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Methionine in Velvet Bean *(Mucuna pruriens)* Based Broiler Starter Diets and Bean Influence on Finishing Broilers

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Abstract

The performance of broiler chicks fed starter diets containing 30% raw or heat treated, and 20% heat treated velvet beans with varying levels of methionine was determined. The influence of varying levels of heat treated velvet beans on growth and carcass characteristics of finishing broilers was also investigated. There was no beneficial effect of adding methionine to broiler starter diets containing 30% raw or heat treated velvet beans. Addition of methionine to starter diets containing 20% heat treated velvet beans significantly ($P < 0.05$) improved weight gain. Optimal performance was achieved with birds consuming the diet containing 0.2% added methionine. The content of total dietary methionine and sulphur amino acids were 0.66 and 1.0% respectively. When heat treated and added at levels up to 20% of the diet, velvet beans proved to be a good source of protein for finishing broilers. Addition of 30% heat treated velvet beans to a finisher diet, however, decreased ($P < 0.05$) weight gain and increased ($P < 0.05$) carcass yield.

Key words: Velvet beans, methionine, broilers, autoclaving, roasting

Introduction

Reducing the cost of feed is a major concern of poultry producers in Uganda. One approach to reducing feed cost is the production and utilization of alternative feed grains which cost less than conventional ingredients. Prerequisites for the utilization of an alternative feed grain are that it be agronomically efficient and that it possesses a nutrient profile comparable with the bird's requirements, without antinutritional factors.

Several species of tropical grain legumes demonstrate extraordinary yield potential in the lowland tropics. It is, therefore, suggested that some of these species with better adaptability and fewer pest and disease problems should receive greater attention as poultry feed ingredients. The velvet bean *(Mucuna pruriens)* is among the most interesting and potentially useful grain in poultry feeds. Velvet beans contain about 27% protein. Except for the sulphur amino acids and particularly methionine, velvet bean protein appears to be well balanced with respect to the essential amino acids (Olaboro, 1993). Although it has been shown that methionine is a limiting amino acid in velvet beans, precise information has not been obtained with regard to the growth response in chicks attributable to supplemental methionine in starter diets containing

raw or heat treated velvet beans. Influence of velvet beans on finishing broilers has also not been established.

The objectives of the work reported here were to determine the influence of adding graded levels of methionine to broiler starter diets containing raw or heat-treated velvet beans and to establish the effect of different levels of velvet beans on growth and carcass characteristics of finishing broilers.

Materials and methods

General bird management

Broiler chicks used in all experiments were purchased at day-old from local hatcheries. The chicks were brooded in electrically-heated battery cages with raised wire floors with trays underneath. The birds were housed in these cages for the experimental period of 21 days in experiments 1, 2 and 3. Experimental diets and feed were provided *ad libitum*. Data were collected on feed consumption, weight gain and mortality.

Experiment 1

The experiment was conducted to establish the influence of supplemental methionine in broiler starter diets containing 30% raw velvet beans on broiler chick performance. Methionine levels were: 0, 0.1, 0.2, and 0.3% of the diets. The percent composition of diets is presented in Table 1 and the amino acid profile in Table 2. There were 36 birds per treatment and a Latin square design of 4 (replicates) x 4 (methionine levels) was used.

Experiment 2

This experiment was designed to ascertain the effect of supplemental methionine to broiler starter diets containing 30% autoclaved velvet beans on broiler chick performance. Prior to compounding diets ground velvet beans were spread in metal trays to a depth of approximately 2.5 cm and autoclaved at 121°C for 40 minutes. Diets used and experimental design were the same as in Experiment 1.

Experiment 3

The influence of graded levels of methionine on the nutritive value of roasted velvet beans for broiler chicks was determined in this experiment. Roasting was earlier shown to produce the same growth response in broiler chicks as autoclaving at 121°C for 40 minutes or extruding at 200°C. The roasted velvet beans were included in diets at the 20% level while the levels of supplemental methionine added to the bean diets were : 0, 0.1, 0.2 and 0.3%. The level of protein and other nutrients satisfied the NRC (1984) requirements for broiler chicks (Table 3). The amino acid profile is shown in Table 4. There were 3 replicates of 8 chicks each per treatment.

Experiment 4

Broiler chicks were housed as described earlier for four weeks, during which they were fed on a commercial broiler starter. At the end of the fourth week, equal numbers of males and females were randomly assigned to dietary treatments after weighing. They were then transferred to floor pens in an open sided house with natural ventilation and coffee husks as litter material. Experimental diets (Table 5) were initiated at the beginning of the fifth week of age. All diets were prepared and fed in mash form. Birds were fed *ad libitum* from wooden trough feeders. Water was provided in metal trough waterers. There were 10 male and 10 female birds per treatment. Birds on each dietary treatment (combined sexes) were kept in one pen and each bird acted as an experimental unit. Birds were fed the experimental finisher diets for 21 days (three weeks).

