ISSN 1427-4410

National Animal Production Research Institute
Ahmadu Bello University
P.M.B 1096, Shika-Zaria,
Kaduna State, Nigeria.
Email:japr@napri.gov.ngUrl:journals.napri.gov.ng

J. Anim. Prod. Res. (2020) 32(2):25-33

EFFECT OF PROCESSING METHOD OF DIETARY KIDNEY BEAN SEEDS ON THE PROFITABILITY OF BROILER CHICKEN PRODUCTION IN NIGERIA

EFFECT OF PROCESSING METHOD OF DIETARY KIDNEY BEAN SEEDS ON THE PROFITABILITY OF BROILER CHICKEN PRODUCTION IN NIGERIA

[*1]Damang, P. J., [2]Tuleun, C. D., [2]Oluremi, O. I. A., [3]Carew, S. N. and [4]Dawang, C. N.

[1]Plateau State College of Agriculture, Garkawa
[2]Department of Animal Nutrition, University of Agriculture, Makurdi
[3]Department of Animal Production, University of Agriculture, Makurdi
[4]Department of Agricultural Economics, University of Jos
[*]Corresponding Author: pjdamang@yahoo.com +234 803 913 1936

ABSTRACT

A study was conducted to compare the profitability of broiler chicken production in Nigeria using broiler chickens fed diets containing kidney bean (Phaseolus vulgaris L.) seeds subjected to various processing methods. Sun-dried kidney beans procured from local markets were subjected to four processing methods, namely, boiling, toasting, fermenting and sprouting, to destroy the inherent anti-nutritional factors. They were ground and incorporated into the diets of broiler chickens at both starter and finisher phases. There were six dietary treatments altogether. Diet 1, the control diet, had no kidney beans. It was the conventional corn-soyabean-groundnut cake-based diet. Diet 2 had raw kidney beans. Diets 3, 4, 5, and 6 contained boiled, toasted, fermented and sprouted kidney bean seeds, respectively. The dietary levels of the kidney beans were uniform across the treatments. At the end of the finisher phase, the cost-benefit analysis of each feeding regime was made. The profitability was determined by obtaining the difference between the income and expenditure. Profitability index was also determined. The highest profitability index was 0.40 (i.e. 40 kobo per naira invested) recorded on the chickens fed the control diet. Out of the chickens fed kidney bean diets, the birds with the highest profitability index were the ones fed boiled kidney bean diet, with 0.29. They were followed by those fed fermented, toasted and raw kidney bean diets with 0.27, 0.24 and 0.18, respectively. Among the kidney bean diets, the processing method that had the highest return on naira invested was boiliung, closely followed by fermenting. Boiling and fermenting are, therefore, the recommended methods of processing kidney bean seeds for use in making feeds for broiler chickens.

Keywords: Profitability, Kidney beans, Processing methods, Broiler chickens

INTRODUCTION

The conventional protein feedstuffs for broiler chickens such as soyabeans and groundnut cake are fast becoming unaffordable to poultry farmers due to the high demand for them by the human population. This has made the search for alternative ingredients inevitable. The availability of alternative sources of nutrients will encourage a shift to the sources for which there is less competition from humans as food. One of such ingredients is the kidney beans (*Phaseolus vulgaris* L.).

Kidney bean is a leguminous crop grown in different parts of the world. Several varieties of this crop are currently cultivated in fairly large quantities in Mangu and Bokkos areas on the

Jos Plateau, Nigeria. The varieties cultivated have crude protein contents ranging from 17 to 28% (Olomu, 2011), and are worth investigating for possible use as a protein ingredient in the diets of broiler chickens.

However, like other grain legumes, the usefulness of kidney bean seeds as a feed ingredient for poultry may be limited due to the presence of some anti-nutritional factors (Kingsley, 1995). The presence of these anti-nutritional substances has been associated with growth depression and pancreatic hypertrophy in many species of monogastric animals (Birk, 1988).

