

Response of broiler chickens to graded levels of locust beans (*Parkia biglobosa*) pulp meal

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Abstract

Two hundred and twenty five, day-old Arbour Acre broiler birds were use to investigate the effect of graded dietary levels of Parkia biglobosa pulp meal (PBPM) on the performance, haematological and carcass parameters of the birds from 0-8 weeks of age. Five isocaloric and isonitrogenous diets were formulated to contain PBPM at 0,10,20, 30 and 40 percent respectively making a total of 5 treatments. Each treatment was replicated three times with 15 birds per replicate in a completely randomized design experiment. Feed and water were supplied ad libitum. Records taken included weekly weight changes and weekly feed intake. There was no record of mortality throughout the duration of the experiment. Results obtained showed a decrease in the bird's performance as the dietary levels of the pulp increased. The final weight (g/b) and weight gain (g/b/day) decreased from 2122 and 33.91 for the control to 1309 and 20.97 for the 40% inclusion level of PBPM meal respectively However birds placed on 10% dietary level had a performance that were not significantly (P>0.05) different from those placed on the control diet which were on standard broiler starter and finisher rations. Also it was observed that values obtained for the haematological parameters fall within the range often reported for healthy birds indicating that the pulp did not impart any deleterious effect on the health of the birds. It can be concluded that broiler chickens can be fed up to 10% dietary level of PBPM without adverse effect on the performance of the birds.

Keywords: Parkia pulp, Dietary levels ,Broiler chickens, Performance

Introduction

The population of developing countries has continued to increase resulting in increased demand for protein of animal sources. Nigeria has the highest population in Africa which is about 150 million and the acute shortage of animal protein in the diet of average Nigerians requires a logical solution like increasing the production and consumption of poultry (FAO, 1997). Christopher *et al.* (1997) and Fasuyi (2005) reported that per capita consumption of animal protein has been on the decline over the past decades. This is because the livestock industry in Nigeria has never supplied the Nigerian market with adequate quantities of animal products (Abeke 2005). Available statistics indicate that Nigeria is one of the countries where the protein intake of the people ranks among the lowest. It is estimated that on the average, Nigerians consume only about 7g of animal protein on a daily basis, as against the minimum requirement of 28g/head/day recommended by FAO (Uchegbu *et al.* 2007). High cost of feed ingredients has been identified as a major hindrance to the expansion of the poultry industry in Nigeria and other developing African countries

(Fasuyi, 2005). Feed constitutes about 70-80% of the cost of producing broilers (Abeke, 2005). The growing demand for maize in the last few years for both human and livestock consumption has pushed its market price to an alarming rate that has directly affected the production cost of farm animals, particularly the non-ruminants. This has invariably escalated the market prices of livestock products out of the reach of the common man. There is therefore, an urgent need for an alternative to maize in livestock feeds to reduce the current pressure on maize as staple food for man (Uchegbu and Udedibie, 1998).

In an attempt to boost poultry production, nutritionists have tried to harness and utilise agro-industrial by-products that are not directly utilized by man. A large number of alternative feedstuffs that have potential as poultry feed ingredients abound in Nigeria (Ologhobo, 1992). Adeniyi and Balogun (2002) stated that research into the use of cheaper industrial by-products and wastes have been intensified in the last few years to determine the efficiency of their utilization in terms of growth and production. According to Fadipe (1996) the search for cheaper sources of feed ingredients for livestock feeding in Nigeria and many developing countries will continue, as long as the protein requirement in human diet has not been met. One alternative novel feed ingredient that is receiving attention is the African locust bean (*Parkia biglobosa)* pulp. This study was therefore designed to evaluate the nutritive value of *Parkia biglobosa* pulp in broiler diets.

