

PARTIAL REPLACEMENT LEVEL OF SOYBEAN MEAL WITH RAW *Mucuna Sloanei* IN THE DIET OF BROILER FINISHER CHICKEN

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ABSTRACT

An experiment was conducted to determine the effect of the partial replacement level of soybean with raw *mucuna sloanei* in broiler finisher diet. The biological performance, nutrient utilization of levels of raw *Mucuna sloanei* meal, as well as the bio-economics of production of broiler finisher birds fed levels of raw *Mucuna sloanei* meals. Effect of partial replacement level of soybean meal with raw *Mucuna sloanei* meal on broiler finishers was evaluated by replacing soybean meal with raw *Mucuna sloanei* meal at 0, 10, 20, 30 and 40% using 135 Anak broiler birds. Also, growth performance, nutrient utilization and bio-economics of production of the broiler finisher birds were evaluated using a completely randomized design (CRD) experiment. The birds were fed *ad-libitum*. The optimum replacement level of RMS by broiler finisher birds was 40% level of replacement of soyabean meal (or 8.12% RMS inclusion level) based on growth performance and economics of production. RMS significantly ($P<0.05$) depressed nutrient utilization at all levels of replacement except for ether extract and NFE. Cut-parts values were also depressed ($P<0.05$) beyond 10% level of replacement.

Keywords: Soybean meal, *Mucuna* and Broilers

Introduction

High cost of conventional feedstuffs especially protein feedstuffs, is one of the major hindrances to expansion of poultry industry in Nigeria (Faniyi, 2002^a). Generally, protein feedstuffs of animal origin such as fishmeal and meat-meal are more expensive than energy feedstuffs. They are also more expensive than protein feedstuffs of plant origin such as soyabean meal and groundnut cake (Faniyi, 2002^b). Hence, more plant protein sources are used in poultry feed formulation than animal protein sources (Aduku, 1992). Attempts to feed plant protein sources such as *Mucuna cochinchinensis* (Ukachukwu and Obioha, 1997), Pigeon pea (Amaefule and Obioha, 1998) etc. to broiler indicate that search for alternative feedstuff is a continuous exercise in order to reduce the cost of production. It is therefore imperative on the part of Poultry Nutritionist to find a way of enhancing productivity at least cost and to utilize cheap unconventional protein ingredients as substitutes for costly conventional

protein ingredients (Ukachukwu, 1997). The high cost of feed is due mainly to competition between man, livestock and industries for grains and conventional sources of plant and animal proteins (Ezeagu et al., 2003). Presently, commercial feed firms produce broiler feed of doubtful composition of ingredients and adequacy of nutrients. It has become imperative therefore, to turn attention to the exploitation of the under-utilized unconventional feedstuff particularly those indigenous to the tropics (Akinmutimi *et al.*, 2006). One of the under-utilized legumes that come to mind is *Mucuna sloanei*.

Materials and Methods

Determination of Partial Replacement Level of Soybean Meal with Raw *Mucuna Sloanei* in the Diet of Broiler Finisher Chicken

One hundred and fifty (135) day-old Anak broilers were housed in 15 pens with 9 birds in each pen measuring 2.6m x 3m. Brooding was carried out for 4 weeks, and heat for brooding was

supplied using kerosene stove under a metal hover. Also, tarpaulin was used to cover the wire-netting parts of the building to prevent cold during brooding. The hover and tarpaulin was removed at the end of the brooding.

Feeding and drinking troughs were provided. Necessary vaccinations and medications were carried out as follows:

Day 1 – Lentogenic vaccine through intraocular route to prevent Newcastle disease.

Day 10 – Gumboro to prevent infectious bursal disease.

Day 21 – Lasota to prevent Newcastle disease.

Medications that were carried out include giving of biovite for the purpose of relieving stress and ESB3 to prevent coccidiosis.

