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Full Length Research

Economic analysis of broiler chicken diet containing graded levels of sun-dried cassava *(Manihot esculenta cartz)* root meal

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ABSTRACT: An experiment was conducted at the Abubakar Tafawa Balewa University Research Farm, Bauchi, to determine the replacement value of sun-dried cassava (*Manihot esculenta cart*) root meal (SDCRM) for maize in broiler diets. Five diets were formulated in which SDCRM was incorporated in the diet to replace maize at 0%, 20%, 30%, 40%, and 50% levels designated as diet 1, 2, 3, 4, and 5, respectively. The feeds and water were supplied *ad-libitum*) to the birds and the experiment lasted for a period of seven weeks. The chicks were brooded for one week, fed with commercial super broiler starter (vital feeds) with all the routine practices followed. Two hundred and twenty-five (225) chicks were weighed and randomly allotted to five dietary treatments in five replicate lots of 9 chicks per replicate each. The routine management practices were maintained in the five experimental diets for seven weeks in a completely randomized design (CRD). Treatment 1 has the highest total feed in monetary value of ₦279.79^{a} compared to SDCRM values ₦207.83^{d}, ₦223.18^{b}, ₦215.04^{c}, ₦205.89^{e}, for diets 2(20%), 3(30%), 4(40%) and 5(50%), respectively. The gained in weight (kg) of the birds fed SDCRM significantly decreased when compared to the control diet, however, percentage cost saving increased as the inclusion levels of SDCRM increased. The cost of the diet was less for diet with SDCRM leading to an increase in the money saved from feeding the diets to birds. It can be concluded that SDCRM inclusion in the diets of broiler chickens has no or less adverse effects with concomitant reduction in the cost of feed/kg LWG.

Keyword: Broiler chicken, cassava root, cost savings, feed cost, sun-drying.

INTRODUCTION

Scarcity and fluctuation in maize prices can directly impact feed cost, profitability and willingness of poultry farmers for sustainable production. Munyaka *et al*. (2015) reported that there is need to source for other feed materials, which are cost effective in feeding livestock and such feed materials, must be readily and abundantly available in the locality (Nsa *et al*., 2016). The use of cassava as alternative to conventional energy feed stuff like maize could reduce the cost of livestock and poultry feeds (Nsa *et al*., 2016). For cassava to be able to replace maize, it must undergo processing such as cooking, sun drying, roasting, ensiling and fermentation to reduce its cyanogenic glycosides content (Anaeto and Adighibe, 2011). The low cost of cassava can reduce the total feed cost which is in line with the observation by Nsa *et al*. (2016). Cassava root meal could be used as an alternative energy source to replace the costly cereal grains (maize) which invariably reduce feed cost in poultry production (Morgan and Choct, 2016). Nsa *et al.* (2019) reported significant depression in weight gain, feed intake and feed

conversion ratio values of chickens fed diet above 25% cassava root meal with significant reduction in the feed cost. Cassava root meal beyond 25% depressed weight showing that the cassava root meal was poorly utilized by the birds (Nsa *et al*., 2019). Bakare *et al*. (2021) reported no harmful effect of using sun-dried and oven dried cassava tuber based diet for poultry production.

Cassava is a starchy root crop widely available in many regions of Nigeria. This can serve as raw material for the production of animal's feed where maize that is use as a primary energy source is too expensive. The high energy content of cassava can meet the nutritional requirement of broiler chickens but cassava contained some anti-nutritional compounds, which may be harmful if not properly processed to remove cyanogenic glycosides. Adequate processing method such as sun-drying help to improve its nutritional value that will ensure safety and optimal utilization in poultry birds. Sun-drying as a processing technique seems to offers practical and cost-effective means of processing cassava root meal which depends on natural and intensive sunlight available especially in northern part of Nigeria remain an affordable option for small-scale poultry farmers. Therefore, the objectives of the study were:

1. To reduce the anti-nutritional content of cassava root meal using sun-drying as a processing technique to improve its nutritional value and make it more suitable safe for poultry consumption.
2. To assess the cost-effectiveness of using sundried cassava root meal as alternative energy source into broiler diets.

