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Performance, Digestibility and Carcass and Organ Weights of Finisher Broiler Chicks Fed Graded Levels of Fermented Locust Bean (*Parkia biglobosa*) Seed Meal

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Abstract: One hundred day-old Anak broiler chicks were used to evaluate the optimum inclusion levels of Fermented *Parkia Biglobosa* Seed Meal (FPSM) based diets on Body Weight Gain (BWG), feed intake, Feed Conversion Ration (FCR), Protein Efficiency Ratio (PER), Apparent Digestibility Coefficient (ADC), carcass and organs weight and cost/ benefits of finisher broilers. The birds were randomly allotted to five dietary treatments of 20 birds each, replicated two times per treatment with 10 birds each in a Completely Randomized Design (CRD). Each treatment contained 0, 25, 50, 75 and 100% FPSM replacement for groundnut cake. Results showed that the Body Weight Gain (BWG) was significantly ($p<0.05$) improved with FPSM inclusion levels in the diet. The BWG was significantly ($p<0.05$) higher at 100% FPSM when compared with the control and others diet. The feed intake was reduced at 75% FPSM and highest at 0% FPSM (control) diet. The FCR and PER were better at 100% FPSM dietary inclusion with values of 1.59 and 2.93, respectively. The ADC of crude protein, crude fibre and ether extract were similar ($p>0.05$) at 0, 25, 50, 75 and 100% FPSM but significant ($p<0.05$) differences existed among 0, 25 and 50, 75, 100% FPSM dietary inclusion levels. The ash digestibility was highest at 50% FPSM inclusion level and least in control diet but not significantly affected ($p>0.05$). Carcass and organs weight (liver and gizzard) significantly ($p<0.05$) increased with increased FPSM dietary inclusion levels while the organ weights (Lungs, spleen, heart and kidney) where similar ($p>0.05$) among the dietary treatment groups. The abdominal fat deposit was highest at 50% diet and least from the 0% (control) diet. The cost/benefits of production was significantly ($p<0.05$) save with FPSM dietary inclusion levels in order of 100, 75, 50, 25, 0%, respectively. It was concluded that FPSM could replace GNC up to 100% with reduce cost and without adverse effect on growth performance, digestibility and organs weight.

Key words: Performance, digestibility, organs weight, fermentation, *Parkia biglobosa*, broiler chickens

INTRODUCTION

The cost of poultry feed has been recognized as the major factor affecting the development and expansion of poultry enterprise in African countries (Eckman, 1995). The feed ingredients that are rarely available for human consumption (groundnut cake (GNC) and Soybean) are also being competed for by the livestock sector. This situation has resulted to drastic decline in livestock production with a resultant short fall in protein intake of the people in the less developing countries (Daniel, 1992; Job, 1992). The high cost, scarcity and insufficient supply of conventional plant protein ingredients (GNC and Soybean) have necessitated the need for a search for alternative source of protein for the poultry industry (Daniel, 1992). The search for the least-cost formulation is currently exploring the replacement of these expensive feed raw materials with cheaper alternatives in the formulation of poultry ration. Atteh *et al*. (1995) suggested that the alternative plant protein should have comparative nutritive value to or preferably be cheaper than the conventional protein sources. The use of *Parkia biglobosa* seed will reduce the cost of broiler production (Alabi *et al*., 2005). Fermented *Parkia biglobosa* is popularly known as Daddawa in Hausa and Iru in Yoruba, a soup condiment in African (Campbell-Platt, 1980). It has been reported that the husks and pods are good for livestock (Obiozoba, 1998). Earlier investigation have mentioned the food and nutritive value of *P. biglobosa* and other species of seeds (Odunfa, 1983; Alabi, 1993; Omafuvbe *et al*., 2002; Bridget *et al*., 2004). However, *P. biglobosa* seed has been reported to contained anti-nutritional factors (Mohan and Janardhaman, 1995; Alabi *et al*., 2005) such as oxalate, hydrogen cynide, tannins and phytate. Processing by application of heat, fermentation, cooking, sprouting and enzymatic addition has been reported (Liener, 1989; Alabi *et al*., 2005) to reduce or eliminate anti-nutritional factors in grain legumes.

There is dearth of information on the carcass and organs weight of broilers fed fermented *P. biglobosa* seed. Hence, this study was aimed at evaluating the optimum inclusion level of fermented *P. biglobosa* seed as a protein source in diets for broiler chickens and effect on performance, nutrient utilization and digestibility, carcass yield and organs weight.

MATERIALS AND METHODS

The experiment was conducted in the poultry unit of Federal college of Wildlife Management, New Bussa, Niger State, Nigeria from the months of August to October, 2006.

