% ether extract (EE), 3.73 - 13.56% ash 7.90 - 26.33% acid detergent fibre (ADF), 34.38- 41.11 nitrogen free extract (NFE) and 2909.83- 3267.51 ME (Kcal/Kg) gross energy.

Table 3: Proximate and Energy Composition of Test Ingredients and Experimental Diets

	Treatments/Diets					ARM	
Nutrients	**T1(0%)**	**T2(5%)**	**T3(10%)**	**T4(15%)**	**T5(20%)**	**Rw**	**Pr**
DM	96.32	95.94	94.47	94.91	93.63	94.14	94.67
CP	26.38	26.36	30.00	30.44	25.56	31.75	30.44
CF	8.90	8.80	9.0	9.50	9.80	12.60	11.40
EE	8.33	8.61	9.24	8.44	9.07	6.00	8.60
NFE	41.11	39.29	34.38	35.77	38.56	35.05	40.50
Ash	11.60	12.88	11.80	10.76	10.64	9.24	3.73
ADF	7.90	9.97	11.92	11.21	11.65	28.40	26.33
ME(Kcal/Kg)	3116.86	3074.41	3090.41	3086.51	3056.53	2909.83	3267.51

Key: DM = Dry Matter, CP = Crude Protein, CF = Crude Fibre, EE = Ether Extract, Ash = Ash, ADF =Acid detergent fibre,, NFE = Nitrogen free extract. ARM = Awara Residue Meal, RW = Raw Awara Residue Meal, Pr = Processed awara residue meal

The proximate composition showed that the test diet is highly nutritious. The percent crude protein obtained in this work is in line with 30.90% crude protein reported by Herman *et al.* (2004), while Vishwanathan (2011) obtained 34.7% CP. The crude fibre reported in this research was almost similar to 12.7% reported by (Farhat *et al.*, 1998), however, higher value of 31.1% CF was reported by Herma*et al.* (2004. Furthermore, the metabolizable energy of 3267.51 ME (Kcal/Kg) recorded in this experiment was in agreement with the work of Herman *et al*. (2004) who reported 3388 ME (Kcal/Kg). The implication here is that the nutrient composition of the above analysis is enough to supply the nutrient requirement of the broiler chicken without causing any adverse effect on the growth performance and low cost of production

3.2 Economics of Production of Broiler Chicken Fed Graded Levels of Awara Residue Meals.

The results of economic analysis of broiler chickens fed soya bean residue meal is presented on Table 4. Total feed intake was high in the broiler chickens fed 20% test diet, which has the highest the highest level of inclusion and that phenomenon can be attributed to the fact that birds eat to satisfy their energy requirements. Reduction in cost of feed/Kg(₦) across the treatment groups may be attributed to the lower cost of awara residue meal in the market especially when compare to the cost of soya bean which was costly and highly competitive. Furthermore, the cost savings per diet in ₦/Kg increases across the treatment as the level of inclusion of awara residue was increased. Consequently, Broiler chicken fed 5% soya bean residue meal recorded the highest feed total feed cost. In addition, the result obtained in this research agrees with the report of Ekenyen (2002), that reducing feed cost/Kg was only justifiable when production results were comparable with the standard (control). The implication here is that, there is significant reduction in cost of broiler chickens' production when awara residue was use up to 20% in formulating and compounding feeds for broiler chickens, especially when the cost of controlled diet is compare with the other treatments. Highest cost savings of ₦348.40 was recorded in broiler chickens fed 20% soya bean residue meal which was almost similar to ₦385.85 reported by (Lawan *et al*., 2022) when they fed broiler chickens soya bean residue based diet supplemented with enzymes.

Table 4: Economic Analysis of Broiler Fed Graded Levels of Awara Residue Meal (1-7weeks)

	Diets/Treatments (%)				
Parameters	**T1 (0%)**	**T2 (5%)**	**T3 (10%)**	**T4 (15%)**	**T5 (20%)**
TFI(Kg)	4.65	6.25	5.25	5.63	5.65
FC(₦/kg)	560.00	540.00	510.00	490.00	450.00
TFC(₦)	2604.00	3375.00	2677.50	2758.70	2542.50
TWG(Kg)	1.55	1.93	1.73	1.82	1.91
FC ₦/kggain	1680.00	1748.70	1547.68	1515.76	1331.15
Cost Saving((₦)	-	-68.70	132.32	164.24	348.85

KEY: TF1=Total feed Intake. FC=Feed Cost. TFC= Total Feed Cost. TWG= Total Weight gain.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

From the result obtained in this study, conclusion can be drawn that the nutrients and amino acid composition of awara residue meal are high and can replace soya bean meal successfully. Inclusion level up to 20% of awara residue meal in broiler diets supplied the protein requirements of the birds, thereby facilitating better performance, and lower cost of broiler production.

