

Performance, nutrient digestibility and cost evaluation of raw and roasted *Afzelia africana* seed meal fed finisher broiler chicks.

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Abstract

Ninety-nine, 28 day-old broilers were used to investigate the effect of raw and roasted *Afzelia Africana* seed meal (AASM) on performance, apparent nutrient digestibility and nitrogen retention and cost of broiler production under deep litter system of management for 35 days in the finisher phase. The birds were allotted to three treatments with 33 birds. Each treatment was replicated three times (11 birds per replicate). The data collected were feed intake and body weight gain. Protein efficiency ratio (PER), feed conversion ratio (FCR) and apparent nutrient digestibility were also calculated. The results obtained revealed that chicks fed control (A) diet were significantly ($P < 0.05$) higher in weight gain and feed intake than others. Superior ($P < 0.05$) feed conversion ratio (FCR), protein efficiency ratio (PER), daily feed cost and feed cost per kg weight gain were obtained in roasted dehulled AASM (C) diet when compared to the control and raw AASM diets. The apparent nutrient digestibility of dry matter, crude protein, crude fibre, ash, nitrogen free extract and nitrogen retention of roasted diet compared favourably with that of the control diet. The raw AASM (B) diet depressed performance and nutrient retention values. The cost per kg diet and cost per live weight gain reduced significantly ($P < 0.05$) in AASM based diets when compared to the control diet. However, the control diet significantly ($P < 0.05$) increased the revenue generated and gross profit when compared to AASM based diets. Based on the results of this study, it is recommended that higher levels of roasted AASM may have some benefits.

Keywords: Performance, Nutrient utilization, *Afzelia africana* seeds, cost evaluation, broiler finisher.

Introduction

In recent years, there has been increased interest in the utilization of processed soybean and groundnut cake (GNC) as a source of protein supplement for poultry feeding. These ingredients are however not sufficiently available to rely on its use alone as plant protein ingredients in poultry feeds. This limitation coupled with the high costs poses the challenge to search for alternative cheaper and rich plant protein sources

to reduce the dwindling poultry industry in the nation resulting from feed shortage.

The search for alternative protein sources of feed ingredients as a partial or complete substitute to soybean and GNC, a conventional costly ingredient in poultry rations has been long and still on-going. This search has attracted a closer look at lesser-known wild legumes. Other unconventional plant protein sources that had

been used at various times include pigeon pea (*Cajanus cajan*) (Amaefule and Obioha, 2001), *Proposis africana*, locust bean (*Parkia biglobosa*) and *Acacia sp* (NAS, 1979), *Lablab sp.* (Okeke 2000).

Afzelia Africana seed (AAS) belongs to the family of leguminosae and sub-family caesalpinocae. It is a perennial tree that thrives along the savannah and drier parts of the forest region (Keay *et al.*, 1964).

The tree grows to a height of 34m in the savannah and 13m in dry situations, with a girth of up to 3m. When matured and dried, their pods dehiscent by an explosive mechanism to expose the seeds from November to February. *A. africana* is a quick growing leguminous tree and it is adaptable to a wide variety of soils (Keay *et al.* 1964). The AAS have been reported (Keay *et al.*, 1964) as a good source of protein for human and animal nutrition. The foliage is looped for fodder and also makes good manure. The use of AAS as a protein source in animal feed is not widely reported in literature. The scarcity and high cost of the conventional protein sources (GNC, SBM) necessitate the need for conducting a research in this relatively unknown AAS. However AAS seeds like other grain legumes contain anti-nutritional factors (Ezeagu *et al.*, 1994; Madubuike *et al.*, 1994; Ajah and Madubuike, 1997; Oduguwa *et al.* 1999; Oboh and Ekperigin, 2003) such as trypsin inhibitors, tannin, lectin, phytate, oxalate, alkaloid and cyanogens which tend to limit their use as feed sources. Liener (1989) reported effect of some of these anti nutritional factors (ANF) to poultry as follows: tannins interferes with protein and starch digestibility; lectins depressed growth and impose death; trypsin inhibitors depressed growth, pancreatic hypotrophy and interferes with protein digestion; phytate interferes with minerals availability; alkaloids reduce palatability

and depressed growth and cyanogens affect respiratory organs. A variety of processing procedures such as soaking, cooking, heating and sprouting of grain legumes have been employed to eliminate the negative effect of ANF present in tropical raw legumes and other vegetable protein sources (Liener, 1990; Apata and Ologhobo, 1997). To avert this problem, heating (roasting) of AAS was employed to eliminate the ANF. The objectives of this study therefore were to investigate the performance, nutrient digestibility and the cost effective of feeding processed AAS to broiler-finisher chicks.

