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GROWTH, HAEMATOLOGY AND ORGAN HISTOPATHOLOGY IN BROILERS FED RAW AND PROCESSED VELVET BEAN-BASED DIETS

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Abstract

Velvet beans (*Mucuna pruriens*) is currently being promoted as food for man and feed for animals in Nigeria. Its potential and implication as alternative plant protein was studied with one hundred and eight 1-d-old Anak broiler chicks. Raw and heated *Mucuna* bean meals (RMBM & HMBM, respectively) were used to replace soybean meal (SBM) and to assess the effect on performance, histopathological changes and haematology in broiler starters and finishers. Three diets were formulated. Diet 1 was the basal diet and contained 120 g kg⁻¹ SBM while diets 2 and 3 contained 120 g kg⁻¹ HMBM and RMBM, respectively in place of SBM. Each diet had 3 groups of 12 birds each. Feed intake, FCR and weight gain in birds on the RMBM and HMBM diets were significantly ($p < 0.05$) depressed compared to birds on the SBM diet at the starter phase but not at the finisher phase for the HMBM diet but in both phases for the RMBM diet. The packed cell volume (PCV), haemoglobin (Hb), red blood cell count (RBC) and white blood cells (WBC) were significantly ($p < 0.05$) reduced in the RMBM diets compared to the other 2 diets. Histopathological results showed that birds on the RMBM diet showed severe and widespread vacuolar degeneration and necrosis of the hepatocytes, interstitial congestion, tubular degenerations and necrosis in the kidneys. The hearts in birds on the RMBM diet had degeneration and fragmentation of their myofibrils and lymphoid depopulation in the spleen. These results suggest the possibility of utilising *Mucuna* bean meal to replace soybean meal in broiler feeding at both starter and finisher phases only when subjected to heat treatment. Thus, in spite of its present promotion as food for man and feed for animals in the country, the bean should be subjected to appropriate processing to overcome its depressive effects on feed intake, growth and degenerative syndromes in organs.

2 Introduction

In Nigeria, there is a need for readily available, high quality, alternative plant proteins that are inexpensive and capable of reducing production costs of meat and other animal products. It seems that the utilization of underutilized tropical legumes will help in this regard. Such legumes may possess as much agronomic and nutritional potential as the conventionally used ones. An inexpensive and readily available but neglected legume is *Mucuna pruriens* (Velvet bean).

Mucuna pruriens is an important cover crop (or green manure crop) in many parts of the world, especially among subsistence farmers (BUCKLES, 1995; BUCKLES *et al.*, 1998). Like other beans, *Mucuna* contains a high level of protein, vitamins and minerals making it an attractive and important source of plant protein for feeding poultry. However, it contains some antinutritional factors (ANFs) such as antitrypsin factors, tannins and cyanide (RAVINDRAN AND

RAVINDRAN, 1988), anticoagulants (HOUGHTON AND SKARI, 1984), analgesic, antipyretic and anti-inflammatory factors (IAUK et al., 1993), and others (OLABORO et al., 1991). L-dopa, a potentially neurotoxic agent occurs in large amounts in *Mucuna* (CAREW et al., 2003). This study was designed to investigate the effects of dietary raw and heated *Mucuna* beans on the performance, hematology and histopathology in the liver, spleen, kidney, heart, lungs and intestines of broiler.

3 Materials and Methods

3.1 Animal housing and diets

One hundred and eight day-old broiler chicks (Anak strain) were used for this experiment. The chicks were housed in temperature controlled brooder pens. Heated *Mucuna* was produced by roasting the seeds obtained from a local feed shop with sand over fire for 40 minutes until the shiny seed coat became dull. The roasted beans were milled using a hammer mill with a 3/16 in screen. Three diets were formulated as shown in table 1. The control diet contained 120 g kg⁻¹ soy bean meal (SBM), diet 2 contained 120 g kg⁻¹ heated *Mucuna* bean meal (HMBM) as a replacement for SBM, and diet 3 contained 120 g kg⁻¹ raw *Mucuna* bean meal (RMBM) in place of SBM. The chicks were allocated to the 3-experimental diets in a completely randomized design with each treatment diet having 3 replicates of 12 birds. Feed and water were given *ad libitum*. The duration of the study was eight weeks. Feed consumption and live weight measurements were taken weekly and used to compute feed conversion ratio (FCR). Hematological parameters, serum biochemistry and organ histopathology were also assessed. At the end of week 8, the birds were killed, their cavity opened and the liver, spleen, kidney, heart, lungs and intestines were quickly removed. Tissue samples from the organs were taken for hematological and pathological analyses.