It has been established that heat treatment and other processing methods exert beneficial effects on the seeds of grain legumes by destroying the anti-nutritional factors inherent in them (Balogun *et al*., 2001). Some of the anti-nutritional factors are, however, thermostable, requiring different processing methods applied individually or in combination. For instance, heat treatment was found to be less effective in detoxifying tannin, phytate and oxalate in kidney beans (Emiola *et al*., 2007). Other processing methods need to be explored in addition to heat treatment in order to reduce the anti-nutritional factors to tolerable levels in the diets of boiler chickens. However, each method of processing the kidney beans has cost implications which will add to the overall cost of broiler production, hence the need to study the profitability of broiler production as influenced by kidney bean processing methods.

OBJECTIVE

The objective of this study was to determine the effect of processing method of kidney bean seeds on the profitability of broiler chicken production in Nigeria.

MATERIALS AND METHODS

The red kidney bean variety, the most widely cultivated variety on the Jos Plateau, Nigeria, was selected for the study. It was procured and subjected to various processing methods with the aim of destroying the anti-nutritional factors. The methods of processing employed were sun-drying (raw seeds), boiling, toasting, fermenting of boiled seeds, and sprouting of the seeds.

Sun-drying (raw seeds)

The raw seeds procured from the market were sun-dried for 72 hours to minimize variations in their moisture content and ensure that they were sufficiently dried for feed production (approximately 90% dry matter). All the seeds procured were subjected to this treatment prior to the application of the other processing methods.

Boiling

Boiling of kidney bean seeds involved heating the water until it began to boil (100^{o}C) before turning the seeds into the boiling water. Care was taken at the onset to ensure that the water was sufficient to cover the seeds throughout the cooking time. The seeds were then cooked for 60 minutes. The cooking time was taken from the moment the seeds were turned into the boiling water. Thereafter, the cooked seeds were turned into a basket to drain off the water. The seeds were subsequently sun-dried for five days and then ground for use in making the feed.

Toasting

Toasting of kidney bean seeds involved sprinkling some water onto them, after which they were turned into an empty pan set on fire. The seeds were stirred continuously to ensure uniform heating, and to avoid charring. The sprinkled water was to facilitate deeper penetration of heat into the seeds. The heating continued until the seeds became crispy. They were then evacuated from the pan and sun-

dried for 3 hours, ground and used in making feed.

Fermenting

The kidney bean seeds were first of all boiled for 60 minutes as described above; thereafter, they were drained of the water, turned into a plastic jar and covered for 72 hours to ferment. The fermented seeds were then washed using clean water to remove any fungal growth and/or anti-nutritional factors that may be adhering to the surface of the seeds, and sun-dried for five days, ground and used in making the feed.

Sprouting

The kidney bean seeds were turned into a plastic jar containing enough water to cover the beans. They were left to soak for 12 hours, after which the water was drained off and the seeds were partially spread on the floor and covered with empty bags to induce sprouting. They were gently washed with clean water every 12 hours to prevent fungal growth, and then covered on the floor. This was repeated daily for 4 days (96 hr) when over 90% sprouting was observed. The seeds were then sun-dried for five days, ground and used in making feed.

The kidney beans in each processing method were used to make feeds for broiler chickens at both starter and finisher phases. The dietary inclusion levels of the kidney beans were uniform across the treatments; variations were only in the method of processing the beans. Another dietary treatment without kidney beans, but containing only the conventional protein feedstuffs (groundnut cake and soyabeans) was used as a control treatment. The diets were iso-caloric and iso-nitrogenous. Thus, there were six dietary treatments as listed below:

i. Control diet – without kidney beans
ii. Sun-dried (raw) kidney bean diet
iii. Boiled kidney bean diet
iv. Toasted kidney bean diet
v. Boiled/fermented kidney bean diet
vi. Sprouted kidney bean diet

The experimental diets for the starter and finisher phases of this study were as presented in Tables 1 and 2.

