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Replacement Value of Maize with African Locust Beans (*Parkia biglobosa)* Pulp Meal on Performance, Haematological and Carcass Characteristics of Broiler Chickens

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Target audience: Poultry farmers, Nutritionists, feed manufacturers.

Abstract

Two hundred and twenty five Marshal broiler chicks were used to investigate the effect of replacing maize with Parkia biglobosa pulp on performance, haematological and carcass characterics of broiler chicken. Five diets were formulated. Diet 1 which served as the control was a normal broiler starter and finisher diet, respectively. Diets 2-5 had maize replaced at 25, 50, 75 and 100 percent, respectively. The birds were housed under the deep litter system. Feed and water were given ad libitum throughout the duration of the experiment. Each of the diet represented a treatment and each treatment was replicated three times with 15 birds per replicate in a completely randomized design experiment. The study lasted for 8 weeks. Results obtained indicated that broilers can tolerate up to 25% replacement of maize with Parkia pulp without adverse effect on the performance, haematological and carcass characteristics of the birds.

Key words: Parkia pulp, broiler chickens, carcass, haematological parameters, performance.

Description of Problem

The need to source, harness, process and utilize alternative feed stuff other wise known as unconventional feed ingredients in the diets of poultry birds is more critical now than ever. This is because feed cost accounts for over seventy percent of the cost of producing edible meat and eggs. Conventional feed ingredients such as maize, soya beans cake and groundnut cake have become very scarce and expensive due to their multiple uses for human and animal feed (1, 2). There is also the need to expand the ingredient base to provide an array of alternative feedstuffs for poultry feed formulation. Unconventional feedstuffs are cheap, easily available and do not elicit competition from humans as they are not consumed as food. They abound in the form of unrecognized and underutilized legume beans, by products of agricultural and other industrial processing, food processing wastes, farm

wastes, homestead wastes and fermentation by products. These can be processed and packaged in such a way to make them suitable for incorporation into poultry diets (3,4). The result will be cheaper feed, reduced cost of meat and eggs and improvement in per capita animal protein intake. The benefit of this to a growing population like Nigeria which is presently being estimated at over 150 million cannot be over emphasized.The attendant malnutrition in Nigeria especially among children occasioned by very low animal protein intake of 7-8% as against the (5) recommendation of 35% per capita per day cannot be overlooked, hence urgent action is needed to improve the animal protein intake of Nigerians. This paper in an attempt to address this need, focuses on the replacement value of maize with *Parkia biglobosa* pulp meal in the diets of broiler chickens.

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, with two distinct (dry and rainy) seasons. The dry season starts in October and ends in March with a temperature range of 13^{o}C-26^{o}C. While the rainy season is from April-September, and the temperature also ranges from 16^{o}C- 28^{o}C. The geographical location of Vom is 8^{o} 45`E, 9$^{o}$ 43`N and 4200 feet (1280m) above sea level. Mean relative humidity ranges from 14-17% (6, 7).

Source, Proximate analysis and antinutritional factor assay of Parkia bibloglosa Pulp

The Parkia pulp used for the experiments was bought from local markets in Zaria and Giwa, Kaduna state. They were sieved to remove impurities and milled to obtained a smooth flour. The proximate analysis, nutritional composition and determination of the antinutritional factors (phytate and oxalate) of Parkia pulp were carried out according to (8) while the tannin content was determined using the method described by (9, 10).

Animal and their Management

Starter phase

Two hundred and twenty five day-old Marshall broiler chicks were used for the experiment. The birds were weighed at the beginning of the experiment and randomly assigned to five dietary treatments containing replacement levels of maize with Parkia pulp at 0, 25, 50, 75 and 100%, respectively. The 100% level of inclusion, replaced maize completely in the diet. Diets were formulated to meet the (11) standard requirements. The experimental diets is presented in Table 1.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. Feed and water were supplied *ad libitum* to the birds throughout the starter phase of the experiment. Weighed leftover feed was

also subtracted from the total feed supplied for the week to obtain feed consumption per week for each of the replicate. Routine vaccination and medication were administered as at when due. The starter phase lasted from 0-4 weeks.

