Nutritional Evaluation of Cowpea Shell as a Source of Fibre in the Diets of Broiler Chickens

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Abstract
An experiment was conducted at the school of Undergraduate studies College of Education, Azare poultry research farm. 100 day old Anak 2000 broiler chicks were raised for 8 weeks of age (56 days). The birds were fed with diets containing cowpea shell as a source of fibre at 5 different levels at 0%, 25%, 50%, 75% and 100%. Each treatment was assigned 10 birds and each treatment was replicated twice, making a total of 20 birds per treatment, in a completely randomised design. Feed and water were supplied to the bird's adlibitum. At the end of the experiment 2 birds per replicate was randomly selected and slaughtered for carcass characteristics. Result showed that the Daily Feed Intake (DFI), Daily Weight Gain (DWG), Feed Conversion Ratio (FCR) and Feed Efficiency Ratio (FER) were not statistically affected at both starter and finisher phases (P>0.05). Carcass characteristics: live weight, slaughter weight, pluck weight and eviscerated weight were not significant (P>0.05) across the treatments. The cut of parts, organ and gut characteristics are not statistically significant (P>0.05) in all the treatments. It was recommended that cowpea shell can be used as a source of fibre in broiler chickens diet at up to 100% level of inclusion without effects on growth performance and carcass characteristics and reduction in the cost of production.

Keywords: *Broiler chickens, Cowpea shell, performance, carcass, Fibre,*

Introduction

Poultry are domesticated birds kept by humans for the eggs they produce, their meat, their feathers, or sometimes as pets. These birds are most typically members of the galliformes which includes chickens, quails and turkeys (Oluyemi and Robert, 2000). 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 140 million, and there is also high maternal-child mortality due to under- nutrition (Sobayo *et al*., 2008). A large proportion of Nigerian populations are facing the problem of hunger and malnutrition as a result of inadequate protein in their diet. The contribution of animal protein in their diet is low. The inability of Nigeria to feed their teeming population with qualitative and quantitative food is a problem associated with high cost of animal protein accompanied with biological factors such as diseases and pests, social factors such as tradition, custom and ignorance, however poultry birds have been reported to bridge the gap within a shortest possible time due to their short generation interval, short gestation period and fast growth rate (Maidala and Istifanus, 2012).

Several approaches are adopted to guarantee food security for people worldwide especially the use of farm by products in livestock production. Malnutrition problems is more pronounced in less developed nations (FAO, 2008) and this has always led to resurgence of interest in the sourcing of inexpensive alternative feed ingredients as replacement for the more expensive conventional ones in animal feed formulation. The impact of this is to increase the availability and affordability of animal products in order to alleviate global food crisis. The

alternative feed ingredients also referred to as non-conventional feedstuffs are mostly agro-industrial by-products. The importance of agro-industrial by-products and the so-called "wastes" in meeting the energy and protein needs of farm animals is best appreciated when it is realised that feeding alone accounts for about 60 to 85% of the cost of intensively reared mono-gastric animals (Sanni and Ogundipe, 2005).

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 in Nigeria is wasted in the farms (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 protein requirement in human diet has not been met. There are several attempts to reduce the cost of poultry production by replacing some percentage of maize with other agro-industrial by-products such as maize offal, brewers dried grain, wheat offal, cassava peel meal, rice offal etc (Ademosun, 1976; Ogbonna *et al*.1993; Dafwang and Shwarmen, 1996).

