WORLD RABBIT SCIENCE 1996, 4(3),139-141

COMPARATIVE EVALUATION OF RAW AND COOKED JACKBEAN (*Canavalia ensiformis*) ON THE PERFORMANCE OF WEANER RABBITS.

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ABSTRACT : Jackbean (*Canavalis ensiformis*) is a tropical legume which has shown potential as source of forage and seed. The seed contains up to 32 % CP. But as with other tropical legumes, the raw seed contains toxic substances

A 42-day feeding trial was conducted to compare the effect of raw and cooked jackbean on the performance of weaner rabbits. Raw Jackbean seeds were dried and milled and incorporated at 10 and 20 % dietary levels respectively while another batch was cooked for 40 minutes, dried, ground and incorporated also at 10 and 20 % dietary level respectively and each diet fed to 8 rabbits. At dietary level of 20 %, raw jackbean significantly ($P<0.05$) depressed performance of rabbits (ADG 16.2g/d *vs* 20.5 for the control). Cooking for 40 minutes improved the nutritive value of jackbean for weaner rabbits up to 20 % dietary level (ADG of 26.7 and 21.9 g/day for 10% and 20% levels respectively).

RESUME : Evaluation comparative du Jackbean (Canavalia ensiformis) brut et cuit sur les performances de lapins au sevrage.

Le Jackbean est une légumineuse tropical, source potentielle de fourrage et de graines. La graine contient jusqu'à 32 % de proteines brutes. Mais comme pour d'autres légumineuses tropicales, la graine brute contient des substances toxiques. Au cours d'une expérimentation de 42 jours des lapins on été nourris à partir du sevrage avec du jackbean brut ou cuit afin de comparer leurs performances. Des graines de jackbean brutes ont été séchées et moulues puis incorporées à l'aliment aux taux respectifs de 10 et 20 % tandis que d'autres ont été cuites pendant 40 minutes, séchées, moulues et également incorporées à l'aliment aux taux de 10 et 20 % respectivement. Chaque aliment a été distribué à 8 lapins. Au taux d'incorporation de 20 % le jackbean brut diminue significativement ($P<0.05$) les performances des lapins (GMQ de 16,2 g/j vs 20,5 pour le témoin). La cuisson du jackbean pendant 40 minutes améliore sa valeur nutritive pour des lapins au sevrage jusqu'au taux d'incorporation de 20 % (GMQ de 26,7 et 21,9 g/jour pour les taux de 10% et 20% respectivement).

INTRODUCTION

One of the ways of reducing the cost of animal production in Nigeria and therefore making protein available to people at cheaper prices is by the use of agricultural materials which are not directly used by man as food to feed livestock. One of such materials is jackbean (*Canavalia ensiformis*).

Jackbean (*C. ensiformis*) is a tropical legume, a new world plant grown in the drought -ridden regions of Arizona and Mexico in ancient times but has now spread all over the tropical world.

Jackbean seems to have great potential as protein and energy sources for livestock and poultry in view of its high yields as well as high contents of carbohydrates and proteins. Its excellent germination and vigorous initial growth make its establishment relatively easy.

Total yields of forage of the jackbean can reach 10 tonnes DM/ha depending on cutting frequency and fertilizer application (MORA and PARA, 1980 ; POUND *et al.*, 1982 ; ADDISON, 1957). Dry seed yields of 2.5 - 3.5 tonnes/ha have been reported in Zimbabwe (ADDISON, 1957), Dominican Republic (POUND *et al.*, 1982), Venezuela (MORA and PARA, 1980), Mexico (HERRERA, 1991) and Northern Nigeria (OKONKWO and UDEDIBIE, 1991 ; ADEGBOLA, 1992). These yields are comparable to that of soybean grown under temperate conditions. The white seeds are relatively large, about 23 mm diameter, 5 times the size of soybean.

The crude protein content of the dry ripe jackbean seed ranges from 26-32 %. It is relatively low in sulfur-amino acid, methionine but high in lysine ; it contains significant amounts of thiamine, niacin, phosphorus, calcium and particularly iron (BRESSANI *et al.*, 1978 ; D'MELLO *et al.*, 1985 ; UDEDIBIE and NWAIWU, 1987).

But as with a number of other tropical legumes both the foliage and seed of the jackbean contain toxic elements that limit its use as feed ingredient for non-ruminants. Jackbean has been reported to contain in addition to thermolabile inhibitory substances, thermostable anti-nutritional factors such as Canavanine and canaline (ROSENTHAL, 1972), cantoxin (a non-hema glutinating toxic protein ; CARLINI and GUIMARAES, 1981) and more importantly Concanavalin A (Con A) (HAGUE, 1975 ; JAFFE, 1980) which is a lectin. Lectins are reported to negatively affect nutrient utilisation by different mechanisms including binding to the glycoproteins and glucolipids of the digestive tract mucosa (HAGUE, 1975 ; JAFFE, 1980), inhibition of the activity of the enzymes of the brush border of the enterocyte (ROSENTHAL, 1972) and interferring with the adherence of enterobacteria to the intestinal wall (JAYNE-WILLIAMS, 1973). Jackbean proteins have also been shown to exhibit urease activity (SUMMER, 1926). Among the thermolabile toxic substances identified in the jackbean are saponins, cyanogenic glycosides, terpenoids and alkaloids (UDEDIBIE and NWAIWU, 1987).

Research on the development of the jackbean as possible protein and energy feed for Nigerian livestock industry was started at our station in 1985. This was in response to the feed crisis that almost crippled the country's livestock industry, a scenario that started in mid 1982. The objectives of this study were to comparatively evaluate raw and cooked jackbean on the performance of weaner rabbits.

