

Performance, carcass characteristics and feed cost Benefits of broilers fed processed *Mucuna sloanei* seed meal

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Abstract *Corresponding author: emmauniteduk@yahoo.com

The performance of broiler chickens fed boiled, boiled with potash (akanwu) (BWA) or boiled and mix with enzyme (BME) mucuna seed meal (MSM) were investigated. 120 a week old broiler chicken were randomly assigned to 4 treatment diets in a completely randomized experiment that lasted for 49 days. The diets were made of control (soya bean based), D2 (5% boiled MS), D3 (5% BWA MSM) and D4 (5% BME). The proximate composition of mucuna was determined. Other parameters measured were: feed intake, weight gain, and carcass characteristics of broilers. The crude protein content ranged from 22.10-22.16%, while the energy level ranged from 2996.10-3003.60kcal/kg. For growth performance, significance differences ($P < 0.05$) exist for final body weight, total weight gain, daily weight gain and feed to gain ratio except for initial body weight, total feed intake, daily feed intake and mortality. BME gave the best growth performance in terms of significant ($P < 0.05$) higher final body weight (2566.50g), total weight gain (2489.20g), and better feed to gain ratio (2.25) than the control which had: 2198.30g, 2095.10g and 2.56 for FBW, TWG and FGR respectively. For the carcass characteristics, chickens fed diet 4 (BME) was not significantly ($P > 0.05$) different from the control for dressed weight and dressed weight percentage. Control diet had the highest breast cut (31.87%) and diet 4 had the lowest (28.57%) while D4 had the highest thigh cut (18.34%) but the control had the lowest (16.41%). For cost per kg weight gain and gross margin, D4 gave ₦235.03 and ₦708.64 respectively, which compared favourably ($P > 0.05$) with the control (₦231.71, ₦746.68). The revenue and gross margin values observed were direct indices of the biological effects observed in the growth performance (Table 4). From the above, Diet 4 which is boiled mucuna seed meal mixed with enzyme is therefore chosen as the best in terms of cost/Kg weight gain, revenue and gross margin in that it compared favorably with the control diet (D1).

Keywords: boiled, akanwu, enzyme, mucuna, mix

Introduction

Nigerians consume about 3.24g of animal protein per person per day which is far lower than the FAO (1990) recommended value of 34g (Omiyale *et al.*, 2014). The low consumption of animal product has been associated with the high cost of feeding poultry which is about 65-75% of the total cost of livestock production (Nwogu, 2014). Therefore the need to find alternative protein supplement to poultry feeding cannot be overemphasized. The high cost of feed is due mainly to competition between man and livestock for

conventional feed ingredients like soybean seed meal and groundnut seed meal (Adegbola, 1990; Emenalom, 2004; Akintunde *et al.*, 2013). One of the promising ways to solving the problem is to identify cheaper and available feed stuffs that are of low human preference and little or no industrial use that can meet nutritional requirements of poultry with or without processing (Akinmutimi *et al.*, 2011; Amaefule *et al.*, 2013).

One of the grain legumes that have such potential is velvet bean (*Mucuna sloanei*) (Akinmutimi *et al.*, 2011). The seed of

Broilers fed processed *Mucuna sloanei* seed meal

Mucuna sloanei is highly resistant to diseases and pest, and exhibit good nutritional qualities. It yields about 0.8-2 tons of seeds/hectare with crude protein content of about 28% and high energy of 2.71kcal/g (Akinmutimi *et al.*, 2011). It is relatively high in lysine content and compares favourably in terms of methionine content with soya bean meal, thus making it a potential source of protein for poultry (Sridhar and Bhat, 2007).

However *Mucuna* species are known to contain anti-nutritional factors such as L-DOPA, trypsin inhibitors, tannin and cyanogenic glycoside (Carew *et al.*, 2003b; Akinmutimi and Ukpabi, 2008). This normally cause neurologic effect such as dizziness, nervousness, and poor growth, and high mortality of birds (Akinmutimi *et al.*, 2011), thus the need for processing before use in broilers ration. Boiling, boiling in potash solution and application of enzyme are among the common and acceptable means of detoxification among Nigerians.