Table 1: Ingredient composition of broiler Starter Diets

	(%) maize replaced				
Ingredients	0	25	50	75	100
Maize	46.45	34.83	23.22	11.60	-
Parkia pulp	-	11.62	23.23	34.85	50.53
Soyabean meal	35.05	35.05	35.05	35.05	30.97
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
Lime stone	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**	**100**	**100**	**100**	**100**
Calculated Analysis					
Cost/kg	96.16	90.93	86.64	81.88	72.34
ME kcal/kg	2870	2836	2797	2759	2749
Crude protein%	23	23	23	23	23
Crude fibre	4.46	5.52	6.57	7.62	9.15
Ether extract %	3.94	3.23	2.80	2.38	1.83
Calcium %	1.38	1.38	1.38	1.38	1.36
Phosphorus %	0.63	0.63	0.63	0.63	0.61
Cystine %	0.31	0.32	0.31	0.32	0.30
Lysine%	1.45	1.73	2.00	2.28	2.55
Methionine	0.63	0.70	0.77	0.84	0.92

*Optimix premix from Animal care provide/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

Table 2: Ingredient Composition of Broiler Finisher Diets

	(%) maize replaced				
Ingredients	0	25	50	75	100
Maize	53.60	40.20	26.80	13.40	-
Parkia pulp	-	13.40	26.80	40.20	53.60
Soyabean meal	26.40	26.40	26.40	26.40	21.90
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
Lime stone	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**	**100**	**100**	**100**	**100**
Calculated Analysis					
Cost/kg	73.81	68.73	63.63	56.54	51.77
ME kcal/kg	2928	2884	2840	2796	2783
Crude protein%	20	20	20	20	20
Crude fibre	4.25	5.47	6.67	7.88	9.33
Ether extract %	3.73	3.24	2.74	2.26	1.62
Calcium %	1.35	1.35	1.35	1.35	1.34
Av. Phosphorus %	0.58	0.58	0.58	0.58	0.55
Cystine %	0.25	0.26	0.27	0.26	0.26
Lysine%	1.24	1.56	1.88	2.20	2.51
Methionine	0.59	0.67	0.76	0.84	0.93

*Optimix premix from Animal care provide/kg of diet: Vit.A- 13,340 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

Finisher phase

At the end of the starter phase, all the birds were pooled together and fed a common diet for one week. After this, they were randomized and allotted to the five dietary treatments in a completely randomized design with 14 birds per replicate. The experimental diets for the finisher phase are presented in Table 2. Feed and water were administered *ad libitum.* From the records taken in both phases,, feed intake, weight gain, feed conversion ratio and feed cost per kg gain were calculated. The finisher phase lasted from 5 - 8 weeks.

Towards the end of the finisher phase, 2mls of blood samples were collected

from the wings of two birds per replicate in a bottle containing Ethylene Diamine Tetra-Acetic acid (EDTA). These were immediately taken to the Laboratory for analysis. 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 using the method described by (12).The prime cuts and organ weights were expressed as a percentage of live weight.

Results and Discussion

The results of the proximate, nutrient composition and antinutritional factors of the Parkia Pulp are presented in Table 3. The proximate content of Parkia pulp were11.52% crude protein, 12.49% crude fibre, 3.09% ether extract, 4.08% ash and 68.32% Nitrogen free extract, respectively.

Parkia pulp had crude protein content similar to that of maize. This value is higher than 6.70%, 5.25%, 6.62% and 4.81% reported by (13, 14, 15and 16, respectively). The difference may be due to geographical locations, varietal differences or method of processing. The NFE value of 68.32 % is similar to 67.30% reported by (17) and 68.75% reported by (14). The high content of NFE makes it a good substitute for maize as an energy source in poultry diets. The levels of reducing sugar (4.56mg/100g), ascorbic acid (24.22mg/100g) and total starch (5.84mg/100g) could be an indication that the pulp can supply soluble carbohydrate and other important nutrient in the diets of poultry birds.

Parkia pulp contained 150.00mg/100g oxalate, 219.10mg/100g phytic acid and 3.23mg/100g tannins. The low levels of antinutrients shows that Parkia pulp is partially safe for incorporation into poultry diets but some processing may be needed to reduce these anti nutrients and improve its utilization by birds

Table 3: Proximate, Nutritional composition and Antinutritional factor content of Parkia pulp

Nutrientcomposition	**Proximate**
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
Antinutritional factors	
Oxalate mg/100g	-150.00
Phytic acid mg/100g	-219.10
Tannins mg/100g	-3.23

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

The growth performance of broiler chicks fed diets in which Parkia pulp replaced Maize at the starter phase is presented in Table 4. There was a significant (P<0.05) decrease in all these production parameters measured as the replacement levels of Parkia pulp for maize increased in the diets. This could be due to low energy and high levels of fibre in the diets as the level of the African locust bean (*Parkia biglobosa*) pulp increased. It could also be associated with increased powdery nature of the diet as the level of the pulp increased. Birds tend to be put off feed when diets are powdery and unpalatable. This trend was observed by (13) when the level of Parkia pulp increased across the dietary treatments. High fibre content was found to interfere with nutrient availability for growth and maintenance in broilers (18,19). According to these authors, Parkia pulp also has a slight sour taste which have a negative effect on palatability and consequently, feed intake. The level of dietary fibre increased while the energy content decreased with increase in level of Parkia pulp in this study, which probably affected the growth performance of the birds. According to (13) feed conversion ratio of broiler chickens was negatively affected as the levels of Parkia pulp increased across the dietary treatments.

Table 4: The effect of replacing Maize with Parkia pulp on the growth performance of Broiler starter (0 – 4weeks)

	% Maize replaced						
Parameter	0	25		50	75	100	SEM
Initial weight (g)	40.45	40.62	40.20	40.33	40.450.	19	NS
Final weight (g)	804.00^{a}	709.00^{b}	563.00^{c}	469.00^{d}	302.00^{e}	4.14	*
Feed intake (g/bird/day)	54.31^{a}	53.08^{a}	49.41^{b}	46.64^{b}	46.47^{c}	0.99	*
Weightgain(g/bird/day)	22.13^{a}	19.11^{b}	14.71^{c}	11.56^{d}	7.28^{e}	0.47	*
Feed conversion ratio	2.46^{a}	2.78^{b}	3.37^{c}	4.05^{d}	6.16^{e}	0.13	*
Feed cost/kg gain (₦)	236.00^{a}	252.00^{a}	292.00^{b}	331.00^{bc}	405.00^{c}	17.86	*
Mortality (%)	0.00^{a}	0.33^{b}	0.33^{b}	0.33^{b}	4.33^{c}	0.09	*

a, b, c, d, = 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.

The cost per kg gain differed significantly (P<0.05) across the dietary treatments. The birds fed the lowest replacement level of 25% Parkia pulp in the diet had significant (P<0.05) lower cost per/kg gain compared to other dietary treatments but was not significantly (P>0.05) different from birds fed the control diet.This may not be unrelated to the poor growth performance of the birds with increasing level of the pulp in the diets. This result was at variance with the report of (20) that the utilization of unconventional feed ingredients in livestock diets has been known to lower cost of production

because they are cheaper, readily available and of no competition with humans. However, itis in agreement with (21) who reported that the cost/kg gain of raising broiler starters fed with ginger waste meal increased as the level of ginger waste meal increased across the dietary treatments.

There was significant (P>0.05) increase in the percent mortality of the experimental birds across the dietary treatments as the level of Parkia pulp increased inthe diets. The reason for this trend is not clear but may be related to some intrinsic factors such as residual antinutrients. According to (18,19) some level of processing is necessary to reduce the antinutritional content of Parkia pulp before being incorporated into poultry diets.The results obtained from this experiment suggest that African locust bean pulp can be used to replace up to 25% of maize in broiler starter diets without a significant increase in cost per kilogramme gain in weight.

Results obtained for the finisher phase (Table 5) indicate that birds fed the control diet and those on 25% replacement diet did not show significant (P<0.05) difference in most of the productive parameters such as final weight, weight gain, feed conversion ratio and feed cost per kilogramme gain. However, these were significantly (P<0.05) better than performance of birds fed higher replacement levels of Parkia pulp. There were significant (P<0.05) decrease in these parameters as the level of Parkia pulp increased in the diets. Poor feed intake and consequently low performance obtained may be due to dustiness and low palatability of the feed resulting from increased Parkia pulp in the diets.Kwari and Igwebuike (13) had earlier reported a decreased in feed intake as the level of Parkia pulp increased across the dietary treatments.

