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Evaluation of Cooked and Toasted Velvet Beans (*Mucuna pruriens*) as Feed Ingredient for Broiler Chickens

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Abstract: A study was conducted to examine the comparative inclusion of graded levels (0, 10, 15 and 20%) of cooked and toasted mucuna seed meal in the diets of broiler chickens. Maize-soybean diet served as the control. About 147 unsexed Anak strain 7 days old broiler chicks were randomly assigned to the seven dietary treatments and each treatment was replicated 3 times. The experiment lasted 9 weeks. Feed and water were supplied *ad libitum* throughout the experimental period. At the end of the experiment, three birds were randomly selected from each dietary replicate and slaughtered for carcass and haematology evaluation. Results showed no significant difference in all performance parameters studied. Carcass weights of birds fed the control diet and the diets with cooked or toasted mucuna seed meal were similar. The total red blood cell count, mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration of broiler on the dietary cooked or toasted mucuna seed meal levels were statistically comparable ($p>0.05$) with the corresponding diet in the control diet. However, broiler on 15 and 20% inclusion levels of toasted mucuna seed meal had significantly higher packed cell volume and haemoglobin values while the lowest value ($p<0.05$) was recorded in the group placed on 10% cooked mucuna seed meal. Broilers on dietary toasted mucuna seed meal had similar total protein values with the birds on control diet. It was therefore, concluded that dietary inclusion level of 20% processed mucuna seed meal adequately supported the acceptable growth performance and normal haematology indices of broiler chickens.

Key words: *Mucuna pruriens*, broiler chicken, performance, haematolgical parameters, Nigeria

INTRODUCTION

One major constraint preventing optimum performance of chickens in many developing countries of the world and Nigeria in particular is the apparent lack of good quality feeds throughout the year. This is attributable, among other factors, to the seasonal fluctuations in supply of conventional ingredients (Fajimi *et al*., 1993; Olorede and Longe, 2000; Amaefule and Obioha, 2001) indicated that the evaluation of unconventional resources along side other strategies would reduce pressure on conventional feed ingredients and consequently the cost of livestock feeds. In Nigeria, feed cost is estimated to be over 70% of the total cost of intensive livestock production (Adenkola *et al*., 2007). Hence, the search for alternative feed resources appears to be an unending one in developing countries of the world if more meat must be made available for the teaming human population at affordable price.

Mucuna bean is one of the alternative feed resources that grow well under dry conditions. Mucuna bean contains 24-35.5% crude protein and good relative amino acid profile (Emiola *et al*., 2003). Mucuna bean has not been extensively used as an alternative livestock feed in Nigeria. Emenalom and Udedibie (1998), Ukachukwu *et al*. (2002) and Tuleun and Patrick (2007) investigated the performance of broiler chickens fed differently processed mucuna seed meal diets. Most legumes require one form of processing or the other before they can be incorporated in animal feeds owing to the presence of some anti-nutrients. Anti-nutrients impair the utilization of important feed nutrients like protein, minerals etc. (Matthew *et al*., 2010). There are conflicting reports on the efficacy of processing methods on legume in livestock feeding.

The present study aims at determining the effect of feeding mucuna bean subjected to cooking and toasting techniques on the performance, carcass and haematology of broiler chickens.

MATERIALS AND METHODS

Experimental site: This study was conducted at the poultry unit in the Teaching and Research Training Farm,

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Table 1: Composition of broiler starter diets containing graded levels of processed mucuna seed meal

Ingredients	1	2	3	4	5	6	7
Maize	48.56	45.13	43.42	41.70	43.13	43.42	41.71
Soyabean cake	30.49	23.92	20.63	17.35	23.92	20.63	17.34
G/nut cake	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Maize offal	6.50	6.50	6.50	6.50	6.50	6.50	6.50
Mucuna	0.00	10.00	15.00	20.00	10.00	15.00	20.00
Bone meal	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total (kg)	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated CP (%)	23.00	23.00	23.00	23.00	23.00	23.00	23.00

To provide the following:-Vit. A 10,000 IU; Vit. D3-2000 IU; Vit. B1-0.75 mg; Nicotinic acid 25 mg; Calcium panthenate 12.50 mg; Vit. B12-2.5-mg; Vit. K3-2.5 mg; Cobalt-0.40 mg; Biotin-0.50 mg; Folic acid-1.00; Cholin Chloride-25 mg; Coper-8.00 mg; Manganese-64 mg; Iron-32 mg; Zinc-4 mg; Iodine-0.8 mg; Flavomycin-100 mg; Spiromycin-5 mg; DL Methionine 5 mg; Selenium-0.16 mg; L-Lysine-120 mg