Source and Preparation of Test Ingredients

The seeds were sourced from the college-reserve estate. The *P. biglobosa* seeds were cooked over night (12 h) with large pots in open firewood to softened the seed coats. The seeds were lightly pounded with pestle and mortar to separate the seed coats from the seeds. The decorticated seeds were wrapped in a polyethylene bag, placed inside a basket and kept in a tight enclosure under roof for 5 days for microbial degradation. After 5 days, the fermented seeds were removed, sun-dried for 4 days and then ground to form fermented *P. biglobosa* seed meal (FPSM).

Experimental Diets

Five experimental diets were formulated such that diet 1 (0% control) had no FPSM but 100% Groundnut Cake (GNC) while diets 2, 3, 4 and 5 contained 25, 50, 75 and 100% FPSM. The experimental diets were maintained from day-old to 56 days of study (Table 1).

The increased palm kernel cake in the FPSM based diet is to ensure that the same protein content (%) was supplied in all the diets since GNC and FPSM have disparity in their crude protein contents, hence direct replacement of GNC with FPSM would not yield a balance crude protein and energy content of the diets. The low fat, ash and crude fibre contents of the FPSM based diet (Table 2) than the control (GNC) based diets is an indication that cooking, dehulling and fermentation of the locust bean seed caused degradation of the crude fibre, reduction in the ash (mineral) content which resides in the hulls (seed coat) and leaching of lipids in the process.

Management of the Birds

One hundred day-old Anak broiler chicks were randomly divided into five treatment groups of 20 birds, each having two replicates of 10 chicks in a Completely Randomized Design (CRD) of deep litter system of management for 56 days. Each diet was offered *ad libitum* to the birds until termination of experiment. All routine management operations applicable to broilers were strictly adhered to.

Table 1: Composition of experimental diets fed broilers

	Diets (%)				
Ingredients	1(0)	2(25)	3(50)	4(75)	5(100)
Maize	52.00	50.00	49.00	48.00	47.00
Wheat offal	10.00	11.00	10.00	10.00	9.00
GNC	23.00	17.25	11.50	5.75	-
FPSM	-	5.75	11.50	17.25	23.00
Palm kernel cake	3.00	4.00	5.00	5.00	5.00
Fish meal	4.00	4.00	4.00	4.00	4.00
Blood meal	4.00	4.00	5.00	6.00	8.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Vit/premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00

Premix to provide the following additional micronutrients: Vit. A: 10,500,000IU; VitD_3, 2,000IU; Vit. E, 20 g; Vit K_3,3 mg; Vit B_{12} 0.05 g; Nicotinamide acid: 35 mg; Pantothenate: 15 mg; Cholinechloride, 500 mg: Folicacid; 1 mg; Riboflavin: 6 mg; manganese; 55 mg; Iron: 55 mg; Zinc: 80 g; Copper: 12 mg;Iodine, 1.5 g; Cobalt: 0.3 g; Selenium: 0.15 g and Anti-oxidant: 70 mg

Table 2: Chemical composition of experimental diets (% dried matter basic)

	Diets				
Parameters	1	2	3	4	5
Dry matter	88.08	88.44	85.51	84.87	86.14
Crude protein	22.87	22.79	22.64	22.55	21.50
Crude fibre	6.26	5.12	5.35	5.41	5.48
Ether extract	7.60	7.00	6.98	7.00	6.95
Total ash	4.01	3.48	3.94	3.91	3.83
Nitrogen free extract	47.34	49.55	46.55	46.56	48.38
Metabolizable energy (Kcal kg^{-1})	2870.00	2860.00	2867.00	2862.00	2863.00

Parameters Measured

At the beginning of the experiment, the chicks were weighed as individual replicate groups. Weekly feed intake and weight gain were recorded from which FCR and PER were calculated. At the end of the 8th week, two birds per replicate were moved to the metabolic cage. A four day adjustment period followed by 4 days dropping collection. The excreta were bulked together and oven-dried at 60°C for 12 h and then ground for analysis. The apparent nutrient digestibility was calculated using Vogtman *et al*. (1975).

Carcass and Organs Weight Determination

At the end of 8 weeks, two birds per replicate were selected at random and starved for about 18 h to empty the crops. The were killed by decapitation, scalded, plucked and eviscerated. The carcass, internal organs (liver, heart, lungs, kidney, spleen and gizzards) and abdominal fats were removed and weight and expressed as a percentage of live weight.

Proximate Analysis

The experimental diets and excreta samples were analyzed for proximate composition using AOAC (1990) methods.

Economic of Production

The economical study was carried out using the input-output analysis of cost according to procedures of Sonaiya *et al*. (1986).

Data Analysis

Data generated from this study were subjected to analysis of variance (ANOVA) using graph pad instat 3.05 for window as outlined by SAS (1995) and Duncan's multiple range test (Duncan, 1955) for significant differences of means.

RESULTS

The proximate values of dry matter, crude protein and nitrogen free extract were similar across the dietary treatments, while the crude fibre, ether extract and ash content of the control diet were higher than those of FPSM based diet (25, 50, 75 and 100%) respectively (Table 1).

The final body weight and body weight gain were significantly ($p<0.05$) different among the dietary treatments except birds on diets 1 and 2 which were similar ($p>0.05$). The best weight was obtained from birds fed diet 5 while the least was diet 1 (Table 3).

The feed intakes were similar ($p>0.05$) among the diets with highest value from diet 1 and least in diet 4. The daily feed intake followed the same trend as total feed intake. Mortality occurred in treatments 1, 2, 4 and 5 and was not influenced by dietary FPSM inclusion levels. The feed conversion values were best at 100% inclusion level (1.59). The (PER) improved with higher FPSM inclusion levels with best value from diet 5 (2.93). Feed cost per kg diet, cost of feed consumed per bird, revenue generated and profit index were best with increased FPSM in diet (Table 3).

The Apparent Digestibility Coefficient (ADC) of crude protein, crude fibre and ether extract were not significantly different ($p>0.05$) among diets 3, 4 and 5. Similarly, diets 1 and 2 were the same ($p>0.05$). The highest ADC was in diet 5 for crude protein and ether extract while diet 4 had the best crude fibre digestibility. Birds on diet 1 had the least ADC values for all parameters measured (Table 4).

Table 3: Performance and cost/benefit of broilers fed experimental diets

	Diets					
Parameters	1	2	3	4	5	SEM
Mean initial body weight (g)	36.00	36.00	36.02	36.00	36.00	0.00
Mean final body weight (g)	2108.10^{d}	2108.41^{d}	2195.00^{c}	2273.00^{b}	2320.41^{a}	47.88
Mean body weight gain (g)	2072.09^{d}	2072.41^{d}	2158.98^{c}	2237.00^{b}	2284.41^{a}	47.88
Mean daily body weight gain (g bird^{-1})	37.00	37.00	38.55	40.00	41.00	0.89
Mean total feed intake (g bird^{-1})	3668.80^{a}	3649.30^{a}	3634.00^{a}	3610.84^{a}	3642.00^{a}	10.61^{a}
Mean daily feed intake (g bird^{-1})	65.51	65.17	64.89	64.48	65.00	0.19
Feed Conversion Ratio (FCR)	1.77	1.76	1.68	1.61	1.59	0.04
Protein Efficiency Ratio (PER)	2.47	2.46	2.66	2.75	2.93	0.09
No. of birds survived	18.00	19.00	20.00	19.00	19.00	-
Number of mortality	2.00	1.00	0.00	1.00	1.00	-
Cost per kg diet (N)	48.50^{a}	43.20^{a}	38.00^{b}	35.23^{b}	31.62^{c}	3.33
Cost of feed intake bird^{-1} (N)	178.00^{a}	157.65^{b}	138.09^{c}	127.21^{c}	115.16^{d}	12.47
Cost per kg body weight gain (N)	85.90^{a}	76.07^{b}	63.96^{c}	56.87^{d}	50.41^{e}	7.19
Revenue (N300 kg^{-1} live weight Gain birds^{-1} (N)	621.27^{c}	621.72^{c}	647.70^{c}	671.10^{b}	685.32^{e}	14.40
Profit index (N)	3.49	3.94	4.69	5.28	5.95^{a}	0.49

$^{a, b, c, d}$: Means on the same row with different superscripts are significantly different ($p<0.05$), Data without superscript are not significantly different ($p>0.05$)

Table 4: Apparent digestibility coefficient of experimental broiler birds fed fermented *P. biglobosa* seed meal (% DM)

	Diets					
Nutrients	1	2	3	4	5	SEM
Crude protein digestibility	72.34^{b}	78.61^{b}	85.02^{a}	88.85^{a}	89.15^{a}	3.61
Crude fibre digestibility	51.74^{b}	58.33^{b}	64.60^{a}	68.37^{a}	66.67^{a}	3.43
Ether extract digestibility	81.71^{b}	85.88^{b}	92.00^{a}	91.93^{a}	90.75^{a}	2.26
Ash digestibility	40.92	38.64	43.00	41.75	40.85	0.80

$^{a, b, c}$: Means on the same row with different superscripts are significantly different ($p<0.05$), Data without superscript are not significantly different ($p>0.05$)

Table 5: Carcass yield, organs weight and abdominal fat expressed as percentage live weights of experimental birds at 8 weeks

	Diets					
Parameters	1	2	3	4	5	SEM
Live weight (g)	2108.10^{d}	2108.41^{d}	2195.00^{c}	2273.00^{b}	2320.41^{a}	47.88
Carcass weight (%)	87.56	89.40	89.60	89.40	91.30	0.66
Liver (%)	1.77^{d}	1.85^{d}	1.98^{c}	2.21^{b}	2.30^{a}	0.11
Lungs (%)	0.61	0.63	0.65	0.67	0.69	0.02
Spleen (%)	0.18	0.19	0.21	0.21	0.23	0.01
Heart (%)	0.58	0.59	0.60	0.61	0.62	0.01
Gizzard (%)	4.50^{d}	4.51^{d}	4.62^{c}	5.15^{b}	5.70^{a}	0.26
Kidney (%)	0.53	0.56	0.59	0.61	0.63	0.02
Abdominal fat	1.59^{c}	1.61^{c}	1.95^{a}	1.82^{b}	1.86^{b}	0.08

$^{a, b, c}$: Means on the same row with different superscripts are significantly different (p<0.05), Data without superscript are nor significantly different (p>0.05)

There were significant differences (p<0.05) among dietary groups in live weight gain, carcass and organ weights (liver and gizzard) while the lungs, spleen, heart and kidney were similar (p>0.05) among the diets. Abdominal fat deposit increased with increased fat digestibility in the diets (Table 5).

DISCUSSION

The superior growth performance, nutrient utilization and digestibility of diet 5 (100% replacement) might be due to better amino acids in diets with increased FPSM inclusion levels. GNC has been reported to contained lower lysine (4.18 mg) and methionine (0.18 mg) (Eyo, 2001) when compared with FPSM with 6.79 mg of lysine and 7.42 mg of methionine (Ekop, 2006). This is evident as higher levels of FPSM replacement gave superior growth performance, FCR, PER and nutrient digestibility than at lower inclusion levels of FPSM and control diet, hence, the best protein sparing among the FPSM based diet. This observation is in agreement with earlier reports by De Silver and Anderson (1995) that betters growth performance of birds could be as a result of balance of nutrients and amino acids. Bonnet *et al*. (1997) reported that a reduction in feed digestibility might contribute to a decrease in the amount of nutrients available for growth. This may be responsible for the low performance and digestibility values of birds on diet 1 and others diet (2, 3 and 4). The superior growth performance of experimental FPSM, especially diet 5, revealed that cooking and fermentation are better methods of processing to eliminate the anti-nutritional factors in *P. biglobosa* seeds such as tannin, oxalate, phytate and hydrogen cyanide (Alabi *et al*., 2005). It could also be that unidentified growth factors are enriched during fermentation and further breakdown of crude fibre was enhanced when compared with GNC based diet (control). Enrichment of amino acids has been reported in fermented locust bean seed (Bridget *et al*., 2004; Ekop, 2006) An increase in the nutritional values of legumes through fermentation has reported by Popoola and Akueshi (1989), Matsui (1996) and Bridget *et al*. (2004) may have attributed to better nutrients utilization in terns of FCR and of birds fed diet 5.

The significant (p<0.05) increased percentage carcass and organ weights of the liver and gizzards among diets 1, 2 and 3, 4 suggests that the different dietary FPSM inclusion levels promoted the development of carcass and organs weight (liver and gizzards) while similar (p>0.05) increased in heart, lungs, spleen and kidney sizes observed among the dietary treatments corresponds to their live weight gain. The carcass and organs weight of this study agrees with reports of Braodbent *et al*. (1981) that lower carcass, dressed percentage and organs weight of broilers are resultant of their live weight, since the surface area determine the amount of feathers and visceral organs required respectively.The highest fat digestibility noticed in diet 3 (Table 4) may have transformed into higher abdominal fat deposit recorded in this treatment.

The substitution of GNC by FPSM significantly ($p<0.05$) reduced the cost of feed per kg and cost of feed consumed. It was also apparent that increasing the level of FPSM in broiler diets could be advantageous at long run in that it resulted in reduction of the cost of feed needed to gain a kilogram of weight. The Economy of Weight Gain (EWG) is used to describe the total financial cost in kobo of ingredients consumed per unit of body weight gain (Igbinosun and Roberts, 1988). Thus ingredients of minimum EWG will give rise to the most economical feed. The most economic feed is in order to diets 5, 4, 3, 2 and 1, respectively.

CONCLUSION

This study demonstrated that the FPSM could replace GNC completely (100% inclusion level) in the diets of broiler chicken without any adverse effect on performance, nutrient utilization and digestibility, carcass and organs weight with a lot of financial servings for the farmers.

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