VELVET BEAN (*MUCUNA PRURIENS*) IN MONOGASTRIC ANIMAL NUTRITION: EFFECT OF SOME LOCAL PROCESSING METHODS.

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Introduction

- The velvet bean plant (*Mucuna pruriens*) is an important cover crop in many parts of the world, especially among subsistence farmers (Buckles 1995)

- Velvet bean usually produces substantial biomass which covers the soil and strangles all the weeds.

- It climbs as high as its supports (weeds, trees, associated crops) allows.

Introduction(cont'd)

- There are reports that VB can be used for reducing nematode populations.
- It produces prolific qualities of the beans or seeds that is little known and used by humans and animals
- Velvet bean has for many year been used in Indian medicines.

Introduction(cont'd)

- The use of the unprocessed raw VB in diets for both human and chickens is often accompanied by toxic symptoms (Olaboro, *et al*. 1996)

- On the other hand processed *Mucuna* bean has been reported to have beneficial effects on monogastric animal performance.

- Relative to protein content, the amount of essential amino acids in VB are comparable in most cases to those of soybean (NRC,1994) Del Carmen (1999).

INTRODUCTION(CONT'D)

- Research on the development of VB as possible protein and energy feed for the poultry and pig industries in tropical countries were started at our station in 1995.

- This was in response to the feed crisis that almost crippled the country's poultry industry.

- The thrust of the research has been to develop methods of reducing the toxic load of the VB so as to render it utilizable by non ruminants, particularly poultry and pigs.

OBJECTIVES

- To evaluate the effects of processing methods on the nutritive value of Mucuna beans as measured by

- Broiler performance till market age.

- Laying hen performance and

- Pig performance and organ characteristics.

PROCESSING METHODS/FEED TRIALS

- Raw, Toasted and Cooked Velvet Bean
- Water- Soaked and cooked Velvet Bean
- Cracked, Water-Soaked and Cooked Velvet Bean
- $Ca(OH)_2$ - Soaked Velvet Bean
- Water-soaked whole or cracked Velvet bean cooked in Maize cob ash solution.

FEEDING TRIAL

- 10% raw, toasted, cooked and 20% cooked VB were added to broiler diets fed 5-8 week of age.
- The birds weighed 63.2, 71.3, 82.7 and 66.0% of the control, respectively (Table. 1).
- With raw VB there was clear depression in growth rate and marked deterioration in feed conversion values but not feed intake.
- Weights of heart and gizzard were heavier in VB diet groups than the control. Liver weight decreased only with the 10% cooked VB diet.
- 10% cooked VB, compared favorably with the control.

Table 1: Performance and organ weights of finisher broilers fed raw, cooked and tested *Mucuna*

	Control	10%RM	10%CM	20%CM	10%TM
Feed Intake (gm/d)	88.95[a]	89.39[a]	82.13[a]	68.34[b]	73.64[b]
Growth Rate (gm/d)	48.19[a]	30.46[b]	39.85[a]	31.82[b]	34.39[b]
Feed Conv.	1.85[a]	2.96[b]	2.08[a]	2.16[a]	2.14[a]
Heart	0.45	0.54	0.51	0.56	0.54
Liver	1.81[a]	2.07[b]	1.74[a]	2.06[b]	1.85[a]
Gizzard	4.31[a]	5.06[b]	4.57[a]	5.01[b]	5.18[b]

Soaking in water or Ca $(OH)_2$ solution prior to cooking

- Mucuna soaked in tap water for 48 hours, cooked for 60 minutes, sun dried and ground into meal.
- Mucuna soaked 3% Ca $(OH)_2$ solution for 48 hours, sun dried and ground into meal.
- Mucuna soaked in 3%Ca$(OH)_2$ solution, cooked for 60 minutes, sun dried and ground into meal.
- Mucuna soaked in 3% Ca $(OH)_2$ solution for 48 hours rinsed with tap water, cooked for 60 minutes at 100°C (timed from boiling), sun dried and ground into meal.

FEEDING TRIAL

- Water-soaked and cooked VB meal was incorporated into broiler finisher diets at 20 and 30% levels.
- The birds had 12 and 28% reductions in growth rate and 9.2 and 4.0% reductions in feed intake (Table. 2).
- There was marked deterioration in feed conversion values only in birds fed 30% VB.
- At 20% dietary level, the birds compared favorably with those on the control diet.

Table 2: Performance of broilers fed soaked and cooked Nigerian or Brazilian Mucuna (5 – 9 weeks)

MEASUREMENTS	0% CONTROL	20% NM	30% NM	20% BM	30% BM
Initial body wt(g)	662.8	648.8	660.2	658.9	658.4
Final body wt(kg)	1.89^{a}	1.72^{a}	1.54^{b}	1.76^{a}	1.65^{b}
Avg. daily gain (g)	43.8^{a}	38.3^{a}	31.4^{b}	39.3^{a}	35.4a^{b}
Feed intake (g/d)	166.4^{a}	151.1^{ab}	160.4^{a}	144.4^{b}	170.0^{a}
Feed gain ratio	3.60^{a}	3.95^{a}	5.10^{b}	3.67^{a}	4.82^{b}

CRACKING PRIOR TO SOAKING WATER AND COOKING.

- Whole Velvet bean seeds were cracked into 2 to 4 parts/seed using a hammer mill.

- The cracked seeds were soaked in clean water for 48 hours, rinsed with fresh water, cooked for 60 minutes sun dried and ground into meal.

FEEDING TRIAL

- Cracked-soaked and cooked *Mucuna* meal was incorporated in broiler starter, finisher and layers diets at 0, 20, 25 and 30% levels respectively.
- Starter broilers weighed 87.4, 89.6 and 83.3% of control, respectively (Table.3).
- Finisher broilers weighed 85.0, 85.0 and 61.1% of control, respectively. (Table.4)
- Laying hens laid 88.1, 82.1 and 77.5 % of control, respectively(Table 5).
- Birds on *Mucuna* diets produced significantly heavier and bigger sized eggs than the control
- Pigs fed 15% raw and 20,30 and 40% cracked- soaked and cooked VB meal weighed 72.6, 92.5, 94.1 and 95.2 % of control, respectively (Table6)

Table 3: Performance of broilers fed cracked-soaked and cooked *Mucuna* (1 – 5 weeks)

Parameters	Control (0.0%)	CSCM (20.0%)	CSCM (25.0%)	CSCM (30.0%)
Average initial weight (g)	291.67	289.59	291.67	300.00
Average final weight (g)	954.17	868.75	885.42	862.50
Average weight gain (g)	662.50	579.17	593.75	562.50
Growth rate (g/b/d)	31.55	27.57	28.27	26.29
Average total feed intake (kg)	1.74	1.70	1.78	1.82
Feed conv. (g feed/g gain)	2.63^{b}	2.94^{ab}	2.99^{ab}	3.24^{a}

Table 4: Performance of finisher broiler fed cracked and soaked *Mucuna* seed meal diets.

Parameters	0% Control	20% CSCM	25% CSCM	30% CSCM
Average initial weight (kg)	0.97	0.97	0.98	0.97
Average final weight(kg)	2.91[a]	2.62[b]	2.62[b]	2.61[a]
Average weight gain (kg)	1.93[a]	1.64[a]	1.64[a]	1.18[b]
Daily weight gain (g/b/d)	55.17[a]	46.90[a]	46.80[a]	33.75[b]
Feed intake (kg)	5.37[a]	4.84	5.04	4.79
Protein ratio	1.79[a]	1.71[a]	1.64[a]	1.26[a]
Feed conv. ratio	2.78[b]	2.95[b]	3.08[b]	4.06[a]

Table 5: Effect of processed *Mucuna* seed meal on the performance and egg quality characteristics of laying hens.

Parameters	Control (0.0%)	CSCM (20%)	CSCM (25%)	CSCM (30%)
Hen-day production (%)	77.80[a]	68.53[a]	63.86[b]	60.32[b]
Average egg weights (g)	61.31[b]	65.22[ab]	66.65[a]	68.19[a]
Feed intake (g/b/d)	112.68[b]	116.05[a]	115.81[a]	112.66[b]
Kg feed/kg egg	1.84[a]	1.78[a]	1.74a[b]	1.65[b]
Haugh unit (HU)	78.03	80.69	78.18	79.93
Shell Thickness (mm)	0.39	0.36	0.38	0.36
Horizontal circum. (cm)	13.93[b]	14.17[ab]	14.33[a]	14.07[b]
Oblong circum. (cm)	16.16a[b]	16.56[a]	16.63[a]	15.93[b]

Table 6: Performance carcass and organ weights of pigs fed raw, cracked-soaked and cooked *Mucuna*.