MATERIAL AND METHODS

This experiment was conducted at Poultry Research Unit of the Department of Animal Production, Abubakar Tafawa Balewa University, Yelwa, Bauchi. The study lasted for seven weeks. The chicks were brooded for one week in a deep litter house. A commercial broiler starter mash (vital feed) was fed to the birds during the study. Electricity, lantern and burnt charcoal were used as source of heat. On the sixth day, first dose of gumboro vaccine was given. The two hundred and twenty-five arbor acres broiler's birds were thereafter weighed and randomly allotted to five dietary treatments in five replicate lots of 9 chicks each. The birds were watered and fed *ad-libitum* for 7 weeks in a completely randomized design (CRD). Other management practices such as routine vaccination, drug administration and maintenance of cleanliness in and outside the poultry house were observed.

Five experimental diets each of the starter (23% CP) and finisher (20) % CP) phases in which sun-dried cassava root replaced maize at 0, 20, 30, 40, 50% levels were formulated as shown in Tables 1 and 2. The experiment lasted for four weeks (starter phase) and three weeks (finisher phase), respectively.

Feed given was weighed in each treatment and replication and the leftover collected and weighed the next morning before another feed was given. Daily record of feed consumption for each bird in a treatment per day was obtained by dividing the total amount of feed consumption in a day by the number of live birds. Fee consumed by the birds were calculated as average daily feed intake multiply by number of days in feeding period multiply by number of broiler chicken. The birds were weighed on a weekly basis using a digital scale and the group weight were divided by the number of birds in a group. The body weight gains were the difference between the initial and the final weight. Feed cost refers to cost incurred for providing feed or nourishment to the birds, while total feed cost encompasses all cost related to feeding the birds and other additional expenses, and cost saving were determined as reported by Guluwa *et al.* (2017).

All data collected were subjected to analysis of variance (ANOVA). The significant difference between treatments means were separated using Duncan's Multiple Range test of SPSS (2012).

RESULTS AND DISCUSSION

Presented in Table 3 is economic analysis of broiler production fed diets containing graded levels of sun-dried cassava root meal based diets. There were significant ($p<0.05$) differences in economics indices of broiler chickens fed sun-dried cassava root meal based diets across dietary treatments. A decrease in final live weight of broiler chickens fed sun-dried cassava root meal in diets 2, 3, 4, and 5 that indicates slower growth of the birds may be due to digestibility issues, palatability, and the presence of some cyanogenic glucosides in the cassava root that were not removed. The result revealed that total feed intake of the bird fed diet 1 was significantly ($p<0.05$) higher than those in diets 2, 3, 4, and 5. This is in agreement with Chang'a (2020) that reported high feed intake in birds fed diets with medium cassava level. Declined in feed intake might likely be due to the presence of natural compound like cyanogenic glycosides, which was reported toxic to broiler chickens if not properly processed. This can lead to decrease in appetite and feed intake. This is in consonance with Nsa *et al*. (2019) that reported significant depression in weight gain due to reduction in feed intake. Efforts at mitigating this problem involve adequate processing through drying that remove the toxic components of cassava root for enhance palatability and improved nutritional value of the diet to support optimal health and well-being of the birds. This is in consonant with Ngiki *et al*. (2014) who reported sun-drying as the most effective method at eradicating cyanide than oven drying. The result in Table 3 showed that feed

Table 1. Ingredient and nutrient composition (%) of sun-dried cassava root meal at the starter phase (2-5weeks).