This study therefore was aimed at investigating the best processing methods of *Mucuna sloanei* seed for broiler production as well as carcass characteristics of broilers fed processed *Mucuna sloanei* seed meal.

Materials and methods

The experiment was carried out at The Poultry Unit of The Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

Procurement and processing of *Mucuna sloanei* seed

Mucuna sloanei seed (Ukpo) was purchased in Aba main market in Aba, Abia State, Nigeria.

The following methods were used in processing of *mucuna* seed.

Boiling in water for 30 minutes

Two litres of water was used for 1kg of *mucuna* seed. The seed was added into the water at boiling point and allowed to boil for 30 minutes after which the heat was removed, the water decanted and the seed dried in the open air under the sun and milled to pass through 2mm sieve, bagged and stored for use in feed formulation for the broiler chicken

Boiling with potash sexquioxide (akanwu) in water for 30 minutes

The potash was added at 5% of the liquid (water) the same time the *mucuna* seed was introduced into the boiling water (at boiling point) and allowed to boil for 30 minutes after which the heat was removed, the water decanted and the seed dried in the open air under the sun and milled to pass through 2mm sieve, bagged and stored for use in feed formulation for the broiler chicken.

Boiling in water for 30 minutes and mixed with a multi-enzyme (maxi grain)

Feed containing the enzyme was prepared through the following procedure: During mixing of the feed ingredients, the micro-ingredients were measured separately including the boiled *mucuna* seed meal. The maxi-grain was added at the rate of 100g/ton of feed to these micro ingredients and mixed together before mixing them with other feed ingredients (the macro ingredients).

Experimental birds and management

A total of 200 day old chicks were purchased from a reputable farm and brooded for one week to enable the birds stabilize. One hundred and twenty (120) of same were transferred and randomly assigned to four treatment groups replicated into three with 30 birds per treatment and 10 birds per replicate in deep litter pens spread with wood shavings. The experiment was a completely randomized design (CRD). 5% level of boiled, boiled with potash

Ewa

(*akanwu*), boiled and mix with enzyme (BME), respectively of *Mucuna sloanei* seed meal was used for inclusion into diets 2, 3, and 4, respectively, while, diet 1 served as control without *Mucuna sloanei*. Parameters such as growth performance, carcass characteristics and feed-cost benefit of broilers were determined. The feed and water were given *ad-libitum* throughout the period. The birds were given a measured quantity of feed every day and on the following day the left over

were removed and measured to determine the quantity consumed by the birds. The birds were subjected to standard broiler management with necessary drugs and vaccines given as at when due. The experiment lasted for 49 days.

Experimental diets

A total of four diets were formulated having crude protein range of 22.10-22.16% and energy level of 2996.10-3003.60kcal/kg as shown in Table 1.

Table 1: Percentage composition of processed experimental diets containing 5% processed *Mucuna sloanei* fed to broiler chickens

Ingredients	D1 (control)	D2 (Boiled)	D3 (BWA)	D4 (BME)
Maize	60.00	57.50	57.50	57.50
Soya bean meal	30.00	27.50	27.50	27.50
<i>Mucuna sloanei</i>	-	5.00	5.00	5.00
Palm kernel meal	3.40	3.40	3.40	3.40
Fish meal (63% cp)	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00
Vit/ premix	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Dl methionine	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
Calculated composition				
Crude protein (%)	22.10	22.16	22.11	22.16
Crude fibre (%)	3.06	3.37	3.35	3.37
Calcium (%)	0.24	0.33	0.32	0.33
Phosphorus (%)	0.43	0.42	0.42	0.42
Methionine (%)	0.47	0.53	0.53	0.53
Lysine (%)	1.11	1.37	1.35	1.37
Metabolizable Energy (Kcal/Kg)	3003.60	2996.10	2996.10	2996.10

Each 2.5kg Of Premix Contains Vitamin A (8,500,000 Iu), Vitamin D (1,500,000 Iu), Vit E (10,000,000mg), Vitamin K3 (1,500,00mg), Vitamin B1 (1,600,000mg), Vitamin B2 (4,000,000mg), Niacin (20,000,000mg), Pentathenic Acid (5,000,00mg), Vit B6 (1,500,000mg), Vit B12 (10,000mg), Folic Acid (500,00mg), Biotin (750,00mg), Chlorine Chloride (175,000,00mg), Cobalt (200,00mg) Copper (3000,00mg), Iodine (1000,00mg), Zinc (30,000,00mg), Selenium (200,00mg), Managanese (40,00,00 Mg), Iron (20,000,00mg).