Table: 1. Proximate and Nutritional composition of Parkia pulp

Nutrient	Composition
Dry matter (%)	98.04
Crude protein (%)	11.52
Crude fibre (%)	12.49
Ether extracts (%)	3.09
Ash (%)	4.08
NFE	68.32
Reducing sugar(mg/100g)	4.56
Ascorbic acid (mg/100g)	24.22
Total starch (mg/100g)	5.84

Each value is a product of three determinations. NFE = Nitrogen Free Extract

Table 2. Some anti-nutritional factors present in Parkia pulp

Parameter	-	Composition
Oxalate mg/100g	-	150.00
Phytic acid mg/100g	-	219.10
Tannins mg/100g	-	3.23

Each value is a product of three determinations.

Materials and Methods.

Location of the study

The study was conducted at the Large Animals' Experimental Station, National Veterinary Research Institute (NVRI) Vom, Nigeria. Vom is in the Plateau Savannah zone of Nigeria, which has two distinct (dry and rainy) seasons. The dry season starts in October and ends in March with a temperature range of 13°C-26°C or may even be less. While the rainy season is from April-September, and the temperature also ranges from 16°C- 28°C. The geographical location of Vom is 8° 45`E, 9° 43`N and 1280mabove sea level. Mean relative humidity ranges from 14-17% (NVRI, 2006).

The Parkia pulp used for the experiments was bought from local markets in Zaria and Giwa, Kaduna state. To obtain the pulp, the pod is broken up and the pod cover and the seed are removed. They were sieved to remove impurities and milled to obtain smooth flour. The proximate analysis and the nutritional composition were carried out according to (AOAC, 1990) procedures and the determination of the anti nutritional factors (phytate, oxalate and tannins) of Parkia pulp were carried out according to the method described by Santram *et al*.(1981) and Negi (1980). Ascorbic acids, reducing sugars and starch were determined using standard laboratory procedures.

Experimental procedure

Two hundred and twenty-five day-old Arbour acre broiler chicks of a commercial strain purchased from Ajanla Farms, through Zatech Ltd branch office in Jos, were used for the study. The birds were weighed at the beginning of the experiment and randomly assigned to five dietary treatments containing 0, 10, 20, 30 and 40% graded dietary levels of Parkia pulp at the starter and finisher phases. The treatments were replicated three times with fifteen birds in each replicate and a total of forty-five birds per treatment in a completely randomised design. The chicks were brooded conventionally in a deep litter floor pen; using electric bulbs (200watts) as source of heat and light. The experimental diets are presented in Tables 3 and 4 respectively. Feed and water were supplied *ad libitum* to the birds throughout the experimental period. Routine vaccines and drugs were administered as at when due. The birds were weighed at the beginning and weekly thereafter for the duration of each phase of the study. Weighed left over feed was also subtracted from the total feed

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Each value is a product of three determinations.

Table 3: Ingredient Composition of Broiler Starter Diets .

	Graded levels of Parkia pulp (%)				
Ingredients	**0**	**10**	**20**	**30**	**40**
Maize	46.45	37.18	27.67	18.54	9.54
Parkia pulp	-	10	20	30	40
Soybean meal	35.05	34.32	33.83	32.96	31.96
Wheat offal	9.00	9.00	9.00	9.00	9.00
Fishmeal	2.50	2.50	2.50	2.50	2.50
Bonemeal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.25	0.25	0.25	0.25	0.25
Premix*	0.25	0.25	0.25	0.25	0.25
Palm oil	3.00	3.00	3.00	3.00	3.00
Salt	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Cost/kg	76.34	73.39	70.48	67.52	64.54
ME kcal/kg	2870	2849	2820	2796	2773
Crude protein %	23	23	23	23	23
Crude fibre %	4.46	5.34	6.23	7.10	7.99
Ether extract%	3.66	3.31	2.93	2.56	2.19
Calcium %	1.38	1.37	1.37	1.37	1.37
Phosphorus %	0.63	0.63	0.62	0.62	0.61
Cystine %	0.31	0.30	0.31	0.31	0.30
Lysine %	1.45	1.67	1.89	2.11	2.33
Methionine(%)	0.63	0.69	0.74	0.81	0.86