Table 1: Experimental Broiler Starter Diets containing Differently Processed Kidney Beans

	Processing Methods of Kidney Bean Seeds					
Ingredients, %	**Control**	**Raw**	**Boiled**	**Toasted**	**Fermented**	**Sprouted**
Maize	50.00	35.00	35.00	35.00	35.00	35.00
Wheat offal	0.30	0.30	0.30	0.30	0.30	0.30
Kidney bean seeds	0.00	20.00	20.00	20.00	20.00	20.00
Groundnut cake	29.30	21.70	21.70	21.70	21.70	21.70
Full-fat soyabeans	15.00	15.00	15.00	15.00	15.00	15.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	0.45	0.45	0.45	0.45	0.45	0.45
Palm oil	1.00	3.60	3.60	3.60	3.60	3.60
Common salt	0.25	0.25	0.25	0.25	0.25	0.25
Vit-mineral premix*	0.30	0.30	0.30	0.30	0.30	0.30
L-Lysine	0.15	0.15	0.15	0.15	0.15	0.15
DL-Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Chemical Analysis						
Crude Protein, %	23.09	23.09	23.08	23.07	23.10	23.10
ME, Kcal/kg	3006	3010	3011	3009	3012	3010
Energy to protein ratio	130.19	130.36	130.46	130.43	130.39	130.30
Ether extract, %	7.26	9.09	10.06	10.10	9.90	9.95
Crude fibre, %	3.69	4.50	4.20	4.30	3.75	4.15
Calcium, %	1.04	1.06	1.04	1.05	1.07	1.04
Avail. Phosphorus, %	0.52	0.53	0.51	0.52	0.53	0.51
Ca:P ratio	2.00	2.00	2.04	2.02	2.02	2.04
L-Lysine, %	1.08	1.15	1.18	1.16	1.19	1.14
Met+Cys, %	0.90	0.88	0.91	0.89	0.96	0.87
Cost, ₦/kg	**75.05**	**76.45**	**90.65**	**87.45**	**95.75**	**89.55**

*Biomix® Broiler Premix supplied the following per kilogramme of diet:

Vitamin A, 12000 i.u.; Vitamin D_3, 2400 i.u.; Vitamin E, 27.6mg; Vitamin K_3, 2.4mg; Vitamin B_1, 2.16mg; Vitamin B_2, 6.0mg; Vitamin B_6, 3.6mg; Vitamin B_{12}, 0.018mg; Niacin, 33mg; Pantothenic acid, 9.0mg; Biotin, 0.072mg; Folic acid, 0.9mg; Choline chloride, 360mg; Cobalt, 0.24mg; Copper, 3.60mg; Iodine, 1.20mg; Iron, 24.0mg; Manganese, 48.0mg; Selenium, 0.24mg; Zinc, 36.0mg; Anti-oxidant, 1.50mg.

Table 2: Experimental Broiler Finisher Diets containing Differently Processed Kidney Bean Seeds

	Processing Methods of Kidney Bean Seeds					
Ingredients, %	**Control**	**Raw**	**Boiled**	**Toasted**	**Fermented**	**Sprouted**
Maize	54.55	39.55	39.55	39.55	39.55	39.55
Wheat offal	6.00	6.00	6.00	6.00	6.00	6.00
Kidney bean seeds	0.00	20.00	20.00	20.00	20.00	20.00
Groundnut cake	20.00	12.50	12.50	12.50	12.50	12.50
Full-fat soyabeans	15.00	15.00	15.00	15.00	15.00	15.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	0.45	0.45	0.45	0.45	0.45	0.45
Palm oil	0.00	2.50	2.50	2.50	2.50	2.50
Common salt	0.30	0.30	0.30	0.30	0.30	0.30
Vit-mineral premix*	0.30	0.30	0.30	0.30	0.30	0.30
L-Lysine	0.15	0.15	0.15	0.15	0.15	0.15
DL-Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Chemical Analysis						
Crude Protein, %	20.13	20.16	20.18	20.17	20.19	20.16
ME, Kcal/kg	3021	3022	3020	3019	3017	3019
Energy to protein ratio	150.07	149.90	149.65	149.68	149.43	149.75
Ether extract, %	6.07	8.78	8.79	9.10	9.13	8.89
Crude fibre, %	3.76	4.52	4.55	4.90	4.15	4.65
Calcium, %	1.23	1.22	1.23	1.25	1.27	1.24
Avail. Phosphorus, %	0.51	0.52	0.50	0.52	0.53	0.51
Ca:P ratio	2.41	2.35	2.46	2.40	2.40	2.43
L-Lysine, %	1.08	1.15	1.18	1.16	1.19	1.14
Met+Cys, %	0.97	1.03	1.04	1.02	1.06	1.04
Cost, ₦/kg	**69.76**	**71.13**	**85.33**	**82.13**	**90.43**	**84.43**