BWA=boiled *Mucuna* with *akanwu*, BME=boiled *Mucuna* and mix wih multi-enzyme Maxi grain multi enzyme supplemented at the rate of 100g/ton of feed to only diet 4 (BME)

Data collection

Growth performance

Feed intake and weight gain were determined on weekly bases. This was used to calculate the feed to gain ratio. Mortality if any was recorded daily. Data obtained were calculated as follows.

$$\text{Feed intake/bird/day (g)} \equiv \frac{\text{Qty of feed given} - \text{Qty not consumed}}{\text{No of birds} \times 49 \text{ days}}$$

$$\text{Daily weight gain/bird (g)} = \frac{\text{Final live weight} - \text{initial weight}}{\text{Number of birds} \times 49 \text{ days}}$$

Broilers fed processed *Mucuna sloanei* seed meal

$$\text{Feed conversion ratio} = \frac{\text{Qty of feed consumed}}{\text{Weight gain}}$$

$$\% \text{ mortality} = \frac{\text{Number of dead animals}}{\text{Number stocked}} \times \frac{100}{1}$$

Carcass evaluation

At the end of the feeding experiment, two birds per replicate were randomly selected, starved for 24 hours, weighed and slaughtered by severing the jugular vein. They were thoroughly bled and scalded by dipping in warm water (50-55°C) before being defeathered. The defeathered birds were weighed, the head, shank, neck and visceral were separated from the carcass and then the dressed weight taken. Each dressed carcass was cut into parts as reported by Ojewola and Longe (1999) for the purpose of cut parts evaluation. All parts were weighed and expressed as percentage of dressed weight.

Experimental design and statistical analysis

The experimental design used was a completely randomized design (CRD). The

model is shown below;

$$Y_{ij} = \mu + T_1 + e_{ij}$$

Where Y_{ij} = single observation (i.e the j^{th} observation of i^{th} treatment)

μ = overall mean

T_1 = effect of treatment/factor of interest

e_{ij} = the random error or residual error

$E_{ijk} = \text{iind}(0, \sigma^2)$

The random error is independently, identically and normally distributed.

Data collected were subjected to analysis of variance (ANOVA) as was described by Steel and Torrie (1980), and significant means were separated using Duncan Multiple Range Test (Duncan, 1955).

Result and discussion

Biological evaluation of processing methods

Determined composition of experimental is shown in Table 2. The nutrients requirement such as the crude protein, crude fat and energy as recommended by Akinmutimi (2011) for straight line diet for effective broiler production in the tropics were met.

Table 3: showed the growth performance of 8 weeks old broiler chickens fed processed *Mucuna sloanei* seed meal based diets

Table 2: Determined composition of processed *Mucuna* seed meal diet fed to broiler chicken

Parameters	D1 (0% <i>mucuna</i>)	D2 (5% <i>mucuna</i>)	D3 (5% <i>mucuna</i>)	D4 (5% % <i>mucuna</i>)
Dry Matter (%)	90.45	91.40	90.91	01.50
Crude protein (%)	21.74	21.87	22.28	23.23
Crude fat (%)	3.57	3.67	3.81	3.65
Crude fibre (%)	3.88	3.83	4.10	3.80
Ash (%)	6.81	5.91	6.61	6.60
Nitrogen free extract(%)	64.00	62.04	60.20	60.05
Energy (Kcal/g)	4.08	4.08	4.10	4.07

D1=Control, D2=Boiled *mucuna*, D3= *mucuna* Boiled with Akanwu (BWA), D4= *mucuna* boiled and mixed with enzyme (BME)

Table 3: Growth performance of broiler chicken fed diets containing processed *Mucuna sloanei* Seed Meal