*Optimix premix supplied /kg of diet: Vit A- 13340 i.u; Vit. D_3-2680 i.u; Vit. E- 10 i.u; Vit.K- 2.68mg; Calcium pantothenate- 10.68mg; Vit.B_{12}-0.022mg; Folic acid- 0.668mg; Choline chloride- 400mg; Chlorotetracycline- 26.68mg; Manganese- 13mg; Iron- 66.68mg; Zinc, 53.34mg;Copper- 3.2mg; Iodine- 1.86mg; Cobalt- 0.268mg; Selenium- 0.108mg.
ME – MetabolisableEnergy

supplied for the week to obtain feed consumption per week for each of the replicates. From the records taken, feed intake, weight gain, feed conversion ratio and feed cost per kg gain were calculated. The experiment lasted for 8 weeks.

At the end of the experiment (8 weeks), 2mls of blood samples were collected from the wing vein using a 5ml syringe from two birds per replicate in a bottle containing Ethylene diamine tetra-acetic acid (EDTA). At the end of the experiment six birds from each treatment (two birds per replicate) were randomly selected based on average group weight. The selected birds were fasted over night, weighed, bled, dressed and eviscerated similar to the method for dissection of turkey carcases described by Hann and Spindler (2002); and values were expressed as a percentage of live weight.

Results and Discussion

The results of the proximate and other nutrient composition, the antinutritional factors and the ingredient composition of the starter and finisher diets are presented in Tables 1, 2, 3 and 4 respectively. Tables 5, 6, 7, 8 and 9 shows the performance of the birds, the haematological parameters, the carcass parameters, the prime cuts and organ weights expressed as a percentage of the live weight respectively.

The result of the proximate content of *Parkia biglobosa* pulp (table 1) shows that crude protein content was found to be 11.52%, crude fibre 12.49%, ether extract 3.09%, ash 4.08% and Nitrogen free extract 68.32%. This result showed that Parkia pulp has a fairly high crude protein content similar to that of maize. This value is higher than 6.70% (Kwari and Igwebuike, 2002), 5.25% (Bello *et al.,* 2005), 6.62% (Alabi *et al.,* 2005) and 4.81% (Hassan and Umar (2005). The difference may be due to varietal differences or method of processing. The NFE value of 68.32 % is similar to 67.30% reported by Gernah *et al.,* (2005) and 68.75% reported by Bello *et al,.* (2008). This high content of NFE makes it a good substitute for maize as a source of energy in poultry diets. The levels of reducing sugar (4.56mg/100g), ascorbic acid (24.22mg/100g) and total starch (5.84mg/100g) indicates that the pulp can supply soluble carbohydrate and other important nutrient in the diets of poultry birds.

Levels of the anti-nutritional factors (table 2) in the *Parkia* pulp were: oxalate 150.00mg/100g, phytic acid 219.10mg/100g and tannins 3.23mg/100g. These levels of antinutrients are within the range that poultry birds can tolerate (Abeke 2005). However,some other processing methods may be further investigated to reduce these anti nutrients and improve its utilization by birds.

The growth performance indices of the birds (Table 5) indicates that there were no significant difference ($P<0.05$) between birds fed the control diet and those fed 10% dietary *Parkia* pulp in terms of final weight, weight gain and feed conversion ratio. Beyond 10% inclusion level, these values began to decline significantly ($P<0.05$). Also there was no significant difference in terms of feed cost per kilogrammme gain for bird fed up to 20% dietary level of *Parkia* pulp. Feed intake was not significantly ($P<0.05$) reduced up to 30% inclusion level. However, these were significantly better ($P>0.05$) than birds fed higher levels of dietary *Parkia* pulp. These values became worse as the dietary level of Parkia pulp continued to increase. It shows that *Parkia* pulp can be fed up to 20 % dietary level without any adverse effect on feed cost per kilogramme gain.