Cowpea is produce in large scale in Bauchi state and processing of cowpea seeds produce a large amount of by products (Devendra, 1993). Cowpea shell is a by product of cowpea processing which part of it is given to ruminant animals and large quantities remain wasted in the farms. Due to the crisis of global warming and waste disposal of agricultural by-products the use of agro-industrial by products is encourage to reduce the waste disposal issues and environmental problems. With the increasing cost of wheat offal the use of an alternative source of fibre will be of great benefit to the poultry farmer in reduction of cost of production. Among the various species of poultry, broilers are the most important in meat production because they provide a quicker return on investment due to their short growth circle (Atteh, 2004). Fibre is a polymeric plant substance that is resistance to mammalian digestive enzymes and among nutrients constituting poultry feeds, the level of fibre inclusion in poultry feed is very low. Increasing the level of fibre in poultry feeds may enhance performance (Sklan, *et al.*, 2003). The inclusion of dietary fibre in poultry diets increase the retention time of the digesta in the upper part of the digestive tract i.e. from the crop to gizzard and stimulate proper gizzard function (Hetland, *et al.*, 2005). Fibre helps in production of hydrochloric acid in the proventriculus, gastrointestinal motility, reducing gizzard pH which will improve the solubility and absorption of mineral salts in gastrointestinal tract, benefits the development of the gastrointestinal tract and improve the growth performance of the birds (Mateos, *et al*, 2006; Moran, 2006). Wheat bran is a major source of fibre in Nigeria and its usage apart from livestock feeding it is used in breakfast cereal thus increasing the cost of the poultry feed ingredients (Okon and Olowoyin, 2007). Other fibre sources such as millet chaff, millet bran, sorghum bran, corn cobs, brewer dried grains, maize bran, cowpea shell etc. are used in livestock feeding (Oluoku and Olalokun, 1999; Agunbiade *et al.*, 2003). Incorporating different fibre sources in the poultry diets according to Ojewola, *et al*., 2001 has the ability to produce lean carcass, lower production cost, promote bowel movement which aids digestion and supply nutrients such as vitamins, minerals and some unidentified factors which improve growth and reduce the cost of wheat barn and provide a close substitute. It is against this background this study attempt to replace wheat offal with cowpea shell on performance of broiler chickens.

Materials and methods

Experimental Site

This experiment was conducted at the poultry unit of School of Undergraduate College of Education Azare farm. Azare is in Katagum local government area of Bauchi State. Katagum local government is situated on the northern part of Bauchi state, Nigeria. It is located

between latitudes 11^0 42' and 11^0 40^0 and longitude 10^0 31' and 10^0 11' east (Anon, 2009). It shares common boundary with Itas/Gadau local government in north west, Jama'are to the west, Dambam to the east, Misau to the south west, Giade to the south and Shira to the southwest (Azare, 2013). It has a landmass of 1,120 square kilometers (NPC, 2009). The climate of the study area is controlled by the Inter Tropical Convergent Zone (ITCZ) which is marked by the rainy and dry season. The major climate elements that influence the climate of the study area and affecting the farming system are temperature and rainfall, the annual temperature ranged between 22-33^0 C from April to May (Bashir *et al*., 2001). The mean annual rainfall ranged between 615.6-985mm with peak between July- Augusts. The study area is in the Sudan savannah, the vegetation is greatly determined by the nature of the soil. The soil in the study area is aerosol with sandy and loamy sand texture and a high percolation rate.

Experimental Birds and their Management

One hundred (100) Anak 2000 day old chicks were used for this research work. Before the arrival of the chicks, the pens were cleaned, washed and disinfected with antiseptic liquid (Dettol). Three days to the arrival of the chicks to the pens after brooding fresh dry saw dust was spread on the floor to serve as litter material. Two days before the arrival of the day old chicks, the brooding pen was arranged. Heat and light sources were provided using 200 watts electric bulb but in case of electric failure, a rechargeable lantern and a kerosene stove were used to supply light and heat for the chicks. The birds were vaccinated with Gumboro and Lasorta vaccine at the required age of vaccination. Their drinking water was treated with antibiotic to prevent infection. After brooding period of one week (7 days) the chicks were weight and assigned randomly to 5 experimental diets. The experimental diets include; treatment 1 control (100% wheat offal), treatment 2 (25% cowpea shell and 75% wheat offal), treatment 3 (50% cowpea shell and 50% wheat offal), treatment 4 (75% cowpea shell and 25% wheat offal) and treatment 5 with 100% cowpea shell. Each of the treatment was replicated twice consisting of ten (10) birds per replicate (20 birds per treatment) in a completely randomised design. The cowpea shell was grounded with hammer mills before it was incorporated into the feed. The cowpea shell was analysed for proximate composition according to procedures of AOAC, 1990.