Parameters	D1 (0%)	D2 (5%)	D3 (5%)	D4 (5%)	SEM
Initial body weight (g)	100.07	101.40	103.80	97.30	1.21
Final body weight(g)	2198.30 ^{bc}	1929.00 ^c	2262.70 ^b	2566.50 ^a	77.54
Total weight gain(g)	2095.10 ^{bc}	1827.60 ^c	2158.50 ^b	2459.20 ^a	78.20
Daily weight gain(g)	37.48 ^{bc}	32.64 ^c	38.55 ^b	44.10 ^a	1.3945
Total feed intake(g)	5343.77	5495.63	5927.67	5569.57	108.95
Daily feed intake(g)	95.42	98.14	105.59	95.78	2.1445
Feed to gain ratio	2.56 ^b	3.01 ^a	2.75 ^a	2.25 ^b	0.1008
Mortality (%)	6.67	6.67	6.67	6.67	0.1880

Means within the same row with different superscripts (a–c) are significantly ($P < 0.05$) different. SEM- Standard error of mean
D1=Control, D2=Boiled *Mucuna*, D3= *Mucuna* Boiled with Akanwu (BWA), D4= *Mucuna* boiled and mixed with enzyme (BME)

There were significant ($P < 0.05$) differences in all the parameters considered except for initial weight, total feed intake, daily feed intake, total weight gain and mortality. The non-significant ($P > 0.05$) values observed in the initial weight showed that there were no bias in allotting the birds to their different replicate pens among the different treatments therefore the result gotten is not biased but based on the treatment effect. For final body weight, D4 performed significantly ($P < 0.05$) higher than all including the control. It had a value of 2566.50g, followed by D3 (2262.70g). D1 (2198.30g) compared favourably with D3 while. D2 had the least value (1929.00g) but compared favourably with D1. Total weight gain and average daily weight gain followed the same trend with values ranging from 2459.20g (D4) to 1827.60g (D2) and 44.10g (D4) to 32.64g (D2), respectively as the final body weight. For feed to gain ratio, D4 and D1 (with values 2.25g and 2.56g, respectively) were significantly lower ($P < 0.06$) than D2 (3.01g) and D3 (2.75g). D2 and D3 compared ($P > 0.06$) favourably with each other. This report is in line with that of Ekwe (2012) who reported that boiled *mucuna* could not compare favourably with soya bean based diet even at 5% for final live weight, average daily weight gain and

feed conversion ratio. The overall higher quality performance of birds placed on diet 4 (boiled *mucuna* and mix with enzyme) for final body weight, total weight gain, daily weight gain and feed to gain ratio is in line with earlier research works. Adeyemi *et al.* (2013) reported that Enzyme supplementation significantly ($p < 0.05$) improved weight gain and reduced feed to gain ratio but had no effect on feed intake.

The use of enzymes in poultry feeds has predominantly been related to the hydrolysis of fibre or non-starch polysaccharide (NSP) fractions in cereal grains (Adeyemi *et al.*, 2013). These NSPs cannot be digested by the endogenous enzymes of poultry and can have antinutritive effects (Adeyemi *et al.*, 2013). The better growth rate as a result of enzyme supplementation is in consonance with previous findings (Biswas *et al.*, 1999; Swain and Johri, 1999; Midau *et al.*, 2011, Adeyemi *et al.*, 2013). These authors concluded that improved feed utilization due to enzyme supplementation was responsible for the increased live weight gain in broilers on similar levels of dietary nutrient concentration. The observation was however contrary to the report of Omojola and Adesehinwa (2007) that the inclusion of the exogenous enzymes did not significantly ($p > 0.05$) improve body weight

Broilers fed processed *Mucuna sloanei* seed meal

of broiler chicks. Divergent reports exist in literature on the relationship between exogenous enzyme supplementation and feed intake. Adrizal and Ohtani (2002) and Rahman *et al.* (2005) reported that enzymes have no effect on feed intake while, Kadam *et al.* (1991) and Samarasinghe *et al.* (2000) reported reduction in feed intake as a result of enzyme supplementation. Lesson *et al.* (1996) and Augelovicova and Michalik (1997) on the other hand reported increases in feed intake as a result of enzyme supplementation due to increased nutrient digestibility.. These researchers reported that exogenous enzymes greatly improved the feed conversion ratio of broiler chicks fed enzyme supplemented diet. The improved feed to gain ratio observed in the enzyme supplemented diet is a confirmation of the finding of Adeyemi *et al.* (2013) that enzymes increase

digestibility of modern animal feeds, which improve feed to: gain ratios for ruminants and monogastric animals alike. They associated this with the presence of such enzymes as pepsin which has the ability to break down proteins, liberating it for use by the animal tissue.