*Biomix® Broiler Premix supplied the following per kilogramme of diet:

Vitamin A, 12000 i.u.; Vitamin D_3, 2400 i.u.; Vitamin E, 27.6mg; Vitamin K_3, 2.4mg; Vitamin B_1, 2.16mg; Vitamin B_2, 6.0mg; Vitamin B_6, 3.6mg; Vitamin B_{12}, 0.018mg; Niacin, 33mg; Pantothenic acid, 9.0mg; Biotin, 0.072mg; Folic acid, 0.9mg; Choline chloride, 360mg; Cobalt, 0.24mg; Copper, 3.60mg; Iodine, 1.20mg; Iron, 24.0mg; Manganese, 48.0mg; Selenium, 0.24mg; Zinc, 36.0mg; Anti-oxidant, 1.50mg.

Table 3: Costs of different methods of processing dietary kidney beans (per 100kg)

Processing Method	Materials Used	Unit Cost	Total Cost
Boiling	Water (550 litres)	₦0.55 per litre	₦300.00
	Hiring of half drum for 1 day	₦300.00	₦300.00
	Firewood (6 bundles)	₦250.00 per bundle	₦1,500.00
	Labour to boil the beans	₦500.00 per man-hour	₦2,000.00
	Labour to dry the beans for 5 days	₦200.00 per day	₦1,000.00
	Grinding	₦15.00 per kg	₦1,500.00
	Cost	**₦66.00 per kg**	**₦6,600.00**
Toasting	Hiring of 2 toasting pans for 1 day	₦500.00 per pan	₦1,000.00
	Firewood (4 bundles)	₦250.00 per bundle	₦1,000.00
	Labour to toast the beans	₦500.00 per man-hour	₦1,500.00
	Labour to dry the toasted beans	₦200.00 for 3 hours	₦200.00
	Grinding	₦15.00 per kg	₦1,500.00
	Cost	**₦52.00 per kg**	**₦5,200.00**
Fermenting	Boiling 100 kg kidney beans	₦41.00 per kg	₦4,100.00
	Hiring 2 plastic jars for 3 days	₦300.00 per day	₦900.00
	Water (6 jerry cans) to wash the fermented beans	₦25.00 per jerry can	₦150.00
	Labour to wash the fermented beans	₦500.00 per day	₦500.00
	Labour to dry the beans for 5 days	₦200.00 per day	₦1,000.00
	Grinding	N15.00 per kg	N1,500.00
	Cost	**₦8150 per kg**	**₦8,150.00**
Sprouting	Hiring 2 plastic jars for 1 day	₦300.00 per day	₦300.00
	Hiring 2 basins for 4 days	₦200.00 per day	₦800.00
	Water (6 jerry cans per day for 4 days)	₦150.00 per day	₦600.00
	Labour to wash the beans for 4 days	₦500.00 per day	₦2,000.00
	Labour to dry the beans for 5 days	₦200.00 per day	₦1,000.00
	Grinding	₦15.00 per kg	₦1,500.00
	Cost	**₦62.00 per kg**	**₦6,200.00**