Parameters	Control (0%)	15% RM	20% CSCM	30% CSCM	40% CSCM
Final live weight (kg)	35.50^{a}	28.50^{b}	31.83^{a}	31.83^{a}	32.00^{a}
Weight gain (kg)	15.50^{a}	11.25^{b}	14.33^{a}	14.58^{a}	14.75^{a}
Feed int. (kg) (Dry wt.)	36.9	36.0	36.9	36.9	36.9
Feed conv. ratio	2.38^{b}	3.20^{a}	2.58^{b}	2.53^{b}	2.50^{b}
Mortality (%	0.00	50.00	0.00	0.00	0.00
Dressed (%)	65.79^{a}	60.00^{b}	65.79^{a}	58.82^{b}	60.00^{b}
Liver (%)	5.55^{b}	5.75^{b}	5.68^{b}	6.50^{a}	5.71^{b}
Heart (%)	1.87^{a}	0.95^{c}	1.74^{ab}	1.38^{abc}	1.23^{bc}
Kidney (%)	1.18^{ab}	0.95^{c}	1.05^{bc}	1.29^{a}	0.97^{c}
Lungs (%)	3.11^{ab}	2.20^{b}	3.82^{a}	4.32^{a}	2.46^{b}

Soaking in calcium hydroxide solution prior to cooking

- Following the finding of Ruiz Sesma (1999) that 24-hr soaking in water containing 4% ca $(OH)_2$ improved the nutritive value of VB, we embarked on the following trials.
- Whole VB was: 1)soaked in water for 48-hrs, cooked of 60 minutes, sun dried and ground into meal;
- 2) Processed as in 1, but the soaking was done in water containing 3% Ca $(OH)_2$ and
- 3) Soaked in water containing 3% $Ca(OH)_2$, rinsed with fresh water, sun dried and ground into meal.

FEEDING TRIAL

- $Ca(OH)_2$-soaked, $Ca(OH)_2$-soaked and cooked, and water–soaked and cooked VB were each incorporated at 20% level into starter broiler diets fed 7-28 days of age
- . At 28 day of age broilers fed the diets weighed 44.0, 86.1 and 82.0 of control, respectively (Table 7)
- . Feed intake values were not significantly different when compared with the control. Feed conversion values deteriorated only with Ca $(OH)_2$–soaked VB .
- Birds fed 20% Ca $(OH)_2$-soaked and cooked VB had a slightly better performance than those fed water-soaked and cooked VB, indicating a positive effect of the alkaline on the seed.

Table 7: Performance of broiler fed, water and calcium hydroxide soaked and cooked *Mucuna* (1 – 5 weeks)

Parameters	0% Control	20% CSM	20% CSCM	20% WSCM
Initial body wt (g)	101.0	102.0	101.0	102.0
Final body wt (g)	775.0^{a}	398.0^{b}	690.0^{a}	665.0^{a}
Average wt gain (g)	674.0^{a}	296.0^{b}	580.0^{a}	553.0^{a}
Growth rate (g/d)	32.1^{a}	14.1^{b}	28.1^{a}	26.3^{a}
Feed intake (g/b/d)	56.2^{ab}	48.1^{b}	60.8^{a}	63.24^{a}
Feed conv. Ratio	1.75^{a}	3.41^{a}	2.16^{b}	2.41^{b}
Mortality	-	-	-	-

Table 8: Performance and organ weight of broilers fed Ca $(OH)_2$-soaked and cooked *Mucuna* (5 – 9 weeks)

	Dietary levels of velvet bean meals (%)		
Parameters	0.0% Control	20.0%	30.0
Initial body weight (kg)	0.90	0.90	0.90
Final body weight (kg)	2.71^{a}	2.68^{ab}	2.35^{b}
Total weight gain (kg)	1.81^{a}	1.78^{ab}	1.45^{b}
Growth rate (g/d)	65.00^{a}	63.00^{ab}	52.00^{b}
Total feed intake (kg)	4.58^{b}	4.76^{a}	4.38^{b}
Feed conv. ratio	2.57^{b}	2.73^{ab}	3.02^{a}
Heart	0.36^{b}	0.43^{a}	0.42^{a}
Liver	1.45	1.67	1.57
Lungs	0.51	0.56	0.61
Gizzard	2.16^{b}	2.42^{ab}	2.77^{a}
Mortality	-	-	-