Ingredients	Diets				
	D_1 (0%)	D_2 (20%)	D_3 (30%)	D_4 (40%)	D_5 (50%)
Maize	43.73	36.58	32.01	27.44	22.86
Sun-dried cassava	0.00	9.15	13.72	18.29	22.87
Soya beans	37.07	37.07	37.07	37.07	37.07
Fish meal	4.00	4.00	4.05	5.50	7.00
Wheat offal	12.00	10.00	9.50	8.50	7.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100
Cal. Analysis					
CP (%)	23.60	22.90	22.90	23.14	23.63
ME (Kcal/kg)	3063	3016	3013	3018	3031
CF (%)	4.38	4.90	5.21	5.48	5.71
EE (%)	9.10	8.71	8.55	8.41	8.26
As h(%)	3.86	4.12	4.29	3.68	1.52
Ca (%)	1.29	1.31	1.35	1.42	1.52
P (%)	0.80	0.79	0.80	0.82	0.86

Biomix Vitamins and trace minerals premix each containing the following per 2.5kg: Vitamin A 10,000,000.00 i.u., Vitamin D_3 2,000,000.00 i.u, Vitamin E 23,000,000 mg, Vitamin K 2,000.00mg, Vitamin B_1, 1,800.00mg, Vitamin B_2 5,000.00 mg, Niacin 27,500.00mg, Pantothenic Acid 7,500.00mg Vitamin B6 3,000.00mg, Vitamin B_{12} 15.00mg, Folic Acid 750.00mg, Biotin H_2 60,000mg, Chlorine Chloride 300,000.00mg, Cobalt 200.00mg, Copper 3,000.00mg, Iodine 1,000.00mg, Iron 20,000.00 mg, Manganese 40,000.00mg, Selenium 200.00 mg, Zinc 30,000.00mg, Antioxidant 1,250.00mg.

Table 2. Ingredients and nutrients composition (%) of sun-Dried cassava root meal at the finisher phase (6-8 weeks).

Ingredients	Diets				
	D_1 (0%)	D_2 (20%)	D_3 (30%)	D_4 (40%)	D_5 (50%)
Maize	51.4	41.12	35.98	30.84	25.7
Sun-dried cassava	0.00	10.28	15.42	20.56	25.70
Soya beans	27.90	27.90	27.90	27.90	27.90
Fish meal	2.00	3.00	4.50	6.50	8.00
Wheat offal	15.00	14.00	12.50	10.50	9.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100
Cal. Analysis					
CP (%)	19.55	19.51	19.98	20.68	21.15
ME(Kcal/kg)	2936.95	2928.70	2940.17	2959.45	2970.92
CF (%)	4.14	4.83	5.10	5.33	5.61
EE (%)	7.70	7.34	7.18	7.01	6.86
Ash (%)	3.79	5.50	5.31	4.43	4.57
Ca (%)	1.33	1.41	1.51	1.64	1.74
P (%)	0.78	0.89	0.83	0.89	0.92

Biomix vitamins and trace minerals premix containing the following per 2.5kg; vitaminA8,500.00iu, D_3 1500,000,00iu vitamin E 10,000,Vitamin K_3 1,500.00 mg, Vitamin B_1 1,600.00 mg, Vitamin B_2 4,000.00 mg,Niacin 20,000.00 mg, Pantrothenic Acid 5,000.00 mg, Vitamin B_6 1,500.00 mVitaminB_{12}10.00mg,FolicAcid500.00mg, Biotin H_2 750.00 mg, Choline Chloride 176,000.00 mg, Cobalt 200.00 mg, Copper 3,000.00 mg, Iodine1,000.00 mg, Iron 20,000.00 mg, Manganese 40,000.00 mg, Selenium 200.00 mg, Zinc 30,000.00 mg, Antioxidant 1,250.00 mg.

Table 3. Economic analysis and final live weight of broiler chickens fed diets containing graded levels of sun- dried cassava root meal based diets.