The one hundred and fifty (135) broiler birds were allotted to five (5) treatments with thirty (27) birds in each treatment. Each treatment had 3 replicates of 9 birds each. Five (5) experimental diets were formulated. Diet 1 was soybean-based (control). While the test feedstuff (raw *Mucuna sloanei*) replaced 10, 20, 30 and 40% soybean in diets 2, 3, 4 and 5 respectively in a completely randomized design experiment. The birds were randomly assigned to the experimental diets at the 5th week. Feed and water were given *ad-libitum* throughout the experimental period. This experiment lasted for 28 days. The diets were formulated based on the nutrient requirements for broiler finisher birds.

Growth performance

Data were collected on initial, weekly weight and final weight of the animals, quantity of feed given and the left over. The values obtained were used to obtain the following parameters.

(a) Feed intake/bird/day =

$$\frac{\text{Quantity of feed given (g)} - \text{left over feed (g)}}{9 \times 28 \text{ days}}$$

b) Final weight = Recorded values of body weight of birds on the last day of the experiment =

$$\frac{\text{Sum of individual weight of birds}}{\text{Number of birds}}$$

c) Weight gain/ bird/ day =

$$\frac{\text{Final live weight} - \text{initial weight}}{9 \times 28 \text{ days}}$$

d) FCR (feed conversion ratio) =

$$\frac{\text{Quantity of feed consumed}}{\text{weight gain}}$$

weight gain

Determination of Nutrient Utilization Coefficient

At the beginning of the 9th week 3 birds, with similar weight within each treatment were selected from each replicate and transferred to metabolism cages for faecal collection. The birds were fed the first five days in the cages without collection of faecal droppings. This is to get them acclimatized to the cages. Thereafter faecal droppings were collected for the next 10 days while the birds still continued feeding on a measured quantity of the test diets. The faecal droppings collected were dried in a forced-draught oven at 60°C to a constant weight. After drying the dry weight of the faecal samples were taken. The dry samples were ground and stored in air-tight bottles for laboratory analysis. The same procedure was carried out in the finisher phase. The experimental diets were analyzed for proximate components by the AOAC (1995) procedure. The gross energy values of the diets were determined by the Parr Adiabatic oxygen Bomb Calorimetry Technique. Nutrient utilization coefficient was calculated as the amount of nutrient consumed by birds minus amount of nutrient in faeces over the amount of nutrient consumed by same birds.

Gross margin/ Economics of the diets

Gross margin/ Economics of the diets were determined as described by Sonaiya *et al.* (1986), Ukachukwu and Anugwa (1995), and modified by Ekwu (2008). It involves:

$$\text{Cost/ kg of feed} = \frac{\text{total cost of producing 100kg of feed}}{100}$$

$$\text{Cost of feed consumed (N)} = \text{Cost/ kg of feed} \times \frac{\text{total feed consumed}}{\text{consumed}}$$

$$\text{Cost/ kg weight gain} = \text{cost/kg of feed} \times \text{FCR}$$

$$\text{Revenue} = \text{Price of 1kg meat} \times \text{mean weight gain}$$

$$\text{Gross margin} = \text{Revenue} - \text{cost of production}$$

Statistical Analysis

All collected data were subjected to analysis of variance in Completely Randomized Design (CRD) as described by Steel and Torrie (1980) using SPSS statistical package. Mean separation as carried out using the multiple range test as described by Duncan (1955).

Table 1: Percentage composition of Broiler Finisher Diets Containing Graded levels of Raw *Mucuna sloanei*

Ingredients	Replacement level of RMS seed meal				
	0%	10%	20%	30%	40%
Maize	54.00	54.00	54.00	54.00	54.00
Soybean meal	20.30	18.27	16.24	14.21	12.18
Raw <i>Mucuna sloanei</i>		2.03	4.06	6.09	8.12
Palm kernel meal	20.00	20.00	20.00	20.00	20.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
VMP	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
Calc. comp.					
% Crude Protein	19.24	18.95	18.67	18.38	18.09
ME (Kcal/kg)	2942	2837	2932	2926	2921
% Crude fibre	4.83	5.04	5.33	5.59	5.84
% Calcium	1.24	1.24	1.24	1.23	1.23
% Phosphorus	0.64	0.64	0.63	0.70	0.72
Determined analysis.					
% ash	13.90	15.82	16.01	16.79	17.26
% crude protein	19.95	19.85	19.82	19.78	19.74
% crude fibre	5.00	5.26	5.40	6.80	6.38
% ether extract	3.85	3.62	3.60	3.88	4.31
% nitrogen free extract	57.30	55.45	55.17	53.75	52.31
Gross energy (Kcal/g)	3.250	3.106	2.984	2.969	2.947

