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A note on the nutritive value of roasted velvet bean (*Mucuna pruriens*) in broiler diets

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ABSTRACT

The nutritive value of roasted *Mucuna pruriens* var. *utilis* (mucuna or velvet bean) was investigated in a four-week study using 336 mixed-sex three-week old broiler chickens. The birds were randomly allocated to four dietary treatments. Fifty, 100 or 150 g of mucuna beans, roasted in metal bowls over a wood-fired stove until they turned light brown was included into nutritionally balanced diets. Control diet did not contain mucuna beans. Feed and water were supplied *ad libitum*. Performance criteria studied included feed intake, growth rate, feed conversion ratio, carcass parameters and mortality.

Roasted mucuna beans at the levels of 50 and 100 g kg^{-1} significantly ($P<0.05$) improved the growth and feed utilization of broilers. At 150 g kg^{-1} diet, however, mucuna beans depressed weight gains and feed utilization.

KEY WORDS: *Mucuna puriens*, velvet bean, roasting, broiler performance

INTRODUCTION

Mucuna puriens var. *utilis* (mucuna or velvet bean; MP) has been grown from time immemorial in Ghana and other countries as a component of the traditional crop farming system. Among various Ghanaian tribes, the beans find use in the preparation of soups and stews (Ahenkora et al., 1994, unpublished). In recent years mucuna has gained popular acceptance among farmers as a cover crop helping to control weeds and also improve soil fertility by fixing nitrogen (Osei-Bonsu and Buckles, 1993; Buckles, 1995). The large-scale cultivation of mucuna has meant that large quantities of the beans are left un-utilized as human food. The dry

matter of velvet beans MP contains 250 g kg^{-1} protein (Ahenkora et al., 1999) and this makes MP attractive as a potential feed ingredient for poultry that may serve as a replacement (at least partially) for more expensive protein ingredients like fish meal and soyabean meal. There is little published literature in this regard although work using raw MP showed deleterious effects on chick and broiler performance (Vieira and Carvalho, 1996; Osei and Dei, 1998, unpublished). The negative effects of MP have been variously attributed to the presence of toxic antinutritional factors including anti-trypsin factors, tannins, phytic acid, L-DOPA, anticoagulants and others (Liener and Kakade, 1969; Sathe and Salunke, 1984; Ravindran and Ravindran, 1988; Osei-Bonsu and Buckles, 1993; Houghton and Skari, 1994). Several heat treatments have been employed to destroy anti-nutrients in various leguminous seeds (Huisman and Tolman, 1992).

This work was undertaken to investigate the beneficial effects of roasting on the nutritive value of *Mucuna pruriens* for broiler chickens.

MATERIAL AND METHODS

Dried mature mucuna beans (MP) were obtained either from local farmers growing the crop under a Sasakawa Global 2000-sponsored pilot project or from test plots of the Crops Research Institute, Kumasi (Ghana). The beans were roasted in quantities of approximately 1 kg for approximately 20 min in metal bowls over wood-fired stoves until they turned light brown. They were then milled through a 3 mm sieve in a hammermill. The milled beans were analysed for proximate constituents using conventional methods (AOAC, 1980).

Three hundred and thirty six mixed-sex Shaver Tropicbro commercial broiler chickens (Pomadze Poultry Enterprises, Winneba, Ghana) aged 21 days old were initially weighed in groups to obtain the mean weight for the flock. They were then individually weighed and re-allotted in equal numbers to four experimental dietary groups such that the groups were equalized for sex and weight. The control diet was formulated as a combined starter-finisher diet containing approximately 210 g kg^{-1} crude protein; the three other test diets contained 50, 100 and 150 g mucuna per kg, respectively, replacing equal amounts of the control diet (Table 1). The diets were isocaloric and isonitrogenous.

The trial was conducted according to the completely randomised design and each treatment had three replicates. The experimental broilers were reared in raised wire floor coops with floor space averaging approximately 0.14 m^2. Feed and water were supplied *ad libitum*. The trial lasted 28 days.

The following parameters were measured: feed intake, liveweight gain, feed conversion ratio and mortality. On the final day of the trial, three broilers were selected randomly from each treatment replicate and slaughtered for carcass analysis.

TABLE I

Composition and nutrient content of experimental diets, g kg^{-1} DM except ME

Ingredient	Level of mucuna beans g kg^{-1}			
	0	50	100	150
Mucuna beans	0	50	100	150
Maize	600	600	600	600
Fish meal	110	100	90	80
Soyabean meal	150	150	150	140
Wheat bran	110	70	30	0
Constant components[1]	30	30	30	30
Calculated analysis				
crude protein	209	208	108	206
ME ($MJkg^{-1}$)	11.50	11.49	11.45	11.56
ether extract	42.5	43.6	44.2	45.6
crude fibre	49.7	48.4	45.7	43.0
methionine + cystine[2]	7.2	7.3	6.5	6.6
lysine	8.7	8.4	8.3	8.3
tryptophan	1.7	1.6	1.9	1.8
Ca	10.6	10.5	10.0	9.8
P, available	5.92	5.78	5.53	5.40

[1] providing per 1 kg diet: (g) oyster shell 10; dicalcium phosphate 10; NaCl 5; vitamin-mineral premix 5, supplying per kg of diet: vit. A, 20000 IU; D_3, 4000 IU; E, 30 IU; K, 2 IU (mg) B_1, 2; B_2, 9; B_{12}, 0.024; niacin, 50: Fe, 90; Cu, 5; Mn, 120: Co, 1; I, 4; Se, 0.4

[2] amino acid content of mucuna from Achinewhu (1982)

The analysis of variance was used in data analysis while significant differences among treatment means were estimated using Fisher's least significant difference test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Proximate analysis showed that roasted velvet beans contained 92.8 g kg^{-1} dry matter which in turn contained per kg/g: crude protein, 246; crude fibre, 65.4; ether extract, 52.0; ash 32.0; and N-free extractives, 604.6. These values are in close agreement with those presented by Osei and Dei (1998, unpublished) and Dei Carmen et al. (1999) and indicate that heating may generally slightly increase nutrient values as a result of the evaporation of water (Ahenkora et al., 1999). The crude protein content of MP compares favourably with that of chickpea, mung bean and several cowpea varieties (Hsu et al., 1977; Abbey and Ibeh, 1988).

The effects of roasted velvet beans on broiler performance are summarized in Table 2. Roasted MP at 50 or 100 g kg^{-1} diet significantly improved weight gains (2-4%) and feed conversion ratio (1.2-3.4%) over the control diet. At the 150 g kg^{-1} diet level, however, MP significantly depressed weight gain (3.3%) and efficiency of feed utilization (6.7%) compared with the control. The depression in weight

TABLE 2

Performance of broilers

Parameter	Dietary level of mucuna beans, g kg^{-1}				Overall SEM
	0	50	100	150	
Initial body weight, g	480	480	480	480	-
Final body weight, g	1920[b]	1951[a]	1980[a]	1873[c]	48.7
Body weight gain, g	1440[b]	1471[a]	1500[a]	1393[c]	48.5
Total feed intake, g	3251	3270	3287	3270	35.6
Feed: gain ratio	2.25[a]	2.22[a]	2.19[b]	2.35[c]	0.02
Mortality, %	2.4	2.4	0	3.6	-

[a,b,c] $P<0.05$

gain was evident by the end of the second week while impaired feed utilization efficiency was observed at the end of the third week. Del Carmen et al. (1999) have reported that heated MP when fed at 10% of the diet had deleterious effects only early weight gain while 20 and 30% heated MP progressively depressed weight gain and efficiency of feed utilization in a 42-day feeding trial. In an earlier trial, Osei and Dei (1998, unpublished) all levels of raw MP from 5 to 15% of the diet caused significant deterioration in broiler chicken performance. It is suggested that heating in this trial might have destroyed or inactivated anti-nutritional factors present in unheated MP making it possible to include up to 100 g kg^{-1} in broiler diets. Data from Del Carmen et al. (1999) indicates that heat treatment destroyed anti-trypsin activity without affecting L-DOPA. Whether heating affected any other factor is not clear since these were not studied. The depressive effect of the 150 g kg^{-1} MP on broiler performance is difficult to explain. It is possible that other thermostable factors were involved. Ahenkora et al. (1999) have stated that the majority of toxic effects reported in human consumption of MP bean preparations are attributable to L-DOPA.

There were no significant dietary treatment effects on feed consumption, mortality and carcass dressing percentage. Del Carmen et al. (1999) observed significant decreases in feed consumption only in broiler chickens fed diets containing 20 or 30% MP. The highest level of MP in this trial was only 150 g kg^{-1}. The lack of significant effect of MP on mortality and carcass weights agrees with other reports (Osei and Dei, 1998, unpublished; Del Carmen et al., 1999).

Table 3 shows the effects of dietary mucuna on various organ weights. No significant effects on the kidney weight were evident from feeding MP. On the other hand, there were significant depressions in the weights of gizzard, liver and small intestine at all levels of MP incorporation. MP at 150 g kg^{-1} diet exerted the most serious effects. The authors are not aware of work with MP in which organ weights were studied. Most work on antinutritional factors has in fact concentrated on physiological changes (Huisman and Tolman, 1992).

The results of this study show that roasting can improve the nutritive value of MP and permit its incorporation into broiler diets up to 10%. It is however possible that if all the toxic/antinutritional factors were removed it might be possible to include higher levels of MP in broiler diets. A variety of detoxification methods including particurarly boiling and soaking have been employed to make MP beans safe for human consumption. Studies of processing technologies and treatments for improving the nutritive value of MP for chickens are recommended.

TABLE 3

Carcass parameters, liveweight %

Parameter	Dietary level of mucuna beans, g kg^{-1}				Overall SEM
	0	50	100	150	
Dressing percentage	76.7	74.9	77.0	77.2	2.36
Heart	0.87[b]	1.22[a]	1.14[a]	1.25[a]	0.21
Kidney	0.76	0.67	0.63	0.65	0.06
Small intestine	1.70[a]	0.92[b]	0.92[b]	1.21[a]	0.05
Liver	3.78	2.70	2.76	2.98	0.25
Gizzard	1.74[a]	1.07[a]	0.88[b]	0.73[b]	0.16

[a,b,c] different at $P<0.05$

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REFERENCES

Abbey B.W., Ibeh G.O., 1988. Functional properties of raw and heat processed cowpea *Vigna unguiculata* flour. J. Food Sci. 53, 1775-1777

Ahenkora K., Dadzie M., Osei-Bonsu P., 1999. Composition and functional properties of raw and heat processed velvet bean *(Mucuna pruriens* L. DC. var. *utilis)* flours. Int. J. Food Sci. Tech. 34, 131-135

AOAC, 1984. Official Methods of Analysis. Association of Official Analytical Chemists. 15th Edition. Washington, DC

Buckles D., 1995. Velvet bean: a "new" plant with a history. Econ. Bot. 49, 13-25

Del Carmen J., Gernat A.G., Myrhman R., Carew L.B., 1999. Evaluation of raw and heated velvet beans (*Mucuna pruriens*) as feed ingredients for broilers. Poultry Sci. 78, 866-872

Liener I.E., Kakade M.L., 1969. Protease inhibition: In: I.E. Liener (Editor). Toxic Constituents of Plant Foodstuffs. Academic Press, New York

Houghton P.J., Skari K.P., 1999. The effect on blood clotting of some West African plants used against snakebite. J. Ethnopharmacol. 44, 99-108

Hsu H.W., Vavak D.L., Satferlee L.D., Miller G.A., 1977. A multienzyme technique for estimating protein digestibility. J. Food Sci. 42, 1269-1271

Huisman, J., Tolman, G.H., 1992. Antinutritional factors in the plant proteins of diets for non-ruminants. In: P.C. Garnsworthy, W. Haresign, D.J.A. Cole (Editors). Recent Advances in Animal Nutrition. Butterworth-Heinemann Ltd., Oxford, pp. 3-31

Osei-Bonsu, Buckles P., 1993. Controlling weeds and improving soil fertility through the use of cover crops: experience with *Mucuna* spp. in Benin and Ghana. WAFSRN Bull. 14, 2-7

Ravindran V., Ravindran G., 1988. Nutritional and anti-nutritional characteristics of mucuna *(Mucuna utilis)* bean seeds. J. Sci. Food Agr. 46, 71-79

Sathe S.K., Salunke D.K., 1984. Technology of removal of unwanted components of dry beans. CRC Critical Rev. Food Sci. Nutr. 21, 263-286

Steel R.G.D., Torrie J.H., 1980. Principles and Procedures of Statistics: a Biometrical Approach. 2nd Edition. McGraw Hill, New York

Vieira R.D., Carvalho N.M., 1996. Velvet bean *(Mucuna* spp.*)*. In: E. Nwokolo, J. Smartt (Editors). Food and Feed from Legumes and Oilseeds. Chapman and Hall, New York

STRESZCZENIE

Wartość pokarmowa prażonego aksamitnego bobu dla kurcząt brojlerów

Wartość pokarmową prażonego aksamitnego bobu oznaczono w 4-tygodniowym doświadczeniu na 336 trzytygodniowych kurczętach brojlerach obydwóch płci. Kurczęta podzielono losowo na 4 grupy żywieniowe. Pięćdziesiąt, 100 lub 150 g bobu, prażonego w metalowych naczyniach, w piecach ogrzewanych drewnem, aż do uzyskania jasno - brązowego koloru, włączano do zbilansowanych diet. Dieta grupy kontrolnej nie zawierała bobu. Pasza i woda były podawane do woli. Oznaczano pobranie paszy, przyrosty i wykorzystanie paszy, śmiertelność oraz niektóre wskaźniki tuszy.

Udział w dietach bobu aksamitnego w ilości 50 i 100 g kg^{-1} istotnie ($P<0,05$) poprawiał przyrosty i wykorzystanie paszy; dawka 150 g pogarszała te wskaźniki.