Materials and Methods

Experimental site

This study was carried out in the poultry unit of the Federal University of Technology, Minna, Niger State from September – November, 2005
Source and processing of Afzelia africana seed meal

The *Afzelia africana* seed meal (AASM) used for the experiment were obtained from Federal College of Wildlife Management reserve estate, New Bussa, Niger State during the dry season months of December- March when the pods split open mechanically.

The seeds were washed and dried to remove residual soil. A portion of the seeds was processed by roasting in a fry pan using local open fire method applied to roasting of groundnut to remove the anti-nutritional factor (ANF). The roasted seeds were ascertained ready when the white endosperm turn crispy brown as in roasted groundnut. Burning was avoided so as not to destroy some essential amino acids.

The roasted seeds were separated from the sand; lightly pounded with a pestle and mortar and winnowed to remove the chaffs (seed coat). The decorticated seeds were ground in hammer mill and this form roasted dehulled *Afzelia africana*

seed meal (RDAASM). A portion of seed was ground raw and referred to as Raw *Afzelia africana* seed meal (RAASM). The control diet (0%) contained no AASM.

Experiment diets

Three iso-proteinous and iso-caloric finisher diets were formulated such that control diet (A) contained groundnut cake as protein source while diets B and C contained RAASM and RDSAASM respectively, which partially replaced the GNC (Table 2).

Management of the experimental birds

Ninety-nine, 4-weeks-old Arbor acre broiler finishers were raised for this study. The birds were randomly allotted to three dietary treatments of 33 birds each with three replicates of 11 birds each in a completely randomized design (CRD). All routine management and medication were carried out. Feed and clean water were provided *ad libitum* while the amount of feed given and the left over were recorded on a daily basis. The experimental birds were weighed initially and weekly thereafter until they were 9 weeks old when the experiment was terminated. Weekly feed intake and weight gain were recorded from which feed conversion ratio (FCR) and protein efficiency ratio (PER) were calculated. Daily records of mortality were recorded and expressed as percentage at the termination of the experiment.

Digestibility trial

At the end of the experimental trial two birds per replicate from each treatment (18 birds) were taken and placed in metabolic cages with facilities for feeding, water supply and collection of droppings. The birds were allowed five days to adjust to the environment before weighed quantity of feed given. Droppings was collected for five days. The droppings were wrapped in

aluminium foil and oven dried at 60°C for twenty four (24) hours. The droppings were bulked, ground and samples were taken for proximate analysis. The procedure of Vogtmann *et al.* (1975) was used in calculating the digestibility for fat, crude protein, crude fibre, Ash and NFE.

Apparent digestibility coefficient

$$= \frac{\text{Nutrient in feed} - \text{Nutrient in faeces}}{\text{Nutrient in feed}} \times 100$$

Chemical Analysis

The proximate composition of the test ingredient (AASM) and experimental diets (Table 1 and 2) were determined by the method of (AOAC, 1990).

Economic of Production

Money spent on labour for collecting, milling, sun- drying and transporting AASM was recorded. The market cost of each experimental ingredient at the time of the study was used to calculate the total cost of the feed per kg diet, total cost of feed consumed per bird, Gross Profit (G.P) and Revenue (R) were calculated as described by (Faturoti and Lawal, 1986).

Statistical Analysis

Data obtained were subjected to analysis of variance (ANOVA) by methods of Steel and Torrie (1980). Significant means were separated by Duncan (1955) Multiple Range Test.

Results and Discussion

The chemical composition of both raw and roasted AASM (Table 1) shows that the RDAASM contain high dry matter (91.745%), crude protein (28.64%), ether extract (23.40%) and Nitrogen free extract (38.05%) but decreased crude fibre (3.20%) and ash (2.90%) when compared to the respective raw AASM components.

Afzelia africana seed meal on the performance of broilers

Table 1: Proximate composition of *Afzelia africana* seedmeal (% DM basis)

Fraction (%)	RAASM	RDAASM
DM	89.53	91.75
Crude protein	24.00	24.60
Crude fibre	7.06	3.20
Ether Extract	21.00	23.00
Ash	3.22	2.90
NFE	34.25	38.05

RAASM: Raw *Afzelia africana* seed meal

RDAASM: Roasted dehulled *Afzelia africana* seed meal

Table 2: Composition of the experimental finisher diets (%)