Table 2: Composition of broiler finisher diets containing graded levels of processed mucuna seed meal

Ingredients	1	2	3	4	5	6	7
Maize	53.69	50.13	48.54	46.83	50.26	48.55	46.83
Soyabean cake	26.86	20.32	17.01	13.72	20.29	17.00	13.72
G/nut cake	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Maize offal	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Mucuna	0.00	10.00	15.00	20.00	10.00	15.00	20.00
Bone meal	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total (kg)	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated CP (%)	20.00	20.00	20.00	20.00	20.00	20.00	20.00

University of Agriculture, Makurdi (07°41'N, 08°37'E) located in the Southern Guinea Savannah zone of Nigeria with annual rainfall ranges from 1,317-1,323 mm while temperature range is 26.5-42°C (Ako, 2002).

Mucuna seed meal preparation: Mucuna seeds were obtained from International Institute for Tropical Agriculture (IITA) Ibadan, Nigeria and multiplied. The seeds were divided into two portions and subjected to two different heat treatment techniques (cooking and toasting). The first portion was introduced to boiling water and cooked for 60 min as described by Kaankuka *et al.* (1996). The second portion was subjected to toasting, a process which involved mixing the seeds with sand in an open frying pan and heating. The mixture was stirred continuously until the seeds were crispy and acquired the characteristic aroma of toasted beans. The processed seeds were milled with a hammer mill and kept in bags until required for use. Seven iso-nitrogenous experimental diets designated as control, $CMSM_{10}$, $CMSM_{15}$ and $CMSM_{20}$, $TMSM_{10}$, $TMSM_{15}$ and $TMSM_{20}$ were compounded such that the Cooked Mucuna Seed Meal (CMSM) and the Toasted Mucuna Seed Meal (TMSM) were included at 10, 15 and 20% level, respectively both at the starter and finisher phases (Table 1 and 2). A total of one hundred and forty seven healthy 7 days old Anak strain broiler chicks purchased from reputable hatchery in Nigeria were randomly divided into seven groups and assigned to one of the seven broiler starter and finisher diets. Each dietary treatment with twenty one broiler chicks was divided into three replicates at the rate of seven chicks per replicate. The birds were raised in a deep litter house and fed *ad libitum* on broiler starter diet for 4 weeks and broiler finisher diet for 5 weeks. Routine management production for broiler chickens in terms of sanitary measures, medication and vaccination programmes were strictly adhered to. Data collected were performance indices; body weight, feed intake, protein intake, Feed Conversion Ratio (FCR), Protein conversion Ratio (PER) and mortality. At the end of the trial (63rd day), the birds were randomly selected from each dietary group for carcass evaluation. Prior to slaughter, the birds were starved of feed for about 15 h, weighed, slaughtered by severing jugular vein then dressed and weighed. The weights of the carcass cuts (thigh, drumstick, back, wing, shoulder, breast and neck) and visceral organs (Liver, spleen, heart, proventriculus, kidney and gizzard) were taken. Abdominal fats were also measured. All carcass weights were expressed as percentage of fasted live weight of corresponding chicken were subjected to log transformation before analysis. The blood of the slaughtered birds were collected in a bijou bottle containing EDTA as anticoagulant at the rate of 2 mg mL^{-1} (Adenkola *et al.*, 2010) were used for haematological studies which included Packed Cell Volume (PCV), total Red Blood Cell (RBC) counts and Haemoglobin concentration (Hb) determination as described by Schalm *et al.* (1975).

Statistical analysis: Data collected were subjected to the Analysis of Variance (ANOVA) using the procedure of Steel and Torrie (1980) and where significant differences were observed, means of parameters were separated as described by Obi (2002).

RESULTS AND DISCUSSION

The performance of broiler chickens in the feeding trial is shown in Table 3. There were no significant differences ($p>0.05$) between broiler chickens fed the control diet and the groups fed graded levels of cooked (CMSM) and Toasted Mucuna seed Meal (TMCM) diets in the daily weight gain, feed intake, protein intake, feed conversion ratio and protein conversion ratio. Results of

Table 3: Performance of broiler chickens fed dietary boiled and toasted mucuna seed meal