Individual body weight gains, feed consumption and feed : gain ratios (combined sexes) by treatment pens were determined at the end of the eighths week. At the conclusion of the grow-out period, birds were bled, plucked, eviscerated and carcass yields and abdominal fat weights determined. Carcass yield after bleeding and plucking, eviscerated yield, giblets, viscera, legs and abdominal fat pad were expressed as a percentage of live body weight (LBWt). Abdominal fat pad was the sum of the abdominal and

Table 1: Percent composition of diets used in Experiment 1.

	Diets			
	1	2	3	4
Ingredients (%, air-dry basis)				
Maize	41.00	40.90	40.80	40.70
Velvet beans	30.00	30.00	30.00	30.00
Soybeans	20.00	20.00	20.00	20.00
Fish meal	5.00	5.00	5.00	5.00
Oyster shells	1.00	1.00	1.00	1.00
Bone meal	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50
Bromix (vitamins)	0.50	0.50	0.50	0.50
Methionine	--	0.10	0.20	0.30
Calculated analysis				
Methionine	0.35	0.45	0.55	0.65
Crude protein	22.00	22.00	22.00	22.00

Table 2: Percent amino acid composition of basal diets used in Experiments 1 and 2

Amino acid	Requirement NRC, 1984	Raw bean diet	Heat treated bean diet
Arginine	1.44	1.38	1.25
Tryptophan	0.23	0.24	0.26
Threonine	0.80	0.84	0.88
Cystine	0.43	0.29	0.31
Valine	0.82	1.14	1.04
Methionine	0.50	0.35	0.38
Isoleucine	0.80	0.98	0.97
Leucine	1.35	1.78	1.71
Tyrosine	0.62	0.79	0.71
Phenylalanine	0.72	1.03	0.95
Histidine	0.35	0.57	0.53
Lysine	1.20	1.28	1.19

gizzard fat weights. Fat samples were removed from the carcasses by the same individual to minimize variation in the fat measurements.

Statistical analysis

Data were subjected to analysis of variance according to Snedecor and Cochran (1973) and differences among treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955).

Table 3: Percent composition of diets used in Experiment 3.

	Diets				
	1	2	3	4	5
Ingredients (%, air-dry basis)					
Maize	41.00	41.00	40.90	40.80	40.70
Velvet beans	--	20.00	20.00	20.00	20.00
Soybeans	25.00	25.00	25.00	25.00	25.00
Cotton seed cake	12.50	--	--	--	--
Fish meal	10.00	10.00	10.00	10.00	10.00
Oyster shells	1.00	1.00	1.00	1.00	1.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50	0.50
Bromix (vitamins)	0.50	0.50	0.50	0.50	0.50
Methionine	--	--	0.10	0.20	0.30
Maize bran	7.50	--	--	--	--
Calculated analysis					
Methionine	0.46	0.46	0.56	0.66	0.76
Crude protein	23.80	23.00	23.00	23.00	23.00

Table 4: Percent amino acid composition of diets used in Experiment 3.

Amino acid	Requirement NCR, 1984	Control diet	Basal bean diet
Arginine	1.44	1.82	1.48
Tryptophan	0.23	0.31	0.30
Threonine	0.80	0.96	0.98
Cystine	0.43	0.35	0.34
Valine	0.82	1.23	1.19
Methionine	0.50	0.46	0.46
Isoleucine	0.80	1.13	1.12
Leucine	1.35	1.92	1.92
Tyrosine	0.62	0.77	0.81
Phenylalanine	0.72	1.16	1.07
Histidine	0.35	0.59	0.58
Lysine	1.20	1.37	1.43

Results

Experimental 1

The results from Experiment 1 demonstrated that methionine supplementation to diets containing 30% raw velvet beans did not improve performance of broiler chicks (Table 6). The addition of 0.2% methionine, however, increased weight gain by 18% ($P > 0.05$) and feed consumption by 34.5% ($P < 0.05$).

Table 5: Percent composition of diets fed in Experiment 4.

	Diets			
	1	2	3	4
Ingredients (%, air-dry basis)				
Maize	59.40	57.20	54.60	52.00
Velvet beans	--	10.00	20.00	30.00
Soybeans	30.00	20.00	10.00	--
Fish meal	7.00	9.20	11.80	14.40
Oyster shells	1.00	1.00	1.00	1.00
Bone meal	2.00	2.00	2.00	2.00
Bromix (vitamins)	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30
Calculated analysis				
Methionine	0.39	0.40	0.43	0.46
Crude protein	19.35	19.18	19.17	19.16
M.E. (MJ/Kg)	13.03	12.58	12.19	11.79

Table 6: Effect of methionine supplementation to 30% raw velvet bean diet on performance of broiler chicks (Experiment 1)

Treatment	Weight gain (g)	Feed intake (g)	Feed conversion (g feed : g gain)
Basal diet	161.67[a]	297.50[b]	1.88[a]
Basal + 0.1% Met.	158.33[a]	320.63[ab]	2.04[a]
Basal + 0.2% Met.	191.00[a]	400.00[a]	2.11[a]
Basal + 0.3% Met.	125.00[a]	275.00[b]	2.29[a]

Means within a column not followed by the same letter differ significantly ($P < 0.05$).

Experiment 2

The results of the effect of methionine supplementation to broiler starter diets containing 30% autoclaved velvet beans are summarized in Table 7. There were no significant differences among the performance parameters considered. The performance of birds in this experiment was generally better than in Experiment 1.

Experiment 3

The influence of graded levels of added methionine on the performance of broiler chicks fed diets containing 20% roasted velvet beans is shown in Table 8. The addition of methionine to the bean diets significantly ($P < 0.05$) improved weight gain. Birds on the diets supplemented with methionine had the same weight gain as the control birds, which had better ($P < 0.05$) weight gain than birds on the basal bean diet. Birds fed the control diet had similar feed consumption to birds fed bean diets supplemented with methionine, but consumed more feed ($P < 0.05$) than birds fed the basal bean diet. There were no significant differences among feed conversion efficiencies of the various dietary treatments.

Table 7: Effect of methionine supplementation to 30% autoclaved velvet bean diet on broiler chick performance (Experiment 2.)

Treatment	Weight gain	Feed intake	Feed conversion
	(g)	(g)	(g feed : g gain)
Basal diet	237.00[a]	441.25[a]	1.85[a]
Basal + 0.1% Met.	230.11[a]	387.50[a]	1.68[a]
Basal + 0.2% Met.	227.50[a]	396.67[a]	1.73[a]
Basal + 0.3% Met.	230.32[a]	425.00[a]	1.85[a]

Means within a column not followed by the same letter did not differ significantly ($P > 0.05$).

Optimum performance with bean diets was achieved with the diet supplemented with 0.2% methionine, which improved weight gain by 24% ($P < 0.05$), feed consumption by 16% and feed: gain ratio by 7%.

Experiment 4

The results on live body weight, weight gain, average daily gain, feed consumption and feed : gain rations (combined sexes) are presented in Table 9. All birds, regardless of the dietary treatment reached market weight of 2.0 kg in 56 days. However, weight gain decreased significantly ($P < 0.05$) when 30% roasted velvet beans were added to the finisher diet. Feed intake and feed conversion efficiency also tended to decrease with the diet containing 30% roasted beans.

Data on carcass yield and abdominal fat pad are summarized in Table 10. Yield after bleeding and plucking, and eviscerated yield increased ($P < 0.05$) when 30% roasted velvet beans were added to the finisher diet. The weights of giblets, viscera, legs and abdominal fat pad were not affected by dietary treatments.

Discussion

The results of the growth trial in Experiment 1 showed that methionine addition to broiler starter diets containing 30% raw velvet beans did not improve growth of broiler chicks. There was a non-significant increase in growth rate of 18% when 0.2% methionine was added. The poor growth of chicks observed could have been due to presence of chick growth depressing factors in raw velvet beans.

The performance of broiler chicks fed on diets containing 30% heat treated velvet beans in Experiment 2, was generally better than that of birds fed raw beans in Experiment 1. It was apparent, therefore, that heat treatment of velvet beans had beneficial effect, due either to destruction of some growth depressing factors in the beans or increased availability of nutrients for growth. In general, addition of methionine to broiler starter diets containing 30% raw or heat treated velvet beans was not beneficial.

On the other hand methionine supplementation to diets containing 20% heat treated velvet beans significantly increased weight gain of broiler chicks in Experiment 3. Optimal weight gain feed consumption and feed : gain ratio were obtained with birds fed on the diet containing 0.2% added methionine. The total dietary methionine and sulphur amino acid levels under these conditions were 0.66 and 1.0% respectively. It would appear, therefore, that the optimal level of methionine supplementation to chick diets containing beans is approximately 0.2%. Marquardt and Campbell (1974 and 1975) reported optimal performance of chicks fed very high (87 and 90%) faba bean diets when 0.21 and 0.24% methionine were added, respectively. The failure of methionine addition to produce significant improvement in the performance of broiler chicks fed diets containing 30% velvet beans in this study could be due to presence of growth inhibiting factors and poor palatability, but cannot be related to the amino acid levels of the different diets as shown in Table 2.

Table 8: Effect of methionine supplementation to 20% roasted velvet bean diet on broiler chick performance (Experiment 3).

Treatment	Weight gain	Feed intake	Feed conversion
	(g)	(g)	(g feed : g gain)
Control diet	480.45[a]	723.02[a]	1.51[a]
Basal bean diet	350.22[b]	570.55[b]	1.64[a]
Basal + 0.1% Met.	419.89[a]	654.45[ab]	1.57[a]
Basal + 0.2% Met.	434.50[a]	661.65[ab]	1.53[a]
Basal + 0.3% Met.	424.85[a]	649.43[ab]	1.53[a]

Means within a column not followed by the same letter differ significantly ($P < 0.05$).

Table 9: Influence of graded levels of heat treated velvet beans on finishing broilers (Experiment 4).

Treatment	Live weight	Weight gain	Average daily gain	Feed intake	Feed conversion
	(g)	(g)	(g/b/d)	(g/b/d)	(g feed : g gain)
Control	2075.00[a]	1115.00[a]	53.10[a]	152.30	2.87
10% beans	2072.34[a]	1132.00[a]	53.90[a]	146.33	2.77
20% beans	2106.67[a]	1136.67[a]	54.15[a]	145.48	2.69
30% beans	1920.00[a]	966.67[b]	46.03[b]	143.65	3.12

Means within a column not followed by the same letter differ significantly ($P < 0.05$).

Table 10: Influence of graded levels of heat treated velvet beans on broiler carcass characteristics (% of Lbwt)

Treatment	Yield after bleeding and plucking	Eviscerated yield	Giblets	Viscera	Legs	Abdominal fat pad
Control	91.41[b]	63.64[b]	6.51[a]	7.65[a]	5.21[a]	2.23[a]
10% beans	90.29[b]	63.15[b]	6.58[a]	7.68[a]	5.33[a]	2.33[a]
20% beans	90.81[b]	64.44[ab]	6.43[a]	7.69[a]	5.20[a]	2.45[a]
30 beans	93.86[a]	65.53[a]	6.25[a]	7.29[a]	5.38[a]	2.17[a]

Means within a column not followed by the same letter differ significantly ($P < 0.05$).

With the exception of cystine, methionine and to some extent arginine, all the other essential amino acids were higher in the diet than the NRC, 1984 requirement of broiler chicks. It is possible, however, that the amino acid availability of velvet beans is poor. This would result in imbalances of available amino acids which methionine addition only could not correct.

Methionine addition to starter diets containing 20% heat treated velvet beans was beneficial. Heat treatment and the lower level in the diet might have reduced the antinutritional effects of velvet beans. The amino acid levels in this case were much higher than the NRC, 1984, requirement such that poor availability of amino acids of the beans could not have caused deficiencies and methionine supplementation under such a condition was beneficial.

Addition of 30% heat treated velvet beans to a finisher diet decreased weight gain of broilers. Feed consumption and efficiency also tended to decrease. Calculated analysis indicated that the energy levels of the diets decreased as the level of beans in the diet increased. The protein and methionine content of all diets used were above the NRC, 1984 requirement of finishing broilers. The decrease in feed intake associated with increase in the level of velvet beans in the broiler finisher diets did not appear to be related to the energy content. Feed intake usually increases as the energy content in poultry diets decreases.

Inclusion of 30% heat treated velvet beans into the finisher diet increased carcass yield. Bougon *et al* (1983) and Hargis and Creger (1980) reported that increasing body fat increased carcass yield. The carcasses of birds fed rations deficient in protein and amino acids usually contain more fat than those from birds fed adequate amounts of a well-balanced protein. This would appear to indicate poor availability of protein and amino acids of velvet beans. The results of this study showed no influence of diet on the sizes of giblets, viscera and abdominal fat pad, although N'guessan *et al* (1989) reported increase in viscera and giblet weight with low feed density.

In conclusion, 20% heat treated velvet beans supplemented with 0.2% methionine can be a valuable supplement in broiler starter diets. The same level of beans without methionine addition can be used in broiler finisher diets. However, the use of 30% velvet beans in broiler diets should be avoided until more is known of the factor(s) that depressed broiler performance.

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