4.2 Recommendations

I. It is recommended that awara residue meals can be used in broiler production at up to 20% inclusion level.

II. Further research can be conducted on the possibility of higher inclusion level of awara residue in rearing broiler and other poultry species.

REFERENCES

Arlete, Becker-Rift, Fernanda, M. I., Vasconcelos, M and C´elia, R. C.(2004).Antinutritional and/or toxic factors in soybean (Glycine max (L) Merril) seeds: comparison of different cultivars adapted to the southern region of *Brazil. Journal of the Science of Food and Agricultur*e **84** (2): 63–270. (Online:2004) DOI: 10.1002/jsfa.1628.

Barretto, R., Buenavista, R. M., Rivera, J. L., Wang, S., Prasad, P. V., & Siliveru, K. (2021). Teff (Eragrostis tef) processing, utilization and future opportunities: a review. International Journal of Food Science and Technology, 56(7), 3125-3137.

Ekenyen, B.U. (2002). Economic viability of weaner rabbits on guinea grass supplemented with graded levels of poultry growing ration. *In proceeding of Nigerian Society for Animal production*.17-21st march, Akure, 180-181. *Farmer's Pride*', KPPA News, **11** (20):301-314

Gombe State Government Website, "Jewel in the Savannah Diary Book", (2009). www.gombestate, accessed in 2013

Herman, J.R. Honeyman, M.S, (2004). Okara: A possible high protein feedstuff for organic pig diet. Iowa State University, Animal industry Report.

Lawan L., Bawa G.S., Omage J.J., Afolayan M. (2022). Performance and cost benefit of broiler finisher chickens fed diets containing soya bean residue supplemented with Kingzyme. *Nigerian Journal of Animal Production, **49**(1),239-245*

Makkar, H. P., Tran, G., Heuzé, V., & Ankers, P. (2014). State-of-the-art on use of insects as animal feed. *Animal feed science and technology*, *197*, 1-33.

Mujyambere, V., Adomako, K., Olympio, S. O., Ntawubizi, M., Nyinawamwiza, L., Mahoro, J., & Conroy, A. (2022). Local chickens in East African region: Their production and potential. Poultry Science, 101(1), 101547.

Obianwuna, U. E., Oleforuh-Okoleh, V. U., Wang, J., Zhang, H. J., Qi, G. H., Qiu, K., & Wu, S. G. (2022). Natural products of plants and animal origin improve albumen quality of chicken eggs. Frontiers in nutrition, 9, 875270.

Pauzenga, U. (1985). Feeding Parent Stock. Zootecnica. International Pp 22-24.

Peydayesh, M., Bagnani, M., Soon, W. L., & Mezzenga, R. (2022). Turning food protein waste into sustainable technologies. Chemical Reviews, 123(5), 2112-2154.

Protein sources in broiler diets. *Journal of Agricultural Science. Mansoura Univ*., **20** (12): 7495–7506.

Rajeh, C., Saoud, I.P., Kharroubi, S. (2021). Food loss and food waste recovery as animal feed: a systematic review. *Journal of Material Cycles and Waste Management* 23, 1–17 (2021). https://doi.org/10.1007/s10163-020-01102-6

Singer, W. M., Lee, Y. C., Shea, Z., Vieira, C. C., Lee, D., Li, X., ... & Zhang, B. (2023).Soybean genetics, genomics, and breeding for improving nutritional value and reducing antinutritional traits in food and feed. *The Plant Genome*, *16*(4), e20415.

Singh, P. and Krishnaswamy, K. (2022). Sustainable zero-waste processing system for soybeans and soy by-product valorization. *Trends in Food Science & Technology*, *128*, 331-344.

Vishwanathan, K.H, Singh, V and Subramanian R (2011) Influence of particle size on protein extractability from soybean and okara. *Journal of Food Engineering*, **10** (2): 240-246.