Table 4: Revealed the cut parts of the control diet and processed *Mucuna* seed meal diets. There were significant ($P<0.05$) differences in all the carcass cuts considered except for drum stick, wing and back cut. D4 was significantly ($P<0.05$) higher than other processing methods (D2, and D3) in live weight, and dressed weight- 2274.30g, 1548.00g, but compared ($P>0.05$) favourably with the control values of 2212.70g and 1598.00g, respectively. D2 had the lowest dressed weight (1362.00g) which favourably compared ($P>0.05$) with D3 (1442.70g) but significantly ($P<0.05$) lower than D4 (1548.00g) and D1 (1598.00g).

Table 4: Carcass characteristics of broiler chicken fed diets containing processed *Mucuna sloanei* seed meal

Parameters	D1	D2	D3	D4	SEM
Live weight (g)	2212.70 ^{ab}	2036.00 ^b	2049.30 ^b	2274.30 ^a	39.55
Dressed weight (g)	1598.00 ^a	1362.00 ^c	1442.70 ^{cb}	1548.00 ^{ab}	32.45
Percent dressed wt (%)	72.13 ^a	66.92 ^b	70.38 ^{ab}	68.06 ^{ab}	0.89
Breast (%)	31.87 ^a	29.96 ^{bc}	31.07 ^{ab}	28.57 ^c	0.44
Thigh (%)	16.41 ^b	17.13 ^{ab}	17.33 ^{ab}	18.34 ^a	0.31
Drum stick (%)	15.47	16.39	15.22	16.40	0.23
Wing (%)	13.78	13.38	13.27	12.92	0.17
Back cut (%)	20.15	17.66	19.45	19.60	0.64

Means within the same row with different superscripts (a – c) are significantly ($P< 0.05$) different .SEM- Standard error of mean. D1=control, D2=boiled, D3=boil with potash (Akanwu), D4= boiled and mix with enzyme

The dressed weight percentage of D4 (68.06%) compared ($P>0.05$) favourably with D1 (72.13%), and D3 (70.38%) while D2 (66.92%) had the lowest value that was only comparable to D3 and D4 (68.06g). The breast weight value showed that D4 (28.57%) compared ($P>0.05$) favourably with D2(29.96%) and both were significantly lower than the control (31.87%) while D2 compared favourably

with D3(31.07) but was significantly ($P<0.05$) lower than the control (D1). D4 (18.34%) had a good thigh percentage that was significantly higher ($P<0.05$) than that of the control (D1=15.47%) but compared favourably with D3(17.33%) and D2(17.13%). The better performance of the control compared to the boiled for live weight and dressing percentage has been reported by Ekwe (2012) in a study with

Mucuna sloanei based diet in broiler chicken reported that the thigh percentage of the boiled (13.95) was comparable to that of the control (13.70%).

The superior performance of the birds placed on boiled *mucuna* and mix with enzyme over the control and other processing methods for live weight and percentage thigh, and its comparable values for dressed weight and dressed weight percentage with the control showed that this method of processing (boiled and mix with enzyme) is the best among others, thereby confirming the earlier report of (Oluyemi and Robert, 2000) that birds fed enzyme supplemented diets gave heavier edible portions as opposed to inedible offal. In his work titled “Soya bean meal replacement with cassava leave: blood meal mix with or without enzyme in broiler diet, Adeyemi *et al.* (2013) reported that enzyme supplementation significantly improved dressing percentage. Other

