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THE FEEDING VALUE OF PROCESSED VELVET BEAN (*Mucuna pruriens*) FOR PULLET CHICKS

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ABSTRACT

A 28-day feeding trial was conducted to evaluate the effects of dietary inclusion of processed velvet bean (Mucuna pruriens) on performance and haematological parameters of pullet chicks. Mucuna bean seeds were soaked in an aqueous solution of potassium bicarbonate (K_2Co_3) at room temperature (22-24°C) for 24 hrs. After discarding the soaking solution, the seeds were cooked with water for 80 minutes, sun-dried for 48 hrs, milled in a hammer mill and used to formulate the experimental diets. Five pullet chicks' starter diets were formulated to contain 0, 5, 10, 15 and 20% levels of processed Mucuna seed meal (MSM), respectively. Ninety 4-week old black Harco breed of pullet chicks were randomly divided into 5 groups of 18 chicks each. Each group was randomly assigned to one of the five treatment diets in a completely randomized design (CRD). Results of the feeding trial showed that there were significant (P<0.05) differences among treatments in final body weight (FBW), average daily weight gain (ADWG), average daily feed intake (ADFI) and FCR. There were also significant (P<0.05) differences among treatments in PCV, Hb, relative liver and small intestine weights and cost of feed per kg weight gain. Chicks fed 15 and 20% processed MSM diets had significantly (P<0.05) higher FBW, ADWG, ADFI, and PCV than chicks fed control diet (0% MSM). Chicks fed 20% processed MSM diet had significantly (P<0.05) higher Hb and lower cost of feed per kg weight gain than chicks fed control diet. The relative organ weights of chicks fed control diets were similar to chicks fed other diets. There was no chick mortality throughout the experimental period. The results revealed that up to 20% processed MSM could be included in pullet chicks' diets without any deleterious effects on chicks.

Key words: effects, growth performance, pullet chicks, feeding, velvet bean.

INTRODUCTION

Intensive poultry production has been identified as one of the means of attaining sufficiency in the supply of animal protein to the diets of average Nigerians (Ani and Adiegwu 2005). However, intensive poultry production in Nigeria has been greatly affected by the high cost of feeds and feed ingredients, especially the conventional energy and protein feed ingredients like maize, soybean cake, and groundnut cake. A possible solution to the escalating cost of these ingredients is to explore the potentials of alternative feedstuffs as part replacement for the more expensive conventional feed ingredients. The alternative vegetable protein being considered in this study is velvet bean (*Mucuna pruriens*). *Mucuna pruriens* is an important cover crop in many parts of the world. The foliage is frequently fed to grazing animals and the beans are sometimes eaten by humans and animals (Buckles, 1995; Camara *et al.*, 2003; Muinga *et al.*, 2003). In Nigeria, *Mucuna* is cultivated in southern and middle belt states (Onweluzo and Eilitta, 2003). However, there is a low sustained interest in *Mucuna* cultivation due to its low utilization as food and feed, and subsequently the lack of market for the beans (Eilitta and Carskey, 2003). Besides, the use of *Mucuna* either as human food or as animal feed is limited because the raw seed contains such antinutritional factors as trypsin inhibitors, tannins, and cyanogenic glucosides (Ravindran and Ravindran, 1988); anticoagulants (Houghton and Skari, 1994); analgesic, antipyretic and anti-inflammatory factors (Iauk *et al.*, 1993); L-dopa (3, 4 Dihydroxy-L-phenylalanine, a potential neurotoxic agent) and others (Olaboro, *et al.*, 1991; Hussain and Manyam, 1997). The feed potential of *Mucuna* can be enhanced by

reducing these antinutritional factors to safe levels either by boiling and roasting or by fermentation (Mary-Josephine and Jonardhanan ,1992). This study therefore was undertaken to investigate the effect of dietary inclusion of processed velvet bean (*Mucuna pruriens* on performance and heamatological parameters of pullet chicks.