The decrease in feed intake as the level of the pulp increased across the dietary treatments may probably be because of

Table 4: Ingredient Composition of Broiler Finisher Diets .

	Graded levels of Parkia pulp (%)				
Ingredients	**0**	**10**	**20**	**30**	**40**
Maize	53.60	44.80	35.40	26.00	16.80
Parkia	-	10	20	30	40
Soybean meal	26.40	25.20	24.60	24.00	23.20
Wheat offal	10.50	10.50	10.50	10.50	10.50
Fishmeal	2.50	2.50	2.50	2.50	2.50
Bonemeal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.25	0.25	0.25	0.25	0.25
Premix*	0.25	0.25	0.25	0.25	0.25
Palm oil	3.00	3.00	3.00	3.00	3.00
Salt	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Cost/kg(N)	73.78	69.77	65.87	61.97	58.03
ME kcal/kg	2928	2898	2881	2854	2829
Crude protein%	20	20	20	20	20
Crude fibre	4.25	5.11	5.99	6.87	7.74
Ether extract %	3.74	3.37	3.01	2.64	2.28
Calcium %	1.35	1.35	1.35	1.35	1.34
Phosphorus %	0.58	0.57	0.57	0.56	0.56
Cystine %	0.25	0.26	0.26	0.26	0.25
Lysine %	1.24	1.45	1.67	1.90	2.12
Methionine(%)	0.59	0.64	0.70	0.77	0.83

*Optimix premix from Animal care supplied/kg of diet: Vit A- 13340 i.u; Vit. D_3- 2680 i.u; Vit.E- 10 i.u; Vit.K- 2.68mg; Calcium pantothenate- 10.68mg; Vit.B_{12}-0.022mg; Folic acid- 0.668mg; Choline chloride- 400mg; Chlorotetracycline- 26.68mg; Manganese- 13mg; Iron- 66.68mg; Zinc, 53.34mg; Copper- 3.2mg; Iodine- 1.86mg; Cobalt- 0.268mg; Selenium- 0.108mg.
ME – Metabolisable Energy

increase in the fibre and dustiness which may have negatively affected the palatability of the feed. Kwari and Igwebuike (2002) had earlier reported a decreased in feed intake with increase in the dietary levels of *Parkia* pulp.

The decrease in final weight and weight gain observed as the level of the pulp increased could be related to the decrease in feed intake. Kwari and Igwebuike (2002) had earlier reported a satisfactory performance of broiler chickens fed diets containing up to 15% African locust bean pulp replacing maize and that beyond this level final weight and weight gain decreased. The same trend was applicable to feed conversion ratio. Kwari and Igwebuike (2002) had earlier reported an increase in Feed conversion ratio as the dietary level of *Parkia* pulp increased up to 15% inclusion level.

Birds fed 10% *Parkia* pulp diet had the least cost per kg gain across the dietary treatment which was similar to the control and 20% *Parkia* pulp diet. As the level of Parkia pulp increased across the dietary treatments, the cost/kg gain increased. The birds fed 10% *Parkia* pulp diet had the least cost probably because of lowered feed cost occasioned by inclusion of the pulp in the diets. According to Abeke *et al.,* (2003) one reason for the use of unconventional feed ingredient is to

Table 5: Effect of graded levels of Parkia pulp on the growth performance of Broiler chickens

	Graded Levels of Parkia pulp (%)						
Parameter	**0**	**10**	**20**	**30**	**40**	**SEM**	**LOS**
Initial weight (g)	42.03	42.04	42.03	42.04 42.0	0.01		NS
Final weight (g)	2122[a]	1961[a]	1616[b]	1486[bc]	1309[c]	80.05	*
Feed intake (g/bird/day)	87.97[a]	87.51[a]	80.75[a]	89.56[a]	77.97[b]	4.68	*
Weight gain (g/bird/day)	33.91[a]	33.25[a]	25.90[b]	22.69[b]	20.97[b]	0.96	*
Feed conversion ratio	2.34[a]	2.48[a]	2.97[b]	3.84[c]	3.59[c]	0.25	*
Feed cost/kg gain (~~N~~)	303[a]	294[a]	320[a]	410[c]	359[b]	2.53	*
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00	NS

a, b, c = Means in the same row having different superscript are significantly different (P<0.05).
NS = Not significant (p>0.05)
* = Significant difference (p<0.05)
SEM = Standard error of means
LOS = Level of significance

reduce the cost of production but their usage should not exceed 10% inclusion level especially if they are not properly processed to eliminate the anti nutritional factors in them.

Results obtained from the haematological parameters (table 6) indicate that some of the blood parameters such as glucose, Platelet, MCHC and RDW showed that dietary levels of *Parkia* pulp had significant effect (P<0.05) on the haematological parameters of the birds although no particular trend was observed among the treatment groups. However, total protein, PCV and Hb increased as the level of Parkia pulp increased across the dietary treatments. The effect of *Parkia* pulp fed to broiler chickens lowered the levels of Cholesterol and MCV. However, the level of RBC production increased while MCH and RDW were not negatively affected. It was generally observed that the values of the haematological parameters obtained falls within the range of values reported by Oladele (2000) for healthy birds. This may suggest that levels of *Parkia* pulp had no negative effect on the health status of the birds, rather it encouraged glycolysis, protein synthesis and haemopoesis.

Live weight, carcass weight and dressing percentage (table 7) showed significant (P<0.05) decreases across the dietary treatments as the level of *Parkia* pulp increased. This may probably be due to lowered feed conversion ratio occasioned by poor feed intake, increased dustiness and lowered palatability as well as increased fibre content of the diet as the level of *Parkia* pulp increased. Onifade (1993) and Onifade and Babatunde (1997) reported that high fibre content was found to interfere with nutrient availability for growth and maintenance. Kwari and Igwebuike (2002) also reported a decrease in live weight, carcass weight and dressing percentage as the amount of *Parkia* pulp increased in the diets of broiler chickens.

The prime cuts (table 7) expressed as a percentage of live weight showed that the breast, thighs and drumsticks which are the most preferred and meaty parts of the chicken followed the weight pattern of the bird and decreased as the level of *Parkia* pulp increased in the diets. The reason for this is not far fetched. This is because bigger and meatier birds have better prime cuts that smaller and leaner birds. Mohammed *et al.,* (2009) had earlier reported reduction in sizes of prime cuts when broiler chickens were fed powdery energy alternatives similar to *Parkia* pulp such as yam peels as a replacement for maize in broiler diets.

Table 6: Influence of Parkia pulp on some blood components of Broiler chickens

	Graded Levels of Parkia pulp (%)						
Parameter	**0**	**10**	**20**	**30**	**40**	**SEM**	**LOS**
Glucose (mmol/l)	7.10^{b}	6.57^{c}	7.60^{a}	6.68^{c}	7.62^{a}	0.17	*
Total protein (g/dl)	29.77^{b}	31.85^{ab}	35.32^{ab}	35.22^{ab}	36.52^{a}	0.81	*
Cholesterol(mmol/l)	1.18	1.33	1.08	1.10	1.07	0.15	NS
RBC ($x10^{12}$/l)	2.76	2.66	2.88	2.84	3.01	0.28	NS
PCV (%)	35.78^{b}	33.98^{b}	36.57^{a}	36.58^{a}	38.48^{a}	1.65	*
Haemoglobin (g/l)	131^{ab}	129^{b}	137^{ab}	142^{ab}	148^{a}	1.74	*
MCV (fl)	131	129	129	130	128.1	80.94	NS
MCH (pg)	48.08	48.70	47.88	50.27	49.12	0.76	NS
MCHC (g/l)	366^{b}	380^{ab}	374^{ab}	388^{a}	384^{a}	1.57	*
PLT ($x10^{9}$/l)	12.00^{a}	11.50^{a}	9.33^{a}	10.50^{a}	7.83^{b}	1.84	*
RDW (%)	8.78	9.63	9.43	8.27	8.88	0.51	NS
RDW (fl)	46.68^{a}	48.77^{a}	48.23^{a}	43.75^{b}	45.13^{a}	1.84	*