RMS- Raw *Mucuna sloanei*

*1kg of premix contains: vitamins A (5,000,000 I.U), Vitamin D3 (1,000,000 I.U), Vitamin E (16,000mg), Vitamin K3 (800mg), Vitamin B1 (1,200mg), Vitamin B2 (22,000mg), Niacin (22,000mg), Calcium pantothenate (4,600mg), Vitamin B6 (2,000mg), Vitamin B12 (10mg), Folic acid (400mg), Biotin (32mg), Choline chloride (260,000mg), Manganese (948,000mg), iron (40,000mg), Zinc (32,000mg), Copper (3,400mg), Iodine (600mg), Cobalt (120mg), Selenium (48mg), Anti-oxidant (48,000mg).

VMP: vitamin mineral premix, ME: metabolisable energy, Kcal: kilocalorie, g: gram

Results and Discussion

Growth Performance of Broiler Finisher Chicken Fed Levels of Raw *Mucuna sloanei* in partial replacement of soybean in broiler finisher Diet

Table 2 shows the growth performance of broiler finisher birds fed levels of raw *Mucuna sloanei* in partial replacement of soybean meal in broiler finisher diet. Treatment 1 (0%) performed better in final weight gain than other treatments. Treatment 2 (10%) is statistically the same ($p>0.05$) as treatment 3 (20%) and 4 (30%) but significantly higher ($p<0.05$) than treatment 5 (40%). This could be associated with the presence of anti-nutritional substances in the raw *Mucuna sloanei* that influences the nutrient utilization of the test diet. The similarity ($p>0.05$) between the control and the test diets in feed consumption

could be due to the ambient temperature, as low temperature enhances feed intake. As the raw *Mucuna sloanei* increased in the diet, dietary fibre level also increased. This may have also contributed to the consumption of the test diets. Since higher dietary fibre results in energy dilution of the diets, the birds had to consume more to meet their energy requirement. This agrees with the report of Sandford (1986) and Lebas *et al.* (1986) that growing animals adjust their feed intake according to energy and crude fibre content of the feed given to them. From the table (2) the control was better in terms of final live weight, Average daily weight gain, feed conversion ratio and protein efficiency ratio, whereas these parameters were not significantly ($p>0.05$) different among the test diets. This shows that finisher birds could tolerate raw

Mucuna diets at up to 40% level of partial replacement of soybean meal and therefore raw *Mucuna sloanei* protein can partially replace dietary soybean protein at levels up to 40%

without any adverse effects on the performance of the finisher birds. This partial replacement translates to 8.12% inclusion of raw *Mucuna sloanei* in a broiler finisher diet.

Table 2: Growth Performance of Broiler Finisher Birds Fed Graded Levels of Raw *Mucuna sloanei* Meal-based Diets

Parameters	Treatment 1 (0%)	Treatment 2 (10%)	Treatment 3 (20%)	Treatment 4 (30%)	Treatment 5 (40%)	SEM
Initl Wt (g)	996.67	996.50	996.67	996.67	996.50	0.408
Final Wt (g)	1830 ^a	1623 ^b	1603.33 ^{bc}	1543.67 ^{bc}	1526.67 ^c	34.37
ADFI (g)	123 ^a	121.7 ^a	121.0 ^a	117.7 ^a	117.7 ^a	3.520
ADWG (g)	39.66 ^a	30.32 ^b	28.89 ^{bc}	26.03 ^{cd}	25.24 ^d	1.53
FCR	3.12 ^b	4.07 ^a	4.22 ^a	4.54 ^a	4.64 ^a	0.254
PI	22.36 ^a	21.93 ^a	21.73 ^a	21.05 ^a	20.98 ^a	0.631
PER	1.78 ^a	1.39 ^b	1.24 ^b	1.23 ^b	1.20 ^b	0.885

Initl Wt: initial liveweight, Final Wt: final liveweight, ADFI: average daily feed intake, ADWG: average daily weight gain, FCR: feed conversion ratio, PI: protein intake, PER: protein efficiency ratio, g: gram.

Nutrient Utilization

Table 3 shows the nutrient utilization coefficient of raw *Mucuna sloanei* meal fed to broiler finisher birds. There were significant differences among the treatments for all the parameters considered. It could be observed that treatment 1(0%), 2(10%), 3(20%), 4(30%) and 5(40%) followed the same pattern for DM, CP, CF, and energy. The values for dry matter (DM) ranged from 71.55% in treatment 1 to 58.50% in treatment 5. The result showed that as the level of

raw *Mucuna sloanei* increased in diet the lower the value of dry matter utilization coefficient. This could be as a result of the effect of anti-nutritional factors on the utilization of dry matter of the test diet that increased with the increase in level of raw *Mucuna sloanei*. The crude protein content of the test diet could have also affected the utilization of the dry matter of the test diet. This agrees with the report of Maynard (1972) that higher crude protein content of a diet increases the dry matter utilization.

Table 3: The Nutrient Utilization Coefficient of Raw *Mucuna sloanei* Meal-based Diets Fed to Broiler Finisher Birds

Parameters	Treatment 1 (0%)	Treatment 2 (10%)	Treatment 3 (20%)	Treatment 4 (30%)	Treatment 5 (40%)	SEM
(%)DM	71.55 ^a	67.60 ^b	65.02 ^c	62.64 ^d	58.50 ^e	0.215
(%)CP	81.59 ^a	65.03 ^b	50.25 ^c	45.50 ^d	36.76 ^e	0.620
(%)CF	59.06 ^a	56.36 ^b	48.20 ^c	42.50 ^d	32.23 ^e	1.172
(%)EE	69.06 ^a	70.52 ^a	69.56 ^a	64.78 ^b	63.82 ^b	1.001
(%)NFE	72.10 ^c	74.90 ^b	78.07 ^a	78.21 ^a	68.35 ^d	0.609
Energy (%)	67.58 ^a	55.66 ^b	53.29 ^c	48.47 ^d	46.52 ^e	0.503

DM: dry matter, CP: crude protein, CF: crude fibre, EE: ether extract, NFE: nitrogen free extract

Mupangwa *et al.* (2000) also reported that increase in crude protein intake enhances dry matter utilization. For crude protein, the value ranged from 81.59% in treatment 1 and 36.76% in treatment 5. The value of crude protein utilization coefficient reduced as raw *Mucuna sloanei* increased in the diets. This resulted in low performance of the birds in the raw *Mucuna sloanei* based diets as can be seen in table 2 that the FCR and PER were lower in the test diets

when compared with the control. This could be due to the effect of anti-nutrients in raw *Mucuna sloanei*. This agrees with the report of Aletor and Fasuji (1997), and Osagie *et al.* (1996) that tannins bind dietary proteins and digestive enzymes forming complexes that are not readily digestible. They also observed that phytin exerts its anti-nutritional ability by chelating proteins forming complexes that are not readily broken down. It could be observed that crude fibre

utilization reduced as the level of raw *Mucuna sloanei* increased in the diets. This could be associated with the level of crude fibre in the test diet. Increase in dietary crude fibre level in the diet results in rapid passage of the diet through the gut and high fibre level encourages bowel movement (Esmail, 1977). The value for energy utilization decreased with increase in the level raw *Mucuna sloanei*. The value ranged from 67.58% in the control (treatment 1) diet to 46.52 in treatment 5. This could be associated to the influence of anti-nutritional factors on energy metabolism. For ether extract treatments 1, 2, 3, were similar ($p>0.05$) but higher ($p<0.05$) than treatments 4 and 5 that were themselves similar ($p>0.05$). Nitrogen free extract had no specific pattern and therefore cannot be attributed to treatment effect. The significant differences observed in the finisher phase could be attributed to the effect of anti-nutritional factors contained in the raw *Mucuna sloanei*.

Carcass Characteristics

Table 4 shows the effect of the graded levels of raw *Mucuna sloanei* on the carcass characteristics (Cut-up yeilds) of finisher broiler. There were

significant differences among the treatments for all the parameters considered in the cut parts of finisher broiler birds expressed as percentage of dressed weight. There were significant differences among the treatments for percentage dressed weight, it ranged from 86.38% in treatment 1(0%) to 65.0% in treatment 5(40%). It could be observed that the percent dressed weight reduced as the level of raw *Mucuna sloanei* increased in the diet. However, treatments 1,2,3,4, and 5 had a good dressing percentage that suggests that the live weight is made of mostly edible portion (Oluyemi and Roberts, 2000 Akinmutimi, 2004). For thigh, treatments 1(0%) and 2(10%) were similar ($p>0.05$) but higher ($p<0.05$) than treatments 3(20%), 4(30%) and 5(40%) that were significantly ($p<0.05$) different from each other. The value for thigh ranged from 13.29% in the control (treatment 1) to 10.75% in treatment 5(40%). The value for drumstick in treatment 1(14.09%) was similar ($p>0.05$) to that of treatment 2(13.26%) but different from that of treatments 3(12.36%), 4(11.36%) and 5(10.83%). However, treatment 3 was similar ($p>0.05$) to treatments 2,4 and 5.

Table 4: The Effect of The Graded Levels of Raw *Mucuna Sloanei* on the Carcass Characteristics (Cut-up yeilds) of Finisher Broiler

Parameters	Treatment 1(0%)	Treatment 2 (10%)	Treatment 3 (20%)	Treatment 4 (30%)	Treatment 5 (40%)	SEM
LiveWeight(g)	1725.0 ^a	1525.0 ^b	1475.0	1375.0 ^d	1300.0 ^e	18.257
(%)Dressed wt	86.38 ^a	79.67 ^b	73.21 ^c	68.73 ^d	65.00 ^e	0.349
(%)Thigh	13.29 ^a	13.44 ^a	12.52 ^b	11.12 ^c	10.75 ^d	0.164
(%)Drumstick	14.09 ^a	13.26 ^{ab}	12.36 ^{bc}	11.36 ^c	10.83 ^c	0.744
(%)Breastcut	24.13 ^a	24.11 ^a	21.53 ^b	21.09 ^b	18.86 ^c	0.527
(%)Backcut	25.85 ^a	24.23 ^{ab}	22.30 ^{ab}	21.26 ^{ab}	19.11 ^b	0.319
(%)Wing	11.76 ^a	11.24 ^{ab}	10.92 ^b	10.01 ^c	9.85 ^d	0.158

For breastcut, treatment 1(24.13%) was similar ($p>0.05$) to treatments 2(24.11%) but higher ($p<0.05$) than treatments 3(21.53%), 4(21.09%) and 5(18.86%). However, treatments 3 and 4 were similar ($p>0.05$). The values for wing ranged from 11.76% in treatment 1 to 9.85% in treatment 5. Treatments 2, 3 and 4 were 11.24%, 10.92% and 10.01% respectively. Treatment 1 was not significantly ($p>0.05$) different from treatment 2 but was significantly ($p<0.05$) different from treatment 3, 4 and 5, however, treatment 3 was not significantly ($p>0.05$) different from treatment 2. The significant

($p<0.05$) difference observed among all the parameters considered was also seen in the starter phase. For thigh and breastcut up to 10% level of partial replacement of soybean meal could be used in broiler finisher diet when thigh and breast cut are the primary focus for profit making. However, up to 40% of partial replacement of soybean gave good percentage for drumstick and backcut. For wing up to 30% level of partial replacement is encouraging.