MATERIALS AND METHODS

The experiment was conducted at the Poultry Research Unit of the Department of Animal Science, University of Nigeria, Nsukka. The velvet bean seeds used for the research were the cream-coloured variety bought at Nkwo Ibeagwa market near Nsukka, Enugu State.

Processing of Mucuna seeds

Oil palm fruit bunch was burnt to produce an ash. Five litres of water was slowly added to every kg of the ash to produce a filtrate. An aqueous solution of potassium carbonate (K_2CO_3) was prepared by mixing a litre of the filtrate with 4 litres of water. *Mucuna* seeds were soaked in the aqueous solution of K_2CO_3 at room temperature (22 – 24^{0}C) for 24hrs in the ratio of 1kg seeds to 3 litres of the solution. The soaking solution was discarded and the seeds were cooked in water for 80 minutes. Timing was taken from point of boiling (about 100°C). The seeds were sun-dried for 48 hrs, ground in a hammer mill and used to formulate the experimental diets.

Formulation of experimental diets

Five pullet chicks' starter diets were formulated to contain 0, 5, 10, 15 and 20% levels of processed *Mucuna* seed meal (MSM), respectively. The composition of the diets is presented in Table 1.

Experimental design, animals and management

Ninety 4-week old black Harco breed of pullet chicks averaging 269 – 405g body weight were randomly allocated to the five dietary treatments with 18 chicks per treatment in a completely randomized design. Each treatment was replicated 3 times with 6 birds per replicate and housed in 2.6m x 3m deep litter pens of fresh wood shavings. Feed and water were offered *ad libitum*. The birds were properly vaccinated and subjected to standard pullet chicks' management procedure. The experiment lasted for a period of 5 weeks during which feed intake, weight gain, feed conversion ratios and protein efficiency ratios were monitored.

Table 1: Percentage composition of experimental diets

Ingredients	*Mucuna* seed meal level (%)				
	0	5	10	15	20
Maize	55.73	52.16	48.52	44.95	41.36
Soybean meal	25.06	23.63	22.28	20.84	19.43
Mucuna pruriens	-	5.00	10.00	15.00	20.00
Wheat offal	6.20	6.20	6.20	6.20	6.20
Palm kernel cake	6.26	6.26	6.26	6.26	6.26
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	4.00	4.00	4.00	4.00	4.00
Methionine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Vit. Mineral premix[a]	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated analysis					
Crude protein	19.50	19.50	19.51	19.49	19.50
Energy (Kcal of ME/Kg)	2,833	2,868	2,902	2,938	2,973
Cost of diet N/tonne	51,651	50,472	49,311	48,125	46,950
Cost differential (N)	-	1179	2340	3526	4701

[a] supplied per Kg of diet: VitaminA,4,000,000IU; VitaminD_3,8,000,000IU; VitaminK,900mg; Thiamine,,700mg;VitaminE 8,000IU; Riboflavin, 2,000mg; Pyridoxine,1,100mg; VitaminB12, 6mg; Niacin, 11,000mg; Panthothenic acid, 3000mg; Folic acid, 3,000mg; Biotin, 20mg; Choline chloride 160g; Anti oxidants, 50mg; Manganese 32g; Zinc 20g; Iron 8g; Copper 2g, Iodine 480mg; Selenium 80mg; Cobalt 80mg

Haematological evaluation

During week 5 of the experiment, blood was collected from three birds per treatment. The blood, which was collected from the wing vein of each bird, was used for haematological analysis. Packed cell volume (PCV) and haemoglobin concentration (Hb) were determined by the methods described by Ugochukwu (2001).

Proximate and statistical analysis

Proximate analysis was carried out on the raw and processed MSM and on the experimental diets according to AOAC (1990). Data obtained were subjected to analysis of variance (Steel and Torrie, 1980). Significantly different means were separated using Duncan's New Multiple Range Test (Duncan, 1955) as outlined by Obi (2002).

RESULTS AND DISCUSSIONS

Proximate composition of raw and processed *Mucuna* seed meal (MSM)

The proximate composition (Table 2) of raw and processed MSM was as follows: moisture, 9.6%, crude protein (CP), 21.3%; ether extract (EE), 7.6%; crude fibre (CF), 2.6%; ash, 2.8% and nitrotgen-free extract (NFE), 56.1%. The processed MSM had 8.9% moisture, 19.6% CP, 8.4% EE, 3.8% CF, 3.3% ash and 56.0% NFE. The gross energy values for the raw and processed MSM were 4.33Kcal/g and 3.85Kcal/g, respectively. The crude protein value (21.3%) obtained in this study compares with the crude protein values of such legumes as pigeon pea, 25%; jackbean, 25.6%; snap bean, 16% and lima bean, 23.6% (Johnson, 1974; Obioha, 1992). The value also compares with the value (21.0%) reported by Bressani (1993). The differences observed may be attributed to varietal and geographical differences. Geographical and varietal differences have been reported to cause differences in the nutrient compositions of certain legumes and oil seeds (Okorie and Anugwa, 1987; Amaefule and Obioha, 1998). It could be observed (Table 2) that the CP of raw bean differed from that of the processed bean by 1.7%. The observed difference may be attributed to leaching of soluble protein into the cooking water. This suggestion agrees with the report of Ani (2002) that showed that cooking of castor oil bean led to the solubilization and removal of some nitrogenous substance in the castor oil bean. The soluble carbohydrate level (56.00%) is adequate as a source of energy in livestock diet.

Table 2: Proximate composition and energy content of raw and processed *Mucuna* bean seeds

	Raw	Treated
Components (%)	Content	Content
Dry matter	90.4	91.1
Crude protein	21.3	19.6
Ether extract	7.6	8.4
Crude fibre	2.6	3.8
Ash	2.8	3.3
N-free extract	56.1	56.0
Gross energy	4.33 Kcal/g	3.85 Kcal/g

Table 3: Proximate composition of the experimental diets

	Dietary levels of processed *Mucuna* seed meal (%)				
Components (%)	0	5	10	15	20
Dry matter	89.50	88.50	89.00	87.00	87.50
Crude protein	20.56	20.10	20.00	19.68	20.15
Ether extract	7.95	8.25	8.95	9.35	9.95
Crude fibre	9.50	9.55	9.61	9.80	10.01
Ash	9.00	9.10	9.50	10.00	10.50
Nitrogen-free Extract	42.49	41.50	40.94	38.17	36.89

Growth performance and haematological characteristics of pullet chicks fed processed *Mucuna* seed meal.

Table 3 shows the proximate composition of the experimental diets while the data on growth performance and haematological parameters of pullet chicks fed varying dietary levels of processed MSM are presented in Table 4. There were significant ($P<0.05$) differences among treatments in final body weight (FBW), average daily weight gain (ADWG), average daily feed intake (ADFI) and feed conversion ratio (FCR). Chicks fed 10, 15 and 20% processed MSM diets had significantly ($P<0.05$) higher FBW than chicks fed the control diet. Chicks fed 15 and 20% processed MSM diets had significantly ($P<0.05$) higher ADWG and ADFI than chicks fed control diet. The feed conversion ratios of chicks fed 5 and 10% MSM diets were significantly ($P<0.05$) lower than that of chicks on the control diet. There were no significant ($P>0.05$) differences among treatments in protein efficiency ratio, but significant ($P<0.05$) differences existed among treatments in packed cell volume (PCV), and haemoglobin concentration (Hb). Chicks fed 20% MSM diets had significantly ($P<0.05$) higher PCV and Hb than chicks fed 0 and 5% MSM diets. There was no mortality in all the treatments. It was observed (Table 4) that birds fed 15 and 20% processed MSM diets had higher ADFI than those fed 0% MSM diet. This contradicts the earlier report of Ukachukwu and Szabo (2003) that broiler chicks fed 7.5 – 22.5% processed

MSM had similar fed intake with those fed control diet (0% MSM). The result also contradicts the findings of Feirriera *et al* .(2003) and Iyayi and Taiwo (2003) that broiler chicks fed 18 – 20% processed MSM diets had lower feed intake than those fed control diet. The observed differences may be attributed to differences in processing methods. Ukachukwu and Szabo (2003) processed their *Mucuna* seeds by boiling for 45 minutes with addition of 4% wood ash, while Feirriera *et al* .(2003) and Iyayi and Taiwo (2003) used roasted MSM. It seems that the processing method (boiling for 80 minutes after soaking in an aqueous solution of K_2CO_3) adopted in the present work enhanced chicks' intake of dietary MSM. Although chicks fed 0% and 20% MSM diets had similar FCR, the chicks fed 20% MSM diet had faster growth rate than those fed control diet (Table 4). This result contradicts the findings of Feirriera *et al* .(2003), Iyayi and Taiwo (2003) and Ukachukwu and Szabo (2003) that chicks fed 12 – 22.5% processed MSM diets had lower weight gain than those fed 0% MSM diet. Depression in feed intake and weight gain of birds fed high levels of processed MSM had been attributed to the effects of residual antinutritional factors (tannins, hydrocyanic acid, phytic acid, L-dopa and lectins) present in processed MSM (D'Mello and Devendra, 1995; Carew *et al.,* 2002). Grant (2002) showed that lectins in particular exert their antinutritional effects by causing reduction in nutrient absorption by the intestinal villi. The processing method adopted in the present work may have contributed to the effective detoxification of the *Mucuna* seed used, hence, the observed improvement in the growth performance of chicks. Data on PCV and Hb (Table 3) showed that chicks fed 20% processed MSM diet also had higher PCV and Hb than chicks fed control diet. However, the PCV values (21.5 – 29.5%) and Hb values (7.15 – 9.85g/dl) obtained in the present study compare with the PCV value (23.13%) and the Hb value (7.51g/dl) reported by Olorede and Longe (1999) for pullet chicks in humid tropical environments. The values also fall within the normal PCV range (30% to 33%) and Hb range (6.5 – 9.00g/dl) reported by Swenson and Reece (1993) for chickens. The results obtained in the present study strongly suggest that *Mucuna* seed soaked in aqueous solution of K_2CO_3 and boiled for 80 minutes can be incorporated into the diets of pullet chicks without adverse effects on chicks.

Table 4: Performance and haematological parameters of chicks fed varying dietary levels of alkali-treated and cooked *Mucuna* seed meal

	Dietary levels of processed *Mucuna* seed meal (%)					
Parameters	0	5	10	15	20	SEM
Av. Initial body eight	265.3	263.0	271.3	272.3	273.3	4.87
Av. Final body weight (g)	690.67^{d}	721.6b^{cd}	746.00^{abc}	785.67^{a}	753.33^{ab}	15.19
Av. Daily weight gain (g)	15.19^{b}	16.74^{ab}	16.95^{a}	18.33^{a}	17.14^{a}	0.62
Av. Daily feed intake (g)	47.42^{c}	48.72b^{c}	49.30 b^{c}	53.58^{a}	51.19^{ab}	0.85
Feed conversion ratio	3.14^{a}	2.91^{b}	2.91^{b}	2.92^{b}	2.97^{a}	0.06
Protein efficiency ratio	1.56	1.71	1.72	1.74	1.66	0.07
Mortality	-	-	-	-	-	-
PCV(%)	21.5^{c}	22.5^{bc}	24.00^{b}	27^{ab}	29.5^{a}	1.83
Hb (g/dl)	7.15^{b}	7.50^{b}	8.00^{ab}	9.0^{ab}	9.85^{a}	0.64

a,b: means on the same row with the different superscripts are significantly (P<0.05) different. SEM = Standard error of mean