	Control		CMSM			TMSM		
Parameters	1	2	3	4	5	6	7	SEM
Average initial weight (kg)	0.94	0.94	0.92	0.93	0.93	0.93	0.92	0.29
Average final weight (kg)	2.16	2.36	2.01	2.02	2.21	2.36	2.02	0.19
Average daily weight gain (g)	34.86	40.67	29.71	34.57	36.67	40.67	31.43	5.53
Average daily feed intake (g)	126.96	122.10	123.81	122.57	115.98	119.62	109.34	9.02
Feed conversion ratio	3.66	3.03	4.19	4.03	3.18	3.21	3.47	0.48
Average daily protein intake	25.39	24.42	24.76	23.85	22.51	23.92	21.87	1.81
Protein conversion ratio	0.54	0.61	0.84	0.78	0.62	0.64	0.69	0.20

Table 4: Mean values for cooked and toasted mucuna bean of carcass characteristics of broiler chicken

	Dietary treatment							
Carcass parts	1	2	3	4	5	6	7	SEM
Live weight (kg)	2.40	2.18	2.40	2.50	2.43	2.38	2.53	0.26
New York weight	90.50	91.06	89.55	90.35	95.05	85.70	91.35	2.95
Dressed weight (g)	80.10	74.59	73.88	74.45	80.55	77.55	73.95	4.58
Breast weight	25.40	23.45	23.10	24.05	27.50	24.55	22.70	4.58
Back weight (g)	9.85	8.95	9.75	9.05	9.40	11.00	10.15	1.71
Drum stick (g)	10.60	10.90	9.55	11.25	11.30	10.55	11.20	0.98
Thigh (g)	12.25	13.30	12.05	11.45	12.95	7.75	12.35	1.42
Wings (g)	8.50	9.35	7.95	9.17	9.70	10.55	9.10	0.93
Neck (g)	7.85	7.15	8.03	9.35	8.15	8.90	8.35	1.72
Head (g)	2.20	2.70	2.30	2.75	2.85	2.55	2.75	1.06
Shank (g)	4.00	4.15	4.10	4.75	3.95	4.50	4.90	0.78
Liver (g)	1.50	1.45	1.30	1.35	1.80	1.65	1.30	0.64
Kidney (g)	0.55	0.50	0.54	0.50	0.57	0.54	0.65	0.48
Pancreas (g)	0.14	0.19	0.17	0.18	0.21	0.27	0.20	0.26
Lungs (g)	0.50	0.49	0.50	0.42	0.51	0.60	0.57	0.57
Heart (g)	0.33	0.39	0.39	0.39	0.39	0.44	0.37	0.22
Spleen (g)	0.07	0.05	0.06	0.08	0.80	0.06	0.06	0.24
Gizzard (g) E	1.38	1.22	1.42	2.05	1.80	1.70	1.65	0.66
F	2.05	1.93	1.82	2.65	2.39	2.40	2.29	0.62
Gall bladder (g)	0.07	0.07	0.05	0.10	0.11	0.09	1.00	0.22
Abdominal fat (g)	2.20	2.48	2.46	1.31	1.95	1.85	1.20	1.42

SEM = Standard Error of Mean; NS = Means on the same row with superscript are not significant ($p>0.05$)

Table 5: The effect of boiled and toasted mucuna bean on the haematological values of birds fed the experimental diets

Parameters	1	2	3	4	5	6	7	SEM
Total protein (g dm^{-1})	6.53^{bc}	6.03^{c}	7.50^{a}	7.00^{ab}	6.50^{bc}	6.00^{c}	6.00^{c}	0.41*
Packed cell volume (%)	26.00^{cd}	24.00^{d}	27.00^{bcd}	27.33^{bc}	26.33^{cd}	31.33^{a}	29.67^{ab}	0.46*
Haemoglobin concentration (g dm^{-1})	8.73^{bcd}	8.03^{d}	8.97^{bcd}	9.17^{bc}	8.67^{cd}	10.30^{a}	9.73^{ab}	0.48*
Total red blood cell (10^{6} μL^{-1})	4.07	3.59	2.74	3.71	2.79	3.34	3.25	0.47^{NS}
Mean corpuscular volume (fl)	63.36	69.11	102.79	74.48	101.88	95.36	91.99	13.77^{NS}
Mean corpuscular haemoglobin (pg)	21.52	23.03	34.50	24.89	34.09	31.69	33.22	4.60^{NS}
Mean copuscular haemoglobin concentration (gm dL^{-1})	33.29	33.34	33.33	33.29	33.46	30.60	33.38	0.07^{NS}