MATERIALS AND METHODS

The jackbeans used for this study were produced at Vom in Plateau State of Nigeria.

The raw jackbeans were divided in two portions. One half was ground using a 2mm screen wiley mill and the other half was cooked for 40 minutes. Period of cooking was taken as starting from the point of boiling. At the end of the 40 minutes, the water was thrown out and the beans sun dried and milled. Samples of raw and the cooked jackbean meals were subjected to chemical analysis (AOAC, 1980) to

Table 1 : Proximate composition of raw and cooked jackbeans

	Raw jackbeans	Cooked jackbeans
% of dry matter		
Crude protein	28.54	25.38
Crude fibre	7.82	7.02
Ether extract	3.12	3.35
Total ash	3.71	3.70
Calcium	0.14	0.12
Phosphorus	0.71	0.70
Gross energy (kcal/g)	4.70	4.63

determine the effect of the processing method on the nutrient contents of dry matter, crud protein, crude fibre, total ash and ether extract while the gross energy was determined with a Gallemkamp Oxygen adiabatic bomb calorimeter (Table 1).

Using values from the chemical analysis, a total of five dietary treatments were formulated. The control diet (diet 1) contained no jackbean. Diets 2 and 3 contained raw jackbeans at dietary levels of 10 and 20 % respectively. Diets 4 and 5 contained jackbean cooked for 40 minutes at dietary levels of 10 and 20 % respectively (Table 2).

Forty (40) 2-month-old New Zealand White rabbits were divided into five treatment groups of 8 rabbits, giving 2 rabbits per replicate. The groups were balanced for age, sex and weight and housed in cages.

The rabbits were given feed and water *ad-libitum*. They were weighed at the beginning of the experiment and once a week thereafter. At the end of the experiment, all the rabbits were slaughtered and their viscera weighed. Body weight changes, and daily feed intake were recorded and feed conversion ratio subsequently computed.

The data collected were subjected to analysis of variance as outlined by SNEDECOR and COCHRAN (1978), when analysis of variance indicated significance for treatment effect, specific differences between means were detected as outlined by OBI (1990).

RESULTS AND DISCUSSION

The results of this study are shown in Table 3.

At dietary inclusion level of 20 %, raw jackbean significantly ($P<0.05$) depressed performance of rabbits. At a 10 % dietary inclusion level of raw jackbeans, there was noticeable depressed performance which was, however not statistically significant ($P>0.05$). Diets containing cooked jackbeans compared favourably and even better than the control (0 %).

The internal organs, expressed as a percentage of live weight were not affected by treatment except the liver that was necrotic (that is numerous hard white patches). The degree of necrosis increases with increase in the level of raw jackbean in the diet. This condition was however not observed in rabbits fed cooked jackbeans.

The results of the trial suggest that a 20 % dietary inclusion of raw jackbean is not tolerated by rabbits. On the other hand, cooking improves the nutritive value of the jackbeans up to 20 % dietary inclusion level for rabbits. Earlier studies with young broiler chicks have however shown that autoclaving and heat-treatment could not improve the nutritive value of jackbean for young broiler chicks beyond 10 % dietary inclusion level, possibly du to differences in species tolerance (D'MELLO *et al.* 1985).

Jackbean contains toxic substances which limit its use as feed ingredient for non-ruminants. The best known of these substances is Concanavalin A (Con A) a lectin (HAGUE, 1995 ; JAFFE, 1980) which has been reported to have a negative effects on nutrient digestion and absorption (LIENER, 1986 ; SANDHOLM *et al.*, 1976 ; ROSENTHAL, 1972). Canatoxin is a non hemaglutinating toxic protein (CARLINI an GUIMARAES, 1981). It was articulated that the caecotrophic habit of the

Table 2 : Ingredient composition of treatments diets

	Dietary levels				
	Control	Raw jackbean		Cook jackbean	
	0 %	10 %	20 %	10 %	20 %
Ingredients					
Maize meal	60.0	50.0	50.0	50.0	50.0
Jackbean meal	0.00	10.0	20.0	10.0	20.0
Soybean meal	15.0	15.0	10.0	15.0	10.0
Brewer's dried grain	18.0	18.0	13.0	18.0	13.0
Fish scraps	3.0	3.0	3.0	3.0	3.0
Bone meal	3.5	3.5	3.5	3.5	3.5
Common salt	0.25	0.25	0.25	0.25	0.25
Vitamin-mineral Premix*	0.25	0.25	0.25	0.25	0.25
	5·8	60	5·8	5·8	5·8
Chemical composition (% of D.M.)					
Crude protein	19.65	20.71	20.16	20.54	20.65
Crude fibre	5.76	5.66	5.80	5.70	5.80
Ether extract	4.53	4.29	4.14	5.20	5.10
Calcium	0.90	0.89	0.90	1.00	1.10
Phosphorus	0.46	0.44	0.42	0.43	0.42
ME (kcal/kg) **	2812	2895	2900	2810	2815

* To provide the following per kg diets : Vit. A, 10,000 I.U. ; Vit. D_3, 1500 I.U. ; Vit B_6, 5000 I.U. ; Vit. K, 2 mg ; Riboflavin, 3 mg ; Panthotenic acid, 5 mg ; Nicotinic acid, 20 mg ; Choline, 5 mg ; Vit. B_{12}, 0.08 mg ; Folic acid, 4 mg ; Mn, 8 mg ; Zn, 0.5 mg ; Iodine, 1.0 mg ; Iron, 20 mg ; Cu, 10 mg ