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RESEARCH ARTICLE

THE EVALUATION OF TOASTED *MUCUNA SLOANEI* MEAL AS A FEED INGREDIENT IN BROILER DIET

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ABSTRACT

The evaluation of toasted *Mucuna sloanei* meal as feed ingredient in broiler diets was carried out using growth performance, carcass quality, organ weights, anti-nutritional factors and cost implication of the diets as parameters. A total of 120 day-old Marshal broilers were used for this trial. They were allocated into four treatments having three replicates with 10 birds per replicate in a Completely Randomized Design (CRD) experiment. Four iso-caloric (2800Kcal/Kg M.E) and iso-nitrogenous (22.5% CP) diet were formulated. Diet 1 was purely soybean based diet (control diet) while the toasted *Mucuna sloanei* replaced soybean at varying levels of 5%, 10%, and 15% in diets 2, 3, and 4 respectively. The experiment lasted for 56 days. Proximate and gross energy composition of the toasted *Mucuna sloanei* crude protein of 28.96%, crude fat (5.61%), crude fibre (8.11%), Ash (4.55%), Dry matter (90.50%), NFE (28.85%) and Gross energy (3.94Kcal/g). presence of anti-nutritional factors such as L-Dopa (3.61%), Tannin (0.17%), HCN(8.27%) were confirmed. For the growth performance, control diet was superior to others with the final weight gain/bird of 1.75Kg, T2 (1.34Kg) that were significantly higher than others. Also T1 had 0% mortality and the least feed conversion ratio value (0.05). For cut-parts T2 had higher values for the prime parts such as the thigh, drumstick, back-cut and wing. While T1 had the highest value for gross margin (416.25^a) as opposed to others, T2 (209.79^b), T3 (14.73^c), T4 (-143.22^d) making it a superior diet in terms of economics of diet. The overall results showed that the toasted *Mucuena sloanei* even at 5% dietary level of inclusion could not produce good performance, the need then to try other processing methods.

INTRODUCTION

The level of animal protein intake in most developing countries of the world, including Nigeria is low due to the high cost of conventional Feed stuffs such as soybean meal, groundnut cake etc. because they are competed for by man and industries. (Akinmutimi *et al.,* 2006). Food and Agricultural Organization (FAO, 1993) recommended 27g as the animal protein daily requirement for human beings. However0, the intake per average Nigerian is grossly inadequate (3.24g animal protein/day). Research interest has therefore been awakened in the area of alternative feed resources, which have comparative nutritive value but are cheaper than the conventional protein sources with little or no processing. (Akinmutimi, 2001). One of the underutilized legumes that comes to mind is *Mucuna sloanei*. Its consumption by humans is localized and in many cases, it appears to be a last resort legume in circumstances of famine or scarcity of more popular legume (Ukachukwu and Obioha, 1997). The seeds are highly resistant to disease and pest and exhibit good nutritional qualities (Janardhanan and Vadiviel, 1994). It yields about 0.8-2tonnes of seeds/hectare with crude protein of about 28% (Aduku, 1993; Ijeh *et al.,* 2004). One of the major problems with legume utilization is the presence of anti-nutritional factors (Oke *et al*., 2002). The anti-nutritional factors are known to cause negative effects such as less efficient feed conversion, poor growth, intermittent scouring, wasting and sometimes death of animals when consumed raw (Ologhobo *et al.,* 1993). *Mucuna sloanei* seeds have been reported to contain anti-nutrients like tannins, phytins, L-Dopa, cyanogenic glycosides etc. (Ijeh *et al.,* 2004). This calls for detoxification before usage. Toasting is a conventional method of detoxification among the rural dwellers. It was against this backdrop that this study was embarked upon to quantitatively substitute toasted *Mucuna sloanei* seed meal for soyabean meal in broiler diet.

MATERIALS AND METHODS

Environment of Study

The study was carried out at the livestock unit of Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. Umudike of 5° 28' North and 7° 31′ East and lies at an altitude of 122m above sea level. It is located within the tropical rain forest zone and the environment is characterized by an annual rainfall of about 2177mm. The relative humidity during rainy season is well above 72%. Monthly ambient temperatureis characterized by daily temperature ranges from 27°C to 36°C.

Processing of the Test Feedstuff and Experimental Diets

The raw *Mucuna sloanei* were collected from Aba in Abia state. The seeds were toasted until it became brownish in colour. The toasted *Mucuna sloanei* were milled and incorporated in the diets at different levels; 0%, 5%, 10%, and 15% (Table 1).

Management of Birds and Experimental Procedure

A total of 150 day-old Marshal broiler chicks were purchased out of which 120 birds with the same range of weight were selected for trial after one week of brooding. The birds were randomly assigned to four dietary treatments and each treatment had three replicates with ten birds per replicate in a Completely Randomized Design. Feed and water were given *ad-libitum*. Routine vaccinations were strictly adhered to.

Anti – Nutritional Factors Determination

L-DOPA, Hydrocyanic Acid (Hydrocyanides) and tannin were carried out as reported by A.O.A.C (1990), Knowles and Montgomery. (1980) and Maga (1982) respectively.

RESULTS AND DISCUSSION

Animal Trial

Growth Performance Evaluation

Data were collected on initial and final weights of the animals, quantity of feed given, the refusal and the number of animals that died during the experiment in each replicate. The values obtained were used to obtain the feed intake/bird/day, w-eight gain /loss/bird/day (kg), Feed conversion ratio and % Mortality Evaluation of Cut Parts and Organ Weights/Proportion as reported by Ojewola and Longe (1999).Feed cost implication of the Diets – AS described by Shonaiya *et al.* (1986). The proximate composition of the diet and the test feedstuff is as shown in Table 2. The values obtained particularly for crude proteins were similar to the calculated ones. Also, they all fall within the range of crude protein requirement for

Table 1. Experimental diets

	T1	*T2*	*T3*	*T4*
Maize	47.0	47.0	47.0	47.0
Soybean meal	28.5	22.5	15.5	9.5
Blood meal	1.5	2.5	4.5	5.5
Mucuna sloanei	-	5	10	15
Palm Kernel Cake	14.5	14.5	14.5	14.5
Fish meal	5	5	5	5
Bone meal	3	3	3	3
Salt	0.25	0.25	0.25	0.25
Vit. Premix	0.25	0.25	0.25	0.25
Total	100	100	100	100
CP (%)	22.58	22.25	22.31	22.13
ME (Kcal/Kg)	2880.85	2870.50	2859.15	2848.8

1kg of premix contains: Vitamin A: 3,000,000 I.U, Vitamin D3: 800,000 I.U, Vitamin E: 10g, Vitamin K: .8g, Vitamin B1: 0.2g, Vitamin B2: 1.5g, Niacin: 10.0g, Cal. D. Panthotenate: 3.0g, Vitamin B6: 0.2g, Vitamin B12: 3.5g, Folic Acid: 0.4g, Biotin: 0.02g, Choline Chloride: 120.0g, Manganese: 30.0g, Iron: 15.0g, Zinc: 12.0g, Copper: 0.8g, Iodine: 0.5g, Cobalt: 0.09g, Selenium: 0.04g, BHT (Antioxidant): 8.0g

Table 2. Proximate and gross energy Composition of theDiet and test feed stuff

	%CP	%EE	%CF	%ASH	%DM	%NFE	GE (Kcal/g)
T1	21.46	3.59	4.97	7.39	89.47	52.06	3.095
T2	20.98	3.63	5.03	7.46	89.53	52.43	3.098
T3	21.79	3.51	4.89	6.97	89.31	52.15	3.079
T4	21.92	3.47	4.86	7.15	89.65	52.25	3.087
Toasted *Mucuna sloanei*	28.96	5.61	8.11	4.55	90.50	28.85	3.94

Table 3. Anti-Nutritional Factors

	RAW	*TOASTED*	*%REDUCTION*
L-DOPA (%)	5.43	3.61	33.51
TANNIN (%)	0.27	0.17	37.03
HYDROGEN CYANIDE (%)	15.24	8.27	45.73

Table 4. Growth Performance of Broiler Birds Fed Toasted *Mucuna sloanei*

	T1	*T2*	*T3*	*T4*	*SEM*
Initial weight(kg)	.12	.12	.12	.12	.00
Final weight(kg)	1.75^a	1.34^b	0.74^c	0.42^d	0.04
Daily weight gain/bird (g)	29.00^a	22.00^b	11.33^c	5.33^d	0.64
Feed intake / bird/ day(g)	77.05^a	78.68^a	59.09^b	59.64^b	3.06
Feed conversion ratio	2.67^b	3.58^b	5.31^b	9.59^a	1.35
% Mortality	0.00^b	3.33^b	16.67^a	26.67^a	4.08

a-d treatment means in the same row with different superscript are significantly different (P<0.05).

Table 5. Cut-parts of Broiler Birds Fed Toasted *Mucuna sloanei* Expressed as Percentage Dressed Weight

	T1	*T2*	*T3*	*T4*	*SEM*
Live weight kg	1.95^a	1.32^b	0.67^c	0.42^d	0.05
% dressed weight	61.50^b	58.47^c	66.66^a	64.58^a	0.65
Thigh	15.10^b	18.04^a	13.25^c	$14.50b^c$	0.49
Drumstick	16.32^a	16.79^a	13.75^b	11.00^c	0.56
Breast cut	23.66^a	24.54^a	25.00^a	21.66^b	0.59
Back cut	20.75^b	23.25^a	20.00^b	25.66^a	0.74
Wing	15.87^b	17.70^a	13.87^c	14.50^c	0.36

a-c treatment means in the same row with different superscript are significantly different (P<0.05).

broilers birds using a straight diet. (Akinmutimi *et al.,* 2006). The crude protein of the test feedstuff (28.96%) and Gross energy of 3.94kcal/g makes it a potential feedstuff. Table 3 shows the anti-nutritional factors present in both raw and toasted *Mucuna sloanei*. They are as follows; L-Dopa, Tannin, and Hydrogen Cyanide. This confirms the report of earlier workers that *Mucuna spp* are known to contain such anti-nutritional factors. (Carew and Gernat, 2006; Akinmutimi and Okwu 2006). Generally, there was poor reduction in the values of the anti-nutritional factors with the least reduction occurring in L-Dopa with about 33.51% reduction. This suggests the inability of toasting as an effective method of detoxification. Table 4 shows the growth performance of broiler birds fed toasted *Mucuna sloaeni.* There were significant differences (P<0.05) for all the parameter considered. The final weight ranges from 1.75kg (control diet T1) to 0.42 (T4) as shown in Table 4. The final weight obtained for the birds placed on diets containing the test feedstuff fell below the normal market weight of broilers at 8 weeks (Obioha, 1992, Akinmutimi *et al.,* 2004). The daily weight gain followed similar pattern like that of final weight in that it decreases downward. The downward decrease as dietary level of inclusion of the test feedstuff increases could be attributed to the effect of the residual anti-nutritional factors such as L-Dopa, tannin, hydrogen cyanide (HCN), trypsin inhibitor (TIU) it becomes more pronounced as the level of inclusion increased making T4 to have the poorest weight gain. Tannin for example has been reported to depress growth by formation of complexes with dietary protein thereby inhibiting proteolytic enzyme action.

The resultant effect of this is loss of protein and amino-acid resulting in poor growth. (Anele, 2002; Akimutimi, 2004; Akimutimi and Ukpabi, 2008). L-Dopa also has been reported by earlier workers that it reduces the growth of chicken (Carew *et al.*1998; Anele, 2002). Earlier workers reported that hydrolysis of cyanogenic glycosides releases hydrogen cyanide, a substance reported to have the ability to cause marked weight reduction due to the use of methionine or cystine for its detoxification and hence attendant poor growth because of deficiency of cystine or methionine in the diet. (Aletor and Fasuyi, 1997; Akimutimi *et al.* 2006). The control feed intake of birds placed on diet (T1) and T2 were statistically similar and had values that were significantly (P<0.05) higher than T3 and T4. The poor feed intake of birds placed on diet T3 and T4 could be attributed partly to high fibre content as the dietary level of inclusion of the test feedstuff increased. (Akinmutimi, 2004), birds are known to tolerate lower level of fibre (Ani and Omeje, 2008). It could partly also be due to higher content of residual anti-nutritional factors (L-dopa, Tannin, Hydrogen cyanide) as the dietary level of inclusion of the test feedstuff increased. L –Dopa has been reported to reduce feed intake by reducing appetite of chickens (Carew *et al.* 1998; Anele 2002). Also, Tannin has been reported to reduce feed intake by causing poor palatability of the diet containing it. (Aletor and Fasuyi, 1997; Akimutimi and Ezea, 2006). This probably accounts for the poor weight gain of birds placed on these diets. For feed conversion ratio, T1 was significantly different from the treatment4 only. It ranges from 2.67(T1) to 9.59(T4). T1 became the superior diet among others since the lower the feed conversion ratio, the superior the diet. (Ojewola *et al.,* 2007). This was followed by T2, T3 and lastly T4. This probably may be due to good weight gain of T1 and moderate feed intake (Akimutimi, 2004) as opposed to others.

The progressive increase in the % mortality could also be attributed to the above problem earlier mentioned, that is the problem of high fibre content and residual anti-nutritional factors. For example, L-dopa has been reported to cause mortality of chicken (Carew and Gernat, 2006). From the above, the control diet is more superior to any other diets. Cut-parts values are as shown in Table 5 There were significant (P<0.05) differences for all the parameters considered. For % dressed weights, T3 and T4 were statistically similar and higher than T1and T2 showing good edible portion of the live weight. (Oluyemi and Roberts, 2000). For thigh, drumstick, breast cut and wing values, T2 had the highest numerical values that was statistically superior to others for values of thigh and wing. This shows the superiority of T2 for tissue deposition for the above cut parts. (Ologhobo *et al.,* 1993). The back cut values for T4 and T2 were similar and significantly higher than that of T1and T3 showing the superiority of these

Table 6. Organ Weights of Broiler Birds Fed Toasted *Mucuna sloanei* Expressed as Percentage Dressed Weight

	T1	T2	T3	T4	SEM
Heart	0.68^{c}	0.81^{ab}	0.78b^{c}	0.91^{a}	0.04
Liver	4.19b^{c}	3.54^{c}	4.50^{c}	6.33^{a}	0.21
Intestine	10.25^{b}	10.30^{b}	16.25^{a}	10.81^{b}	0.48
Kidney	0.89^{b}	1.07^{b}	1.05^{b}	1.61^{a}	0.07
Proventriculus	0.66^{b}	1.07^{a}	0.97^{ab}	1.04^{a}	0.10
Gizzard	4.19^{c}	3.87^{c}	5.62^{b}	7.33^{a}	0.29

a-c treatment means in the same row with different superscript are significantly different (P<0.05).

Table 7. Cost Implication of the Diets

	T1	T2	T3	T4	SEM
Cost/kg of feed (₦)	92.03^{a}	90.86^{b}	89.02^{c}	87.86^{d}	.00
Cost of feed consumed/ bird (₦)	397.09^{a}	400.23^{a}	294.43^{b}	293.23^{b}	15.33
Cost /kg weight gain(₦)	244.32^{c}	328.49b^{c}	483.87^{b}	1005.24^{a}	61.88
Cost of production (₦)	397.08^{a}	400.21^{a}	294.44^{b}	293.22^{b}	15.33
Revenue (₦)	813.33^{a}	610.00^{b}	309.17^{c}	150.00^{d}	22.15
Gross margin(₦)	416.25^{a}	209.79^{b}	14.73^{c}	-143.22^{d}	24.85

a-c treatment means in the same row with different superscripts are significantly different (P<0.05).

diets in terms of back cut parts. Although T2 had the lowest % dressed weight, it had the highest value for thigh, drumstick, breast cut and wing, and compared favourably for back cut. In conclusion, looking at the thigh, drumstick, breast cut and wing, these are prime parts that command higher monetary value. This makes T2 a superior diet as far as cut part is concerned. Organ weight values expressed as % dressed weight are shown in Table 6. There were significant differences(P<0.05) for all the values considered. The value for the heart, intestine and the proventriculus did not follow any pattern that could be attributed to the effect of the test ingredient. For the value of liver, T4 had the highest value that was significantly (P<0.05) different from every other value. T2 and T3 were statistically similar to T1. The highest value obtained for T4 could be attributed to the effect of anti-nutritional factors. This report is in agreement with the findings of (Ukachukwu, 2000; Akinmutimi, 2004) that reported that liver is a major detoxification organ and hence increase in its activities may result in enlargement and probably increased weight. Kidney values followed similar pattern like that of liver in that T1, T2 and T3 were statistically similar and differ from T4. It is worthy of note that the values obtained for kidney for the diet that contain the test ingredient were numerically higher than the control diet. The higher values obtained for the kidney may probably be attributed to increase activity that probably led to increase in weight. (Akinmutimi, 2004). Kidney has been reported to contain rhodanase, a key enzyme in cyanide detoxification (Ologhobo *et al.,* 1993).

Gizzard values showed that T1and T2 were statistically similar and significantly (P<0.05) lower than T3 and T4. The high values observed in T3 and T4 could be due to increase in the fibre content of the diet, leading to increase activity of the gizzard. (Ologhobo *et al.,* 1993). The resultant effect of this is increased weight of gizzard. The cost implication of the diets of birds fed toasted *Mucuna sloanei* is as shown in Table 4. The values were significantly (P<0.05) different for all the parameters. The cost/kg weight gain favoured diet 4 followed by diets 3, 2 and 1; this is due to the lower cost of the test ingredient when compared to the soyabean meal in the control diet. Cost of feed consumed / bird followed similar pattern in that T3 and T4 had the lowest values that was significantly (P<0.05) lower than T1 and T2. This could be attributed to poor feed intake as well as the low cost of the test feedstuff. Cost /kg weight gain favoured diet 1 followed by diets 2, 3 and lastly 4. T1 and T2 were statistically similar, also T2 and T3 were statistically similar and T4 had value that was significantly higher than all. The favourably cost/ kg weight gain for T1 and T2 could be attributed to good efficiency of converting feed to meat. The revenue generated had high values that ranged between N813.33 (T1) and N150.00 (T4). T1 was favoured as for revenue value due to good weight gain. Gross margin followed a similar pattern than that of revenue in that T1 gave the highest value followed by T2 and the least value T4. This shows the superiority of T1 among others since the higher the gross margin, the more profitable the diet (Ojewola *et al.,* 2007).

Conclusion and Recommendation

In conclusion, concerning the growth performance (feed conversion ratio, % mortality, weight gain, and feed intake), carcass quality, favourable cut-parts and organ weight and highest value of gross margin, the control diet (T1) is superior. The test feedstuff even at 5% dietary level of inclusion could not produce good performance. There is need to try other processing methods that could enhance the potential of the test feedstuff.

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