Soaking in water prior to cooking in maize cob ash solution

- Whole and cracked VB seeds were each:
- Soaked in water for 48 hours,
- Rinsed with fresh water,
- Cooked for 60 minutes at 100^{o}C (timed from start of boiling) in maize cob ash solution (in 1: 4 dilution with water)
- Sun dried and ground into meal.
- The meals so produced were incorporated into broiler diets at 25 and 30% levels each for the whole and cracked seeds.

FEEDING TRIAL

- whole and cracked *Mucuna* seeds soaked water before cooking in maize cob ash solution were incorporated into broiler starter and finisher diets at 25 and 30% levels, respectively.
- starter broilers fed the diets by 28 day of age, gained 95.9, 84.4, 105.9 and 95.4% of control, respectively (Table.9)
- Finisher broilers gained 96.7, 82.5, 97.9 and 98.7% of control, respectively (Table.10)
- Birds on cracked bean diets at both levels had slightly better performance than those on whole VB diets.
- VB so processed appeared to be better than groundnut cake in broiler diets (Table.11).

Table 9: Performance of broilers chicks fed velvet bean cooked in maize cob ash solution (0–4weeks).

	Control	WVB		CVB	
Parameters	0%	25%	30%	25%	30%
Av. Initial wt	76.0	76.5	76.1	77.7	76.3
Av. final wt (g)	895^{ab}	862^{ab}	768^{b}	944^{a}	857^{ab}
Daily growth rate	39.0^{ab}	37.4^{b}	32.9^{c}	41.3^{a}	37.2^{b}
Av. daily feed intake	77.3^{b}	73.6^{b}	71.6^{b}	86.2^{a}	70.7^{b}
Feed conv. Ratio	1.98	1.99	2.22	2.14	1.94
Mortality	2	2	-	2	2

Table 10: Performance of broilers chicks fed velvet bean cooked in maize cob ash solution (5 – 8 weeks).

Control	Control	WVB	WVB	CVB	CVB
Parameters	0%	25%	30%	25%	30%
Initial weights	431.3	435.5	433.4	456.3	448.0
Final body weights	1772.8^{b}	1731.7^{b}	1540.0^{a}	1770.0^{b}	1773.3^{b}
Weight gain	1341.5^{b}	1296.2^{b}	1106.6^{a}	1313.7^{b}	1325.4^{b}
Growth rate (g/d)	47.9^{b}	46.3b	39.5^{a}	46.9^{b}	47.3^{b}
Feed intake	3.38^{bc}	4.08^{a}	2.98^{c}	3.96^{ab}	4.31^{a}
Feed conv. Ratio	2.52^{b}	3.31^{a}	2.77^{ab}	3.02^{ab}	2.28^{ab}
Mortality (%)	2	3	-	2	-

Table 11: Performance of broilers fed soybean, Groundnut and *Mucuna* meals diet (0 – 9 weeks).

Parameters	SBM	GNM	MBM
Total weight (g)	1686.70[a]	1351.00[b]	1481.00[b]
Weight gain g/b/d)	36.77[a]	24.76[b]	30.30[b]
Feed intake (g/b/d)	102.08[b]	114.93[ab]	139.50[a]
Feed conversion ratio	2.78[a]	4.60[b]	4.60[b]

CONCLUSION

- The results of the various trials herein summarized showed that *Mucuna* bean is toxic to monogastric animals.

- All the processing method used affected the feeding value of Mucuna bean with cracking prior to soaking and cooking in maize cob ash solution giving the best result at 30% level.

- With a relatively high seed yield and a dietary inclusion level of30% for poultry and 40% for pigs, there is need to promote its introduction into the farming system of developing tropical countries in order to develop it as an economic crop.

- As an economic crop, it will add to animal feed supply, and reduce the current pressure on conventional feed ingredients in poultry and pig diets.

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