Ingredient	A(Control)	B(Raasm)	C(Rdaasm)
Maize	56.00	49.00	51.00
Wheat Offal	12.00	10.00	10.00
GNC	18.00	15.00	13.00
RAASM	-	12.00	-
RDAASM	-	-	12.00
Fish meal	4.00	4.00	4.00
Blood meal	3.00	3.00	3.00
PKC	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00
Lysine	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
*Vit/premix	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Total	100	100	100
Determined Analysis (%)			
DM	89.00	85.00	84.80
CP	21.04	21.07	21.09
CF	7.00	8.05	5.00
EE	5.00	6.88	6.60
ASH	3.71	4.50	3.54
NFE	51.74	44.51	48.05
Calculated ME	2997	3016	3023
(Kcal/kg)			

• Premix supplied the following additional micronutrients: Vitamins A:10,000iu; VitD₃,20,000iu; Vit.E,25g;Vit.K₃,2.5g; VitB₁,3g; Vit.B₂6g; Niacin,55g; CalciumPenthothenate,11.5g; Vit.B₆5;VIT.B12,0.75g; Cholinechloride, 250g;folicacid,1g; Biotin,0.05g; Mn.,46g; Fe,32g;Zn,40g; Cu,8g;Iodine,0.8g ;Co.,0.4g;Se.,0.6g., Riboflavin 5g, DL-methionine 50g, L-lysine, 120g, Spiramycin, 5g;antioxidant (HTH) 120g.

Keys:

B: RAASM: Raw *Afzelia africana* seed meal

C: RDAASM: Roasted dehulled *Afzelia africana* seed meal

The highest feed intake and body weight gain were recorded by the control diet and were significantly ($P<0.05$) different from the RAASM and TDAASM diets. The FCR and PER were better in the RDAASM when compared to the others. The daily protein intake was highest in the control diet and was significantly ($P<0.05$) different from RAASM and RDAASM (Table 3).

The cost benefit analysis of the diets is presented in Table 4. There was reduced cost per kg diet

from ₦53.00 in control diet to ₦49.60 in RAASM and ₦50.00 in RDAASM diets. The cost of feed consumed/bird reduced from ₦202.43 in diet A to ₦168.53 in diet B and ₦140 in diet C while the cost per body weight gain were ₦80.06 for diet A, ₦60.48 for B and ₦64.36 for C. The highest revenue from birds was in diet A (₦ 673.5), followed by C (₦577.25) and B (₦ 548.75) while gross profit followed similar trend as Revenue.

Table 3: Performance and cost evaluation of chicks fed experimental finisher diets .

Treatments	DIETS			
	A	B	C	SEM
Number of chicks	33	33	33	
Initial body weight (g/bird)	607.06	580.56	586.11	9.91
Final body weight (g/bird)	2104.33	1800.00	1873.33	112.64
Body weight gain (g/bird)	1497.27 ^a	1219.44 ^c	1287.22 ^b	102.52
Daily body weight gain (g/bird)	42.76 ^a	34.84 ^c	36.78 ^b	2.93
Mean Total feed intake (g/bird)	3785.12 ^a	3272.12 ^b	2792 ^c	352.23
Mean daily feed intake (g/bird)	108.15 ^a	93.49 ^b	80.00 ^c	10.00
FCR	2.53	2.70	2.18	0.19
Daily protein intake (g/bird)	22.75 ^a	19.69 ^b	16.83 ^c	2.10
PER	1.82 ^b	1.77 ^c	2.19 ^a	0.16
Mortality (%)	0	9.4	28.6	-
Cost per kg diet (₦)	53.00	49.6	50.0	1.32
Cost of feed intake/bird (₦)	202.43 ^a	168.53 ^b	140.00 ^c	22.17
Cost per kg body weight gain (₦)	80.06 ^a	60.48 ^c	64.36 ^b	7.35
Revenue (N400/kg live weight Gain/birds (₦)	673.53 ^a	548.75 ^c	577.25 ^c	46.37
Gross profit (G.P) (₦)	471.1	380.22	437.25	32.70

^{a, b, c} means on the same row with different superscripts are significantly different ($P<0.05$)

SEM: Standard error of mean

Table 4: Apparent nutrients digestibility and Nitrogen retention of finisher diets (% DM basis)

Parameters	DIETS			
	A	B	C	SEM
DM	88.53 ^a	81.39 ^b	87.67 ^a	2.76
CP	90.38 ^a	81.69 ^b	87.89 ^a	3.17
CF	85.13 ^a	73.92 ^b	89.88 ^a	4.44
EE	87.53 ^a	77.26 ^b	89.14 ^a	4.57
Ash	77.00 ^a	68.38 ^b	87.94 ^a	6.95
Nitrogen Retention	88.23 ^a	81.70 ^b	87.83 ^a	2.60

^{a, b, c} means on the same row with different superscripts are significantly different ($P<0.05$).

SEM: Standard error of mean

The results of the apparent nutrient digestibility and nitrogen retention of roasted diet compared favourably with control diet showing improvement over the raw diet (Table 4).

Discussion

The increased proximate composition values obtained in the RDAASM when compared to RAASM may probably be that roasting seemed to concentrate the nitrogenous compounds in the beans by removing most of the water molecules thus increasing the dry matter, crude protein and ether extract contents. While the decreased crude fibre and ash may be due to dehulling of the seeds which reduced the hard seed coat (testa) of the grain and inorganic contents of the seeds.

The high feed intake of birds in the control diets when compared with the RAASM and RDAASM may be due to the low metabolizable energy in the diet. The results obtained therefore supported the observations of Waldroup *et al.* (1976) and Pesti (1982) that as the level of metabolizable energy in the diet increases or decreases, feed intake changes inversely, although the rate of adjustment is not always sufficient to keep energy intake constant. GNC had been reported to contain 45-49%CP (Eyo, 2001). It could also be supported by views of A.R.C. (1975), which stated that fast growing chicks eat more food than slow growing ones of the same age. The high feed intake experienced by birds on raw diet than roasted diet could be that most raw feed pass through the alimentary system of the chicks undigested. This observation is in conformity with earlier reports by Sklan *et al.* (1975) and Rackis (1978) that ingestion of raw oil seed bean meal by chicks did not affect feed intake but caused growth inhibition. The depressed feed intake and body weight gain in AAS based diet may be due to the

effect of anti-nutritional substances in the seeds. Although the seeds were heated (roasted), it is not impossible that residual protease inhibitors may still be present in the roasted diet.

Afzelra Africana seeds (AAS) is known to contain some trypsin and chymotrysin inhibitors, lectins, haemagglutinins, saponins (Madubuike *et al.*, 1994), alkaloid and other anti-nutritional factors (Obob and Ekperigin, 2003). These interfere with the biological utilization of the protein and to a lesser extent of available carbohydrate and lipids (Mosley and Griffiths, 1979).

The superior ($P < 0.05$) FCR and PER exhibited by RDAASM diet may therefore proved that birds on this group optimally utilized the feed protein consumed to maximize production in relation to diets A and B. The FCR and PER are parameters that suggest the extent of utilization of diets (Maynard *et al.*, 1979). The poor FCR and PER of raw diet could be that the fibre content of raw diet was beyond a tolerable level, which is put at 5-6.5% for broilers (Njike and Ndife, 1980).

The mortality of birds fed AASM based diets may probably be due to the cumulative effect of the anti-nutritional factors (ANF). The post mortem (PM) examination revealed that the lungs appeared dark in colour, the heart and the liver were inflated and congested suggesting toxicity. This could be an indication that the heat applied was not appropriate to eliminate the ANFs in the RDAASM. These findings agreed with reports of Udedibie *et al.* (1994) and Esonu *et al.* (1997) that most legumes have thermo-labile and thermo stable (tannin and phytate) which needed more than one treatment application. The reason for the high mortality in RDAASM compared to RAAS is not clear. However, it is not impossible that the RDAASM could still retain some residue

toxic substances which were inactivated during the heat process.

The improved apparent nutrient digestibility of dry matter, crude protein, crude fibre, ether extract, ash and nitrogen retention (NR) observed in roasted diet may be due to roasted (decorticated) seeds which improved the digestibility of the protein, lowered the tannin content and reduced the crude fibre and calcium content of the seeds (Salunkhe *et al.* 1985). The poor apparent nutrient digestibility and nitrogen retention of diet B could be due to high crude fibre content in diet and residual protein inhibitors especially the tannins that reside in the seed coat. Tannins have been known to interfere with protein and starch digestion (Liener, 1989).

The lower cost per kg of diet observed by birds on RAASM and RDAASM may be due to their local accessibility without high demand. The high cost of feed intake per bird experienced in control diet is in agreement with report (Bogart and Taylor, 1983) that high daily feed intake implies high cost of production. The low cost per live weight gain of RAASM diet could be due to the low feed intake compared with the control and RDAASM. The revenue generated from this study followed similar trend to cost per kg body weight gain. The better gross profit experienced in control diet may probably be due to high growth rate of birds than raw and roasted diets.

Conclusion

The feeding trial shows that broilers fed the control diet were significantly ($p < 0.05$) better in weight gain and feed intake compared to the AASM based diet. The FCR and PER were better in RDAASM compared with the control and RAASM diet. The nutrient digestibility trial of

the control and RDAASM were similar and differs significantly ($p < 0.05$) from the RAASM diet. The cost to benefits such as the revenue generated and gross profit favoured the control diet but considering the FCR and PER which are factors considered when making statement of production and derivable gross margin, RDAASM is favoured. In conclusion, therefore, I recommend that higher levels of RDAASM may have some economic benefits.

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