Table 5: The effects of replacing Maize with Parkia pulp on growth performance of Broilers finisher (5–8weeks)

	% Maize replaced						
Parameter	**0**	**25**	**50**	**75**	**100**	**SEM**	**LOS**
Intial weight (g)	644	6.44	645	644	645	0.77	NS
Final weight (g)	1392^{a}	1388^{a}	1008^{b}	880^{c}	763^{d}	5.35	*
Feedintake (g/bird/day)	112^{a}	110^{a}	97.90^{b}	93.55^{b}	81.16^{c}	1.71	*
Weight gain (g/bird/day)	36.30^{a}	37.36^{a}	20.62^{b}	13.43^{c}	7.58^{d}	1.51	*
Feed conversion ratio	3.07^{a}	2.96^{a}	4.31^{b}	4.35^{b}	5.46^{c}	0.38	*
Cost/kg gain (₦)	249^{a}	225^{a}	348^{b}	446^{c}	440^{c}	28.98	*
Mortality (%)	0.00^{b}	0.33^{b}	0.33^{b}	1.00^{b}	4.00^{a}	0.56	*

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

Birds fed the control diet and 25%Parkia pulp diet had the highest final weight and weight gain compared to other birds across the dietary treatments. It was observed that as the level of inclusion of African locust bean pulp increased, the dietary levels of crude fibre increased and the energy level decreased. Kandra*et al* (22) had earlier reported that body weights in meat type birds decreased when birds were fed higher fibre levels in the diets.The observation on final weight and weight gain supported (13) who reported a decrease in these parameters as the dietary levels of Parkia pulp increased. The same trend was observed for feed conversion ratio with birds fed diet containing 100% Parkia pulp having the worstfeed conversion ratio, probably because of poor feed utilization occasioned by fibre level or dustiness of the feed. Similarly, birds fed 25% replacement level hadthe least feed cost/kg gainwhich was not significantly different from the birds on the control diet. This resultwas in consonance with the findings of (18) who reported a similar result when maize was replaced with brewers dried grain in the diets of broiler finisher. Increase in percent mortality was observed acrossthe dietary treatments with birds fed 100% Parkia pulp diet recording the highest mortality. The palatability of the feed may have been negatively affected and there could have been non availability of nutrients to the birds which may have marredtheir immunity level.

The blood parameters analysed from broilers fed replacement levels of Parkia pulp (Table 6) showed no negative effect on serumchemistry (glucose and cholesterol), platelet, RDW-cv and RDW-sd Also the values obtained for, RBC, PCV, Hb, MCV, MCH and MCHC falls within ranges normally reported for healthy birds (23). This suggests that Parkia pulp may not have had any negative effect on the serum biochemistry and haematology of birds.

Live weight, carcass weight and dressing percentage expressed as a percentage of live weight (Table 7) significantly ($P<0.05$) decreased across the dietary treatments. This is probably a reflection of the final weight of the birds which decreased as the replacement level of parkia pulp increased in the diets. These results concord with the observation of (21) who observed decreased values of live weight, carcass weight and dressing percentage between the treatments as the level of ginger waste meal increased in the diets of broiler chickens.

Table 6: The effects of replacing Maize with Parkia pulp on some haematological parameters of Broiler chickens