researchers also supported this opinion. Augelevicova and Michalik (1997) observed significant ($P<0.05$) increase in dressing percentage with enzyme supplementation which agreed with the report of Lesson *et al.* (1996) who reported increase dressing yield for the addition of enzyme due to higher fat deposition in the carcass. Similar report was given by Abbas *et al.* (1998) that enzyme supplementation to fibrous diet improved growth rate, thereby increasing the dressing percentage. Bharathidhasan *et al.* (2009) also reported a marginal increase in dressing percentage and carcass yield in birds fed enzyme supplemented reduced energy and protein diets. Rahmatnejad *et al.* (2011) reported that supplementation of dried tomato pomace with Rovabio Excel™ significantly increased carcass weight and percentage of abdominal fat but did not affect carcass yield and breast, thigh, and visceral organs percentage.

Table 5: Economics of production of broiler chicken fed processed *Mucuna* bean seed meal based diets.

Parameters	D1	D2	D3	D4	SEM
Cost/Kg feed(₦)	97.36	106.89	106.93	106.89	1.24
Cost of Feed consumed/ bird (₦)	521.95 ^b	587.39 ^{ab}	608.75 ^a	595.32 ^{ab}	14.64
Feed Cost /Kg weight gain (₦)	231.72 ^{bc}	235.61 ^a	281.37 ^{ab}	235.03 ^c	12.62
Revenue (₦)	1269.00 ^{ab}	1158.00 ^b	1168.00 ^b	1304.00 ^a	46.55
Gross margin (₦)	746.68 ^a	570.61 ^{bc}	558.25 ^c	708.64 ^{ab}	30.96

Means within the same row having different superscripts (^{a-c}) are significantly ($P<0.05$) different.SEM =Standard error of mean .D1= Control (No *Mucuna*); D2= Boiled *Mucuna* based diet; D3= *Mucuna* boiled with *Akanwu* for 30 minutes (BWA); D4= Boiled *Mucuna* for 30 minutes + Enzyme (BME)

There were significant ($P<0.05$) differences for all the parameters considered except for cost /kg feed. The cost of feed consumed was highest in D3 (₦608.75) which was significantly ($P<0.05$) different from that of D1 (₦521.95) but was not significantly different from that of D2 (₦587.39) and D4 (₦595.32). The difference in prices of each diet was associated with the method of processing employed in the different test diets. D4 (₦235.03) had the lowest cost /kg

weight gain which significantly ($P<0.05$) differed from D2 (₦235.61) and D3 (₦281.37) but was not significantly different from D1 (₦231.72). The significantly ($P<0.05$) lower cost/kg weight gain observed in D4 could be attributed to the positive effect of enzyme supplementation in this particular diet, enabling the birds to convert the nutrient in the feed to flesh better. This is in line with the report of Adeyemi *et al.* (2013) that

Broilers fed processed Mucuna sloanei seed meal

enzyme supplementation improved weight gain reduced feed to gain ratio and improved nutrient retention, dressing and fat percentage. The result agreed with the findings of Ukachukwu and Anugwa (1995) that least cost feed formulation seeks to achieve cost input minimization and output maximization. For revenue and gross margin, D4 performed better than other test dietary treatment, comparing favourably with the control. D4 had the highest value (₦1304.00) for revenue which was significantly ($P<0.05$) different from D2 (₦1158.00) and D3 (₦1168.00) but not significantly different from D1 (₦1269.00). For gross margin D4 had the highest ($P<0.05$) absolute value (₦708.64) among the processed *mucuna* based diet but was not significantly different from the control diet (₦746.8). This may be the products of favourable weight gain, moderate feed cost and good market price of birds fed diet containing 5% boiled *mucuna* seed meal mixed with enzyme. D3 (₦558.25) had the lowest value which was significantly ($P<0.05$) different from D1 and D4 but not significantly different ($P>0.05$) from that of D2 (₦570.61).

The revenue and gross margin values observed were direct indices of the biological effects observed in the growth performance (Table 4). From the above, Diet 4 which is boiled *mucuna* seed meal mixed with enzyme is therefore chosen as the best in terms of cost/Kg weight gain, revenue and gross margin in that it compared favorably with the control diet (D1).

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