Table 1: Dietary compositions of experimental starter and finisher diets

Ingredients (g kg ⁻¹)	STARTER DIET			FINISHER DIET		
	SBM	HMBM	RMBM	SBM	HMBM	RMBM
Maize	450	450	450	480	480	480
Cassava flour	60	60	60	110	110	110
Wheat Bran	80	80	80	50	50	50
Brewer's Dried Grain	70	70	70	-	-	-
Groundnut cake	121	121	121	164.50	164.50	164.50
Soybean meal	120	-	-	120	-	-
<i>Mucuna</i> seed meal	-	120	120	-	120	120
Fish meal (72 %)	25	25	25	30	30	30
Bone meal	60	60	60	15	15	15
Oyster shell	5	5	5	20	20	20
Methionine	2	2	2	0.50	0.50	0.50
Lysine	2	2	2	5	5	5
Salt	2.5	2.5	2.5	2.5	2.5	2.5
Vitamin - mineral Premix*	2.5	2.5	2.5	2.5	2.5	2.5
TOTAL	1000	1000	1000	1000	1000	1000

*Vitamin-Mineral Premix (Agricare - Mix, Pfizer Production Plc, Lagos, Nigeria) contained per 1000g: Vitamin A, 12,000,000 IU; Vitamin D₃ 2,000,000 IU; Vitamin E 7,000 IU; Vitamin B₂ 4,000 mg; Nicotinic acid 15,000 mg; Calcium d-pentothenate 8,000 mg; Biotin 40 mg; Vitamin B₁₂ 10 mg; Mn 20,000 mg; Fe 50,000 mg; Zn 100,000 mg; 100,000 mg; Cu 10,000 mg; Iodine 750; Co 3000 mg.

4 Results and Discussion

Body weight gain and feed consumption of birds on the RMBM diet were reduced ($P < 0.05$) at both the starter and finisher phases. Birds on the RMBM diet had poor FCR compared to those on the SBM and HMBM diets (Table 2). The reports of HARMS *et al.*, (1961) and OLABORO *et al.*, (1995) support this finding. The depression in growth observed was evident from the early stage of the study and this could be due to the toxic effect of the anti-nutritional factors in the bean. In the first 7 days, birds on the *Mucuna* diets had low feed intake but birds on the HMBM diet, tolerated their feed more than those on the RMBM diets. During the starter phase, birds on HMBM diet had decreased growth rate, but at the finisher phase this depressive effect on growth did not show. The results suggest that heating reduces the growth depressing factors in *Mucuna* beans. Moreover, it was observed that some of the birds on the RMBM diet had leg and neck deformities beginning from week 4 while nervousness was noticed among the birds. These conditions progressively caused paralysis in them by week 8 all contributing to the depressed performance of the birds.

Table 2. Performance characteristics of broilers on diets of raw and heated *Mucuna* bean meal

	STARTER DIET			FINISHER DIET		
	SBM	HMBM	RMBM	SBM	HMBM	RMBM
Wt. gain (kg)	0.51±0.03 ^a	0.36±0.01 ^b	0.27±0.03 ^b	1.79±0.12 ^a	1.69±0.04 ^a	0.94±0.07 ^b
Feed intake (kg)	1.99±0.05 ^a	1.75±0.16 ^a	1.65±0.13 ^a	4.06±0.13 ^a	4.13±0.10 ^a	4.19±0.13 ^a
Feed conversion ratio (FCR)	3.93±0.26 ^b	4.94±0.58 ^{ab}	6.09±0.32 ^a	2.28±0.07 ^b	2.45±0.04 ^b	4.51±0.37 ^a

^{a,b,c} Values on the same row with different superscripts differ significantly ($P < 0.05$)

Results of hematological values (Table 3) indicate that the *Mucuna* diets had significant influence on the PCV, Hb, WBC and Neutrophil values while the Eosinophil and Monocyte values were not affected. CHURCH *et al.*, (1971) observed that hematological traits especially PCV and Hb values are correlated with the nutritional status of the animal and the influence of diet on hematological trait is very strong. The low value of PCV and Hb in birds on the RMBM diet suggests normocytic-normochromic anemia which showed iron deficiency. This observation agrees with the report of GRAITER *et al.*, (1981) who noted a direct relationship between dietary iron Hb, PCV and serum iron. The WBC value obtained on the SBM diet is fairly above the values in the HMBM and RMBM diets which were below normal WBC count. This could mean that the antibody formation and cell mediated immunity of birds fed the HMBM and RMBM diets were affected. MCV values were higher than those of JAIN (1986). The MCHC values for all the diets were of the same average and within the normal range of 30-34% reported. This indicates adequate dietary energy for all the birds. However, the fairly low RBC value and the high MCV value especially for birds on the RMBM diet showed hematological features of macrocytosis or regenerative anemia.

Histopathological changes in the birds SBM diet showed that there were no histological changes in the organs. Birds fed the HMBM diet showed mild to moderately severe vacuolar degeneration of hepatocytes appearing slightly swollen but normal. A mild swelling of the bile ductular cells and vacuolar degeneration were observed. Also, mild interstitial mononuclear cell infiltration was observed. There were however, no lesions observed in the heart and the brain of the birds. The histology of the organs in birds fed RMBM diet showed severe vacuolar degeneration and necrosis of the hepatocytes especially around the periportal region. Mild to moderate lymphocytic periportal aggregation and kupffer cell hyperplasia were observed.

Table 3: Hematological parameters of broilers fed raw and heated *Mucuna* bean meal

PARAMETER	SBM	HMBM	RMBM
PCV (%)	26.50±4.50 ^a	20.00±2.00 ^b	13.50±0.50 ^c
Hb (mg/dl)	8.50±1.50 ^a	6.10±0.30 ^b	4.20±0.20 ^c
RBC (x 10 ⁶ /ul)	4.50±0.50 ^a	3.20±0.40 ^b	2.00±0.20 ^c
MCV (fl)	58.50±3.50 ^b	64.29±14.29 ^{ab}	67.93±4.29 ^a
WBC (x 10 ³ /ul)	3.60±0.20 ^a	2.00±0.60 ^b	1.70±0.40 ^c
MCHC (%)	32.04±0.22	30.96±0.60	31.10±0.33
Lymphocytes ((x 10 ³ /ul)	1.82±0.32 ^a	1.12±0.39 ^b	1.32±0.16 ^b
Neutrophil (x 10 ³ /ul)	1.73±0.17 ^a	0.80±0.24 ^b	0.36±0.23 ^c
Eosinophil (x 10 ³ /ul)	0.04±0.04	0.08±0.03	0.03±0.02
Monocyte (x 10 ³ /ul)	0.02±0.02	0.00	0.00

^{a,b,c} Values on the same row with different superscripts differ significantly (P<0.05)

Furthermore, there were marked interstitial congestion, multifocal areas of glomerular and tubular degenerations and necrosis in the kidneys. Some large tubules contain pinkish pertinacious cast in their lumen. Also there were mild multifocal hyaline degeneration and fragmentation of myofibrils of the heart. The brain showed focal area of neuronal degeneration, gliosis and spongiosis especially in the grey matter while mild lymphoid depopulation was observed in the spleen. These conditions are indicative of the degenerative effects associated with feeding raw or poorly processed *Mucuna* beans.

In conclusion, results of the study showed that *Mucuna* has the potential for feeding broilers. Feeding raw or heated *Mucuna* at a level of 120 g kg⁻¹ diet in place of SBM caused reduced feed intake, weight and FCR with marked effect on the histology of some internal organs and health status of the birds. However, heating the beans prior to incorporation in the diets is effective in ameliorating the depressive effects of the antinutrients in them on the performance of broilers at both starter and finisher phases.

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