	%Maize replaced)						
Parameter	**0**	**25**	**50**	**75**	**100**	**SEM**	**LOS**
Glucose (mmol/l)	7.97	7.70	6.65	5.85	6.90	0.38	NS
Protein (g/dl)	46.33^{c}	51.60^{a}	45.22^{c}	48.59^{b}	45.48^{c}	0.64	*
Cholesterol (mmol/l)	2.20	1.95	1.87	2.13	1.67	0.37	NS
RBC ($x10^{12}$)	2.92^{b}	2.99^{ab}	3.47^{a}	3.30^{ab}	3.20^{ab}	0.31	*
PCV (%)	35.10^{c}	37.03^{bc}	43.40^{a}	0.98^{ab}	37.93^{bc}	0.95	*
Hb (g/l)	146^{b}	152^{ba}	173^{a}	161^{ba}	151^{ba}	2.02	*
MCV (fl)	121^{b}	124^{a}	125^{a}	122^{a}	120^{b}	1.76	*
MCH (pg)	50.03^{a}	50.93^{a}	49.72^{a}	49.08^{a}	47.27^{b}	1.06	*
MCHC (g/l)	415^{a}	409^{ab}	398^{b}	403^{ab}	394^{b}	1.73	*
Platelet ($x10^{9}$)	8.50	10.50	10.00	11.67	8.50	0.74	NS
RDW-cv (%)	7.95	8.17	8.38	8.18	8.62	0.44	NS
RDW-sd (fl)	37.73	40.87	39.72	39.20	38.82	1.81	NS

a,b,c = Means within the same row having different superscripts are significantly different (P<0.05).
NS = Not significant (P>0.05)
* =Significant difference (P<0.05)
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-cv= Red blood cells (erythrocyte) distribution width coefficient of variation
RDW-sd= Red blood cells (erythrocyte) distribution width standard deviation

The Prime cuts (breast, wings and drumsticks) showed a significant (P>0.05) decrease as the level of Parkia pulp increased across the dietary treatments (Table 7). This is also a reflection of the liveweight of the birds.Apart from the gastro intestinal tract which showed significant (P<0.05) differences across the treatments, other parameters did not show any significant (P>0.05) difference among the treatments.

Table 7: The effects of replacing Maize with Parkia pulp on Carcass characteristics of Broiler Chickens.

	% Maize replaced						
Parameter	**0**	**25**	**50**	**75**	**100**	**SEM**	**LOS**
Live weight (g)	1314[a]	1253[a]	949[b]	789[c]	678[c]	47.80	*
Carcass weight (g)	891[a]	818[a]	599[b]	436[c]	312[d]	33.06	*
Dressing percentage	67.80[a]	65.31[a]	63.10[a]	54.97[b]	46.26[c]	1.90	*
Back	12.35	11.37	11.94	11.69	10.67	0.71	NS
Breast	24.55[a]	20.84[b]	19.22[c]	14.65[d]	10.36[e]	0.55	*
Wings	10.14[a]	9.26[ab]	9.57[ab]	8.22[bc]	7.00[c]	0.56	*
Thighs	10.46	10.41	10.3	19.30	9.19	0.67	NS
Drumsticks	9.51[ab]	11.02[a]	10.89[a]	10.34[ab]	8.34[b]	0.74	*
Liver	2.78	2.77	2.55	3.05	2.91	0.18	NS
Heart	0.66	0.67	0.70	0.84	0.83	0.06	NS
Gizzard	2.51	2.11	2.13	1.90	2.14	0.18	NS
Proventriculus	0.63[ab]	0.54[ab]	0.53[b]	0.69[a]	0.56[ab]	0.05	*
Spleen	0.14	0.13	0.15	0.07	0.08	0.03	NS
Small intestine	6.26[d]	6.58[cd]	8.22[bc]	9.59[b]	11.80[a]	0.56	*
Large intestine	0.59[b]	0.56[b]	1.23[a]	0.87[ab]	1.11[a]	0.27	*

a,b,c = Means within the same row having different superscripts are significantly different ($p<0.05$).
NS =Not significant ($p>0.05$) *=Significant difference ($p<0.05$) SEM= Standard error of mean

Conclusion and Application

It was concluded that:

1. *Parkia biglobosa* pulp contain valuable nutrients that can be harnessed and utilized in the diets of broiler chickens
2. Final weight, weight gain, feed conversion ratio and feed cost per kilogramme gain reduced with increasing replacement levels of parkia pulp.
3. Inclusion of Parkia Pulp meal in the diets of broiler chickens did not adversely affect the carcass and haematological characteristics of the birds.
4. Twenty five percent (25%) of maize can be replaced with Parkia pulp without a deleterious effect on performance of broiler chickens.

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