Bio-Economics of Production

Table 5 shows the bio-economics of production of broiler finisher fed graded level of raw *Mucuna sloanei*-based diets. Significant differences were observed for all the parameters measured except for cost per kg weight gain which showed no significant difference ($p>0.05$) among the treatments. This could be due to the ability of the birds to convert feed to flesh and also because of the presence of the low cost diet (raw *Mucuna sloanei*) used to formulate the diet. This agrees with the report of Ukachukwu and Anugwa (1995) who reported that least cost feed formulation seeks to achieve cost input minimization and output maximization. The cost per kg feed and the relative cost per kg feed reduced with increase in the level of raw *Mucuna sloanei* in the diets. The cost per kg feed ranged from N67.99 in treatment 1(0%) to N44.55 in treatment 5 (0%), however, treatments 2,3, and 4 were N59.38, N54.77 and N49.16 respectively. Moreover, the relative cost per kg feed (%) also reduced with increase in the level of raw *mucuna*

sloanei diets. The value ranged from 100% in treatment 1 to 65.52% in treatment 5. However, treatments 2, 3, and 4 were 87.34%, 80.56% and 72.30%. This could be due to the cost and quantity of each ingredient used in compounding the diets especially raw *Mucuna sloanei* in relation to soybean meal which it replaced. The level of replacement of raw *Mucuna sloanei* meal in the diets minimized the cost per kg feed in the treatments. This is in agreement with the observation of Ukachukwu (1997) that most of the alternative feed stuffs are still much cheaper than the conventional ones, and their use will therefore minimize cost input in feed formulation.

For cost of feed consumed per bird, the values significantly ($p<0.05$) reduced with increase in the level of replacement of soybean meal. The values ranged from N110.54 in treatment 5(40%) to N176.59 in treatment 1(0%). However, the values for treatment 2, 3 and 4 were N152,50, N139.76 and N121.92.

Table 5: The Bio-Economics of Production of Broiler Finisher Fed Graded Level of Raw *Mucuna Sloanei*-Based Diets

Parameters	Treatment1 (0%)	Treatment2 (10%)	Treatment3 (20%)	Treatment4 (30%)	Treatment5 (40%)	SEM
Cost/Kg feed (N)	67.99	59.38	54.77	49.16	44.55	
Relative cost/kg feed (%)	100	87.34	80.56	72.30	65.52	
Cost of feed consumed (N)	176.59 ^a	152.50 ^b	139.76 ^c	121.92 ^d	110.54 ^e	4.154
Cost/Kg weight gain (N)	212.36 ^a	241.48 ^a	230.95 ^a	223.02 ^a	206.86 ^a	14.28
Expected Rev (N)	625.0 ^a	470.0 ^b	455.0 ^{bc}	410.0 ^c	397.50 ^c	25.74
Gross margin (N)	448.41 ^a	317.50 ^b	315.24 ^b	288.08 ^b	286.96 ^b	27.02

The differences in the cost (N) of feed consumed per bird among the treatments was derived from the cost per kg of the various feed consumed by finisher broiler birds. Though the diets were equally consumed, the differences in price of each occasioned by the levels of raw *Mucuna sloanei* reflected in the cost of feed consumed per bird. The value for revenue in treatment 1(0%) was significantly ($p<0.05$) higher than treatments 2(10%), 3(20%) 4(30%) and 5(40%). The values were N625.0, N470.0, N455.0, N410.0 and N397.50 respectively. However, treatment 2 was similar ($p>0.05$) to treatment 3 but different ($p<0.05$) from treatments 4 and 5 that were similar ($p>0.05$) to treatment 3. The revenue

value reduced with increase in the level of raw *Mucuna sloanei* in the diet. The value for gross margin was significantly ($p<0.05$) higher in treatment 1(0%) than in the test diets which were similar ($p>0.05$) among the treatments. This could be as a result of the similarity in the feed intake and the rate at which the birds converted feed to flesh.

Conclusion

Since there is significant reduction in the values of growth performance, nutrient utilization, carcass yield and bio-economic gains as *Mucuna sloanei* increased in the diet, thorough processing of the ingredient for maximum utilization is

required. However, the result revealed that *Mucuna sloanei* is a promising least cost alternative feed ingredient that can replace soybean meal if well processed.

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