Parameters	Diets					SEM
	D_1 (0%)	D_2 (20%)	D_3 (30%)	D_4 (40%)	D_5 (50%)	
Final live weight	2.48^{a}	2.17^{abc}	2.20^{ab}	1.81^{c}	1.95^{bc}	0.05
Total feed intake (kg)	5.08^{a}	4.69^{b}	4.67^{c}	4.68^{bc}	4.55^{d}	0.05
Feed cost (₦ / kg)	55.08^{a}	48.03^{b}	47.79c	47.50^{d}	45.25^{e}	0.88
Total feed cost (₦)	279.79^{a}	207.83^{d}	223.18^{b}	215.04^{c}	205.89^{e}	7.32
Total weight gain (kg)	2.12^{a}	1.70^{b}	1.70^{b}	1.65^{c}	1.70^{b}	0.05
Feed cost (₦/ kg gain)	131.98^{a}	131.66^{b}	131.28^{c}	130.33^{d}	121.11^{e}	1.10
Percentage cost savings	-	0.24^{d}	0.53^{c}	1.25^{b}	8.24^{a}	0.83

cost of the bird was significantly higher in diet 1 followed by diets 2, 3, 4, and 5. Significant reduction in feed cost was observed as inclusion levels of SDCRM based diets fed broilers chickens increased. Cost effectiveness and availability has been the reason for inclusion of sundried cassava root meal in broiler production to reduce the cost of maize. Inclusion at higher proportions contributed to reduction in feed cost. This result agreed with the findings of Omoikhoje *et al*. (2008) who reported that the inclusion of 30% level of unpeeled cassava waste meal in the diets of rabbits led to a reduction in the cost of feed, cost of feed/kg weight gain, cost of production and improvement in the profit margin.

Therefore, lowering the feed cost can be achieved by sourcing for less expensive feed ingredient like cassava root meal to optimize feed formulation. Formulating feed with cost effective ingredient like cassava root meal is a strategy for meeting the required nutrient levels of the birds.

There was no noticeable decrease in significant reduction for broiler chickens fed diet 2 and 3, however, reduction in total feed cost for broilers fed diet 4 (₦47.50^{d}) and diet 5 (₦45.25^{e}) might be attributed to cost effectiveness of SDCRM diets. Total weight gains for broilers fed SDCRM were statistically inferior to the control and similar amongst SDCRM based diets except those fed diet 4 which had low significant ($p<0.0$) value. Feed cost ₦/Kg gain had the same trend of significant ($p<0.05$) differences across treatment means.

Higher inclusion of SDCRM into broiler chickens diet can help reduce dependence on maize by providing good source of energy for birds and can be an economical substitute for maize, especially in regions where maize availability is limited and potentially lowered feed cost. This would promote a more sustainable resilient poultry production system. This is in agreement with Morgan and Choct (2016) that reported reduction in feed cost of poultry production due to efficient use of cassava product. Therefore, by incorporating sun-dried cassava root meal into chickens feed, farmers can significantly reduce feed costs, as cassava is generally cheaper and sunlight is more readily available in northern part of Nigeria. The substitution can lead to noticeable percentage cost savings, making broiler production more economical viable.

Conclusion

Reduction in feed cost of broilers fed sun-dried cassava root meal can enable farmers to have more abundant and consistent supply of feed. Increased in percentage cost saving were noticed among broiler chickens fed sun-dried cassava root meal based diets, however, this may be advantageous from a financial perspective.

Similarity in weight gain of broiler chickens fed 20%, 30%, and 50% inclusion of SDCRM may suggest reduction in feed costs. The similar weight gains of broiler chickens fed sun-dried cassava root meal based diet can encourage further research and innovation in poultry nutrition. Similar weight also revealed that sun-dried cassava root meal based diets is providing adequate nutrition for broiler chickens.

Feed cost in naira per kilogram body gain decreased with an increase in the level of SDCRM and percentage cost saving increased significantly at 50%.

Recommendation

That sun-dried cassava root meal can successfully be used as a substitute for the conventional energy food stuffs like maize in broiler rations up to 50%, provided the cassava root meal is well processed and the rations are duly balanced for all nutrients, by supplementing with fish meal and fat to improve texture and reduce dustiness as well can correct nutritional problems associated with the meal.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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