Organ Percentage and intestinal length of chicks fed processed MSM diets

Table 5 shows the relative organ weight to body weight and the intestinal length of chicks fed varying dietary levels of processed MSM. There were significant (P<0.05) differences among treatments in relative weights of liver and intestine to body weights. Chicks fed 10% MSM diets had significantly (P<0.05) higher relative liver weight than chicks fed 15%, while chicks fed 20% MSM diet had higher (P<0.05) relative intestine weight than chicks fed 5 and 10% MSM diets. However, chicks fed 0% MSM diet had similar relative organ weights and intestinal length with chicks fed diets containing 5, 10, 15 and 20% MSM). It could be observed that the values of these organs did not follow any particular trend with the levels of inclusion of processed MSM in the diets. Besides, the results contradict the reports of Carew (1998b) and Carew *et al.*(2003) that intake of raw, unprocessed velvet bean by growing chicks led to increase in relative heart, liver and gizzard weights and lengths of small and large intestines. Liver size in particular is known to increase in response to several factors, especially deficiencies of protein and amino acids (Velu *et al.*, 1971) as cited by Carew *et al* (2003). It is evident from the results that the processing method used might have played a significant role in detoxifying the *Mucuna* seeds, and in

improving the quality and utilization of the MSM protein.

Table 5: Percentage organ weight to the body weight and intestinal length of growing chicks fed varying dietary levels of alkali-treated and cooked *Mucuna* seed meal.

Parameters	Dietary levels of treated *Mucuna* seed meal (%)					
	0	5	10	15	20	SEM
Gizzard weight (%)	6.98	8.19	8.61	8.09	7.76	0.57
Heart weight (%)	0.86	1.11	0.95	0.98	0.89	0.06
Intestine weight (%)	9.26^{ab}	8.58^{b}	8.35^{b}	8.90^{ab}	10.40^{ab}	0.53
Liver weight (%)	5.36^{ab}	5.08^{ab}	5.75^{a}	4.28^{b}	4.94^{ab}	0.32
Intestine length (cm)	110.5	117	111.5	112.5	117	4.81

a,b: means on the same row with the different superscripts are significantly (P<0.05) different. SEM = Standard error of mean

Table 6: Effect of varying dietary levels of alkali-treated and cooked *Mucuna* seed meal on economy of chick production

Parameter	Dietary levels of treated *Mucuna* seed meal (%)					
	0	5	10	15	20	SEM
Total feed intake (Kg)	1.32^{c}	1.36^{bc}	1.38^{bc}	1.50^{a}	1.43^{ab}	0.02
Total cost of feed consumed per animal (N)	68.57^{ab}	68.86^{ab}	68.03^{b}	72.21^{a}	67.30^{b}	1.15
Cost of daily feed intake (N)	2.45^{ab}	2.46^{ab}	2.43^{b}	2.58^{a}	2.40^{b}	0.04
Total weight gain (g)	425.32^{b}	468.72^{ab}	474.60^{ab}	513.24^{a}	479.92^{a}	17.29
Cost of feed/Kg weight gain	161.97^{a}	147.39^{ab}	143.33^{ab}	141.25^{b}	140.38^{b}	5.97

a,b,c: means on the same row with different superscripts are significantly (P<0.05) different. SEM Standard error of mean.

Cost of feeding processed MSM diets to pullet chicks

Data on cost of feeding processed MSM diets to pullet chicks are presented in Table 6. There were significant (P<0.05) differences among treatments in total feed intake, cost of total feed consumed per animal, daily feed cost per animal, total weight gain and cost of feed per kg weight gain. Total weight gain and total feed intake followed the same trend with daily feed intake and daily weight gain (Table 3). Chicks fed 15% MSM diet had significantly (P<0.05) higher cost of daily feed intake than chicks fed 10 and 20% MSM diets. The cost of feed per kg weight gain of chicks fed 15 and 20% MSM diets was significantly (P<0.05) lower than that of chicks fed control diet. The cost of feed per kg weight gain was observed to decrease with increase in the level of processed MSM in the diets. The significant reduction in cost of feed per kg weight gain at 15 and 20% levels of MSM inclusion in the diets may be attributed to the outstanding growth performance of chicks. The result shows that cost of production, especially feed cost can be reduced by the inclusion of 15 to 20% processed MSM in pullet chicks' diets.

CONCLUSION

The result of the feeding trial revealed that up to 20% processed *Mucuna* seed meal can be included in the diets of pullet chicks without any deleterious effects on chicks.

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