Determination of profitability

The cost components in this study included fixed and variable costs. The fixed cost factors were cost of housing and of equipment such as feeders, drinkers lighting and heating equipment and cost of day-old chicks. The variable cost factors included cost of feeds and water, drugs and vaccines, fuels for lighting and heating especially during brooding, cost of labour, transportation and cost of processing the experimental material – the kidney beans, which were subjected to various methods of processing. Out of all the production cost factors, only the cost of processing the dietary

kidney beans varied from one treatment to another. All the other cost factors were common to all treatments in the study. For instance, the cost of heating and lighting was common to all treatments since the same amount of heat and light were provided to all. Therefore the focus of this analysis was on the variations in the cost of processing the kidney beans used in each dietary treatment. The detailed costs of the different processing methods of the dietary kidney beans were as presented in Table 3.

The selling price of the birds was estimated at ₦800.00 per kilogramme dressed weight based on the price of dressed broiler chickens in Nigeria at the time of the study. The dressed weights were determined based on the final live weights of the birds at the end of the finisher phase and the dressing percentages obtained during the carcass analyses.

The profitability was determined by obtaining the difference between the income and expenditure. The profitability index was determined by dividing this difference by the expenditure according the procedure described by Olukosi and Erhabor (1988).

$$\text{Profitability index} = \frac{\text{Income} - \text{Expenditure}}{\text{Expenditure}}$$

The profitability index shows the net return on every ₦1.00 invested.

RESULTS

The cost-benefit analysis of the chickens fed diets containing kidney beans processed using various methods is as presented in Table 4. The production costs other than cost of feeding were similar for all dietary treatments. With respect to the cost of feed consumed per bird, the chickens fed fermented kidney bean diet had a higher value (₦589.05) than those fed boiled kidney bean diet (₦580.31). The birds fed boiled kidney bean diet had a higher cost of feed consumed than those fed toasted kidney bean diet (₦538.80), which in turn, had a higher value than those fed sprouted kidney bean diet (₦501.41). The birds fed boiled, toasted, fermented and sprouted kidney bean diets had a higher feed cost than those fed the control diet (₦451.55). The chickens with the least cost of feed consumed were those fed raw kidney bean diet (₦443.17). The highest profitability index, 0.40 (i.e. 40 kobo per naira invested), was recorded on the chickens fed the control diet. Out of the chickens fed kidney bean diets, the birds with the highest profitability index were the ones fed boiled kidney bean diet (0.29). They were closely followed by those fed fermented and toasted kidney bean diets (0.27 and 0.24, respectively). The birds with the least profitability index were those fed sprouted kidney bean diet with 0.17, even lower than those fed the raw kidney bean diet (0.18).

Table 4: Cost-benefit analysis of broiler chicken production using diets containing differently processed kidney beans

Parameters	Kidney Bean Processing Methods					
	Control	**Raw**	**Boiled**	**Toasted**	**Fermented**	**Sprouted**
Feed intake/bird (g)	5718.00	5534.25	6134.05	5849.05	5908.80	5366.05
Live weight/bird (g)	2611.50	2275.50	2638.50	2520.00	2638.25	2305.75
Dressed weight (g)	1930.00	1610.00	1980.00	1850.00	1960.00	1680.00
Feed cost/bird (₦)	451.55	443.17	580.31	538.80	589.05	501.41
Other costs/bird (₦)	650.00	650.00	650.00	650.00	650.00	650.00
Total cost/bird (₦)	1101.55	1093.35	1230.54	1188.80	1239.05	1151.41
Price/bird (₦)	1544.00	1288.00	1584.00	1480.00	1568.00	1344.00
Profitability index	0.40	0.18	0.29	0.24	0.27	0.17