a, b, c = Means in the same row having different superscript are significantly different (P<0.05).
NS = Not significant (p>0.05) *= Significant difference (p<0.05)
SEM =Standard error of means. RBC= Red blood cells
PCV = Packed Cell Volume
Hb = Haemoglobin
MCV = Mean corpuscular volume
MCH = Mean corpuscular haemoglobin
MCHC = Mean corpuscular haemoglobin concentration
PLT = Platelets
RDW = Red blood cell (erythrocyte) distribution with coefficient of variation
RDW = Red blood cell (erythrocyte) distribution with standard deviation

The result obtained for the organ weights expressed as a percentage of the live weight (table 7) showed that the weights of the organs increased as the level of *Parkia* pulp increased in the diets. The reason for this could due to increased level of antinutritional factors that these organs especially the liver had to contend with in the process of detoxification leading to atrophy of the organ. The enlargement of the gizzard and proventriculus may not be unconnected with the fibre content of the diets. Fibre have the tendency to increased the size of the gastro intestinal tract because of the pressure exerted in its digestion (Abeke, 2005).

Conclusion and Recommendation

The effect of graded dietary levels of *Parkia biglobosa* pulp meal was investigated in the diets of broiler chickens. Results obtained indicates that although performance decreased as the level of *Parkia* pulp increased in the diets, it can be fed up to 10% dietary level without any adverse effect on the performance of the birds.

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Table 7: Carcass characteristics of Broiler Chickens fed diets containing graded levels of Parkia pulp

	Graded levels of Parkia pulp (%)						
Parameters	0	10	20	30	40	SEM	LOS
Live weight(g)	2100[a]	1950[a]	1637[b]	1483[b]	1207[c]	67.73	*
Carcass Weight (g)	1488[a]	1337[b]	1042[c]	848[d]	727[d]	43.77	*
Dressing %	70.85[a]	70.21[a]	63.36[b]	56.90[c]	60.23[bc]	1.56	*
Prime Cuts(%Dressed wt)							
Back	15.23[a]	14.79[a]	12.85[b]	11.38[b]	12.78[b]	0.57	*
Breast	24.61[a]	24.21[a]	20.92[b]	18.86[b]	18.27[b]	0.92	*
Wings	8.66[ab]	9.14[a]	8.61[b]	7.76[c]	9.51[a]	0.23	*
Thigh	11.12[a]	10.16[ab]	9.53[b]	9.53[b]	9.38[b]	0.32	*
Drumstick	11.43[a]	10.53[ab]	10.24[abc]	9.21[c]	9.88[bc]	0.36	*
Organ Weights (% Dressed wt)							
Liver	2.15[b]	2.53[ab]	2.69[ab]	2.55[ab]	3.18[a]	0.21	*
Heart	0.68[b]	0.90[a]	0.92[a]	0.91[a]	0.94[a]	0.06	*
Gizzard	2.34[b]	2.44[b]	2.50[a]	2.53[a]	2.58[a]	0.21	*
Proventriculus	0.52[b]	0.90[a]	0.92[a]	0.91[a]	0.93[a]	0.03	*
Spleen	0.56[b]	0.60[b]	0.53[b]	0.51[b]	0.74[a]	0.04	*

a, b, c = Means in the same row having different superscript are significantly different (P<0.05).
NS = Not significant (p>0.05)
* = Significant difference (p<0.05)
SEM = Standard error of means

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