Data Collection

The birds were fed with the experimental diets for 8 weeks (56 days) during which data on daily feed intake and daily weight gain were taken on daily basis, data was used to compute feed conversion ratio and feed efficiency ratio. Mortality was recorded as it occurred. The birds were weighted at the beginning of the experiment for their initial weight and thereafter on weekly basis. At the end of the experiment 2 birds from each treatment (1 bird per replicate) were randomly selected based on the average group weight. The selected birds were weighted before been slaughtered and bled by severing the carotid artery and weighted again after defeathering to record the plucked weight. The head, legs, back, neck, wings, breast and thigh for each carcass were removed, emptied, washed and weighted. All the weights taken were expressed as percentage of live weight and the dressing percent was calculated from the data recorded as shown below:-

$$\text{Dressing per cent} = \frac{\text{Carcass weight}}{\text{Live weight}} \times 100$$

The weight of all organs (the heart, lungs, liver, gizzard and abdominal fat) and the Gastro-intestinal tract (small and large intestine) were measured using Staton 461 electric scale. The gut components were also expressed as percentage of live weight.

Data Analysis

The data collected for all the parameters including daily feed intake, daily weight gain, feed conversion ratio and feed efficiency ratio were subjected to analysis of variance technique.

ANOVA balanced design Steel and Torrie, 1980 where significant difference exist DMRT was used to separate the means (Duncan's, 1955).

Results

The proximate composition of experimental diet is shown in table 3 and results showed that cowpea shell is high in fibre (60.19%) and this makes it a potential source of fibre for broiler chickens. The performance characteristics of broiler chickens fed cowpea shell as a source of fibre at the starter phase is shown in Table 4. The values of the daily feed intake, daily weight gain, feed conversion ratio and feed efficiency ratio ranged from (33.75-40.89g, 7.39-14.28g, 8.16-16.27% and 0.20-.045%) respectively and the differences between the values were not statistically significant (P>0.05).

The performance characteristics of broiler chickens fed cowpea shell as a source of fibre at the finisher phase is shown in Table 5. The daily feed intake, daily weight gain, feed conversion ratio and feed efficiency ratio of the broiler chickens fed various levels of cowpea shell as a source of fibre at their finisher phase ranged from (75.00-105.54g, 16.33-35.00g, 4.25-7.35% and 0.32-0.41%) respectively and the difference between the values were not statistically significant (P>0.05).

The carcass characteristics of broiler chickens fed cowpea shell as a source of fibre at the starter phase is shown in Table 6. The live weight, slaughter weight, pluck weight and eviscerated weight obtained ranged between (1350.0-1750.0g, 79.49-91.34g, 71.04-76.96g and 28.36-44.75g) respectively. And the difference between the values were not statistically significant (P>0.05). The organ and gut characteristics of broiler chickens fed various levels of cowpea shell as a source of fibre was shown in Table 7. The values of the gizzard, heart, lungs, small intestine, large intestine, liver and abdominal fat ranged between (0.97-1.56, 0.24-0.45, 0.23-1.27, 0.48-0.67, 2.19-3.28, 1.02-1.30 and 0.18-0.65) respectively expressed as percentage of body weight and the values were not statistically significant (P>0.05).

The cuts of parts of broiler chickens fed various levels of cowpea shell as a source of fibre was shown in Table 8. The values of the cuts of parts expressed as percentage of the body weight; head and shank, neck, thigh, wings, breast and chest ranged between (2.89-5.14, 2.07-2.83, 13.07-16.52, 3.04-5.33, 9.08-13.25, 1.89-2.68) respectively and the difference between the values were not statistically significant (P>0.05).