DISCUSSION

The result of this study showed that the cost of feeds consumed by the birds fed boiled kidney bean diet was higher than for those fed toasted, fermented, sprouted, and raw kidney bean diets. This is expected since the birds in this treatment had a higher feed intake (6134.05) than those fed the fermented, toasted, sprouted, and raw kidney bean diets (5908.80g, 5849.05g, 5366.05g and 5534.25g, respectively). This relatively high feed intake (and hence cost of feed consumed) of the birds fed boiled kidney bean diet indicates that boiling kidney beans may have improved the palatability of the feed. The birds fed fermented kidney bean diet had a higher feed cost (₦589.05) than those fed boiled kidney bean diet (₦580.31) even though the latter had a higher feed intake. This is because of the additional cost of fermenting the kidney beans, which was first boiled before it was fermented. The birds fed boiled kidney bean diet had a higher cost of feed consumed than those fed toasted, sprouted and raw kidney bean diet (538.80, 501.41 and 443.17) in that order of decreasing magnitude. This is mainly due to differences in their respective feed intake values and in the cost of processing their component kidney beans. The birds fed raw kidney bean diet had the least feed cost of all the treatments. This was followed by those fed the control diet (₦451.55).

The relatively high feed intake of the birds fed boiled kidney bean diet translated into higher mean live weight (2638.50g) and dressed weight (1980.00g) than the values for the birds in all other treatments. The dressed weight of the chickens fed boiled and fermented kidney bean diets (1980.00g, and 1960.00g, respectively) were higher than the value for those fed the control diet (1930.00). Consequently, the selling price of the dressed chickens fed boiled and fermented kidney bean diets (₦1584.00 and ₦1568.00, respectively) were higher than for those fed the control diet (₦1544.00). The lower cost of feed consumed by the birds fed the control diet and their relatively high selling price resulted in the birds in this treatment having the highest profitability index (0.40). The relatively higher

dressed weight and selling price of the birds fed boiled kidney bean diet, however, did not result in higher profitability index than those fed the control diet. Rather they had lower profitability indices. This is is due to the absence of kidney beans and its processing cost in the control treatment. The profitability index of the birds fed boiled kidney bean diet (0.29) was higher than the values for those fed toasted, fermented, sprouted and raw kidney bean diets (0.24, 0.27, 0.17 and 0.18, respectively).

CONCLUSION

Boiling and fermentation were profitable methods of processing kidney bean seeds for use in making feeds for broiler chickens. This relatively high profitability of birds from these kidney bean processing methods was mainly due to their significantly high weight gains and relatively low feed to gain ratios at both starter and finisher phases of this study. Boiling or toasting is recommended in processing kidney beans for inclusion in the diets of broiler chickens.

REFERENCES

Balogun, T. F., Kaankuka, F. G. and Bawa, G. S. (2001). Effects of Boiling Full-fat Soyabeans on its Amino Acid Profile and on Performance of Pigs. *Nig. J. Ani. Prod*. 28(1): 45 – 51.

Birk, Y. (1988). Protein Protease Inhibitors of Plant Origin and their Significance in Nutrition. In: J. Hiusman, T. F. B. Poel and I. E. Liener (eds). Recent Advances in Research in Anti-nutritional Factors in Legume Seeds. Nov. 23-25. Wageningen, Netherlands.

Emiola, I. A., Ologhobo, A. D. and R. M. Gous, R. M. (2007). Performance and Histological Responses of Internal Organs of Broiler Chickens Fed Raw, Dehulled, and Aqueous and Dry-Heated Kidney Bean Meals. Poult. Sci. June 2007 86(6): 1234-1240 http://ps.fass.org/content/86/6/1234.full

Kingsley, M. O. (1995). Effects of Processing some Anti-nutritive and Toxic Aomponents on the Nutritional Composition of African Oil Bean Seeds (*Pentaclethra macrophylla* Benth). *J. Sci. of Food and Agriculture*. 68: 153 – 158.

Olomu, J. M. (2011). Monogastric Animal Nutrition. Principles and Practice. 2nd Ed. St Jackson Publishing, Benin City, Nigeria. P. 217.

Olukosi, J. O. and Erhabor, P. O. (1988). Introduction to Farm Management Economics: Principles and Applications. Agitab Publishers, Zaria, Nigeria.