SEM = Standard Error of Mean; NS = Mean on the same row with superscript are not significant ($p>0.05$); = $^{a-d}$Means with different superscript are signicant ($p<0.05$)

the carcass characteristics and organ weight measurements of broiler chickens fed on the experimental diets are shown in Table 4. All parameters considered for carcass quality of broiler fed the different dietary treatments were not significantly ($p>0.05$) different in all treatment groups. The cut-up parts (thigh, drumstick, breast, back and shoulder) were also not significantly ($p>0.05$) different. All the organ weights (liver, heart, pancreas, spleen, lungs and gizzard) were not significantly ($p>0.05$) different among birds in all treatment groups. The highest total protein was obtained in animals on treatment 4 while the lowest value was recorded in animals on diet 2 which was significantly ($p<0.05$) different. PCV and Hb obtained was significantly ($p<0.05$) different with the lowest value recorded in animals fed diet 2. There was no significant ($p<0.05$) in RBC and other erythrocytic indices.

It is apparent from the results of this trial that the growth and feed conversion ratio of broilers fed the graded levels of the cooked and toasted Mucuna seed meal up to 20% dietary inclusion were comparable with the birds on control diet (Table 5). Moreover, from

observation, processed mucuna diets acceptance was satisfactory and the birds consumed similar quantities of feed. This result is not surprising since processed mucuna is described as protein source with high nutritional value (Ukachukwu and Obioha, 1997; Bressani, 2002; Tuleun and Patrick, 2007).

Earlier studies have shown that heat treatment resulted in improvement in performance of birds on mucuna diet which brings them to par with that of corn-soybean, control diet (Emenalom and Udedibie, 1998; Iyayi and Taiwo, 2003). The similarity in feed conversion ratio of the birds on this trial is an indication that dietary inclusion of processed mucuna seed meal did not impair nutrient utilization in the growing birds. This could be attributed to the elimination of anti-nutritional factor substances in the mucuna seed meal as a result of processing. Toasting treatment seemed to concentrate the nitrogenous compounds in the bean by removing much of the water molecules and increasing the nitrogen content, thus increasing its crude protein as observed in their protein conversion efficiency. Oke explained that Protein Efficiency Ratio (PER) and Net Protein ratio (NPE) are indicators of protein quality based on weight gain and protein intake. More so, some of the anti-nutritional factors which could interfere with the biological utilization of the protein and to a lesser extent of available carbohydrates and lipids can readily be eliminated or inactivated by heat treatment.

The result of the present study also agrees with the report of Emenalom and Udedibie (1998) that limited quantity of mucuna bean if they are heated for 60 min can be used successfully in broiler chickens diets.

The non-significant different in the carcass measurement shows that the inclusion of processed mucuna seed meal (cooked and toasted) in broiler diets did not suppress the physiological development of these prime carcass cuts (thigh, drumstick, breast, back, neck and shoulder) of broiler finisher to make them statistically inferior to the carcass cuts from the broiler finisher on the control diet. The values obtained in this study are consistent with the range of those reported by other workers (Leeson and Summer, 1980; Njoku, 1986; Adenkola *et al*., 2007). The non-significant difference in the organ weight investigated could also mean that none of the visceral organs was a direct target organ or could suggest that the inclusion of the bean in diet of the broilers did not cause any toxicity or abnormal activities in their organ systems and therefore, safe for use in broiler production. These values of organ weights are in agreement with those reported by Akpodiete *et al*. (1997) and Fanimo *et al*. (2005) who observed no gross morphological manifestation in the organs of birds fed compounded feed from various feed ingredients. The values of haematological parameters obtained in this study fell within the normal range value reported elsewhere in avian species (Swenson and Reece, 1993; Azzez *et al*., 2009). Nutrient has been recognized as an important factor for haematopoesis (Tuleun *et al*., 2007; Adenkola *et al*., 2009). Katunguka-Rwakishaya (1997) showed that animals on high protein diet had higher total iron binding capacity than those receiving a low protein diet and iron has been known to play a positive role in erythropoesis.

The result of this study contradicts that of Esonu *et al*. (2001) who reported that raw mucuna bean meal had a deleterious effect on haematological parameters however, it supported the results of Emenalom *et al*. (2004) and Iyayi *et al*. (2008) that heating improved the nutritive quality of mucuna meal. The fact that birds on treatment 6 had better haematological value showed that the nutrients in the feed were made available by processing the mucuna and thus supported haematopeisis.

CONCLUSION

Based on the comparable results obtained from growth performance, carcass quality characteristics, organ weights and haematological indices, it can be deduced that dietary inclusion level of 20% processed (cooked or toasted) mucuna seed meal can be used successfully as plant protein material in broiler diet.

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