Discussion

The results from Table 4 and 5 indicated that, there were no significant differences (P>0.05) in the Daily Feed Intake, Daily Weight Gain, Feed Conversion Ratio and Feed Efficiency Ratio among the treatments means. Implying that, cowpea shell could replace wheat offal in broiler chickens diet up to 100% without affecting growth parameters. The results agreed with (Afolayan, 2004; Ajaja, *et al*., 2002; Dafwang and Shwarman, 1996, and Chae, *et al*., 2002) in their separate studies using rice bran and corn bran as source of fibre respectively. The values of Daily Feed Intake during the starter phase are lower than (61.55-69.73g) as reported by Adama, *et al*., (2007) who fed sorghum brewer grains to broilers (another fibre source), while the values are higher in the finisher phase. The values of the Daily Weight Gain obtained in this study are in disagreement with the earlier reports of Abeke, *et al*., (2011) on rice offal (25.0-27.5g). Tables 6 and 7 showed no significant difference (P>0.05) in the live weight, slaughter weight, pluck weight, evisceration weight and the harvested organs measured across the treatments as reported by Fafiolu *et al*. (2015) on broilers fed palm kernel waste. From table 8 the values of head and shank, neck, thigh, wings, breast and chest are not statistically significant (P>0.05), these values vary with the report of Fakolade, *et al*. (2014) on broiler chickens fed cowpea shell were they reported significant differences (P<0.05). Marguenda, *et al*. (2006) reported that decrease of dietary fibre, when soluble fibrous sources

are included in rabbit diet enhances the carcass yield and carcass microbiology quality in monogastric. Atteh (2004) also reported that there is an anatomical response of birds to the type of diet consumed, such as the use of whole grain in feed or large fibre particles.

Conclusion

It was concluded that cowpea shell can be used as an alternative source of fibre in broiler chickens diet in the replacement of wheat offal and can replace hundred percent wheat offal this will reduce cost of production and provide alternatives.

Recommendation

From the findings obtained from this research work, the following recommendations can be made:

i. Cowpea shell can be included in broiler chicken diets by up to 100% level of inclusion without any detrimental effect on growth performance or carcass characteristics of broiler chickens.

ii. It is an alternative source of fibre.

iii. Further research on usage of cowpea shell is recommended on other monogastric animals is recommended.

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Table 1: Percentage composition of experimental diets fed to broiler chickens a starter phase (1-4 weeks of Age)

Ingredients	Control	25%	50%	75%	100%
Maize	45.25	45.25	45.25	45.25	45.25
Soya bean	35.85	35.85	35.85	35.85	35.85
Wheat offal	10.00	7.50	5.00	2.50	0.00
Cowpea shell	0.00	2.50	5.00	7.50	10.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Salt (Nacl)	0.25	0.25	0.25	0.25	0.25
Premix *	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis					
Crude protein	23.00	23.00	23.00	23.00	23.00
Metabolizable energy	2800	2800	2800	2800	2800
Crude fibre	4.56	4.56	4.56	4.56	4.56

*Each kilogram contains; vit. A, 10,000,000 IU, vit. D_3 2,000,000 IU, Vit. E 23,000mg, Vit. K_3 2.000mg, Vit, B_1 1,800mg, Panthothenic Acid 7,500mg, Vit. B_6 3,000mg, Vit. B_{12} 15mg, Folic acid 750mg, Biotin 11260mg, Choline Chloride 300,000mg, Cobalt 200mg, Copper 3,000mg, Iodine 1,000mg, iron 20,000mg, Manganese 40,000mg, Selenium 200mg, Zinc 30,000mg, Antioxidant 1,250mg

Table 2: Percentage composition of experimental diets fed to broiler chickens at finisher phase (5-8 weeks) of age

Ingredients	Control	25%	50%	75%	100%
Maize	48.45	48.45	48.45	48.45	48.45
Soya bean	27.65	27.65	27.65	27.65	27.65
Wheat offal	15.00	11.25	7.25	3.75	0.00
Cowpea shell	0.00	3.75	7.25	11.25	15.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Salt (Nacl)	0.25	0.25	0.25	0.25	0.25
Premix*	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis					
Crude protein	21.00	21.00	21.00	21.00	21.00
Metabolizable energy	3000	3000	3000	3000	3000
Crude fibre	5.65	5.65	5.65	5.65	5.65

*Each kilogram contains Vit A 3600, 000IU. Vit. D_3 600.000 IU. Vit E 4.000.000mg. Vit B_1-B_6 640, 1600, 600, 4.00mg. Panthothenic acid 2000mg, Biotin 300mg. Manganese 16000mg. Manganese 16000mg. Selenium 80mg. Vit. K_3 600mg. Cobalt 80mg. Copper 1200mg. Zinc 12,000mg. Folic acid 200mg. Choline chloride 700000mg. Antioxidant 500mg.

Table 3: Proximate composition of cowpea shell

Parameters	Percentage
Dry matter	92.00
Moisture	8.00
Crude fibre	60.18
Ether extract	1.65
Ash	6.27
Protein	20.65

Table 4: Performance characteristics of broiler chickens fed various levels of cowpea shell (starter phase).

Parameters	Levels of cowpea shell					
	0%	25%	50%	75%	100%	SEM
Daily Feed Intake (g)	34.57	40.89	38.75	33.75	36.61	6.14NS
Daily Weight Gain (g)	14.28	11.43	9.84	7.39	12.85	8.89NS
Feed Conversion Ratio	15.20	16.27	12.59	8.61	9.89	7.59NS
Feed Efficiency Ratio	0.45	0.39	0.42	0.32	0.20	0.23NS
Mortality	0	0	2	0	0	-

SEM = Standard error of means, NS = Not significant

Table 5: Performance characteristics of broiler chickens fed various levels of cowpea shell (finisher phase).

Parameters	Levels of cowpea shell					
	0%	25%	50%	75%	100%	SEM
Daily Feed Intake (g)	82.86	105.54	89.11	75.00	80.00	16.54NS
Daily Weight Gain (g)	16.33	26.11	35.00	32.62	24.52	16..67NS
Feed Conversion Ratio	6.63	7.35	4.34	4.89	4.25	3.10NS
Feed Efficiency Ratio	0.40	0.30	0.38	0.32	0.41	0.09NS

SEM = Standard error of means, NS = Not significant

Table 6: Carcass characteristics of broiler chickens fed various levels of cowpea shell.

Parameters	Levels of cowpea shell					
	0%	25%	50%	75%	100%	SEM
Live Weight (g)	1750.0	1550.0	1400.0	1450.0	1350.0	280NS
Slaughter weight %	91.34	86.88	89.48	86.15	79.49	10.85NS
Pluck weight (%)	76.96	71.04	75.13	75.27	74.05	2.81NS
Eviscerated weight	37.23	37.99	44.75	33.91	28.36	9.68NS

SEM = Standard error of means, NS = Not significant

Table 7: Organ and gut characteristics of broiler chickens fed various levels of cowpea shell.

Parameters	Levels of cowpea shell					
	0%	25%	50%	75%	100%	SEM
Gizzard (%)	0.97	0.97	1.33	1.56	1.07	0.10NS
Heart (%)	0.43	0.45	0.36	0.24	0.26	0.21NS
Lungs (%)	0.48	0.45	0.39	1.27	0.23	0.34NS
Small intestine (%)	0.67	0.48	0.50	0.54	0.67	0.36NS
Large intestine (%)	3.26	3.14	3.28	2.58	2.19	1.09NS

Liver (%)	1.12	1.02	1.30	1.24	1.11	0.21NS
Abdominal fat (%)	0.65	0.18	0.31	0.52	0.51	0.22NS

SEM = Standard error of means, NS = Not significant

Table 8: Cuts of parts of broiler chickens fed various levels of cowpea shell.

Parameters	Levels of cowpea shell					
	0%	25%	50%	75%	100%	SEM
Head and shank (%)	3.95	5.41	5.12	2.89	4.13	2.43NS
Neck (%)	2.83	2.07	2.52	2.54	2.38	0.32NS
Thigh (%)	14.53	16.52	17.80	13.07	13.07	2.36NS
Wings (%)	4.24	5.33	4.81	3.04	3.88	1.21NS
Breast (%)	9.75	13.25	12.22	9.62	9.08	3.23NS
Chest (%)	1.89	2.26	2.68	2.08	1.92	0.84NS

SEM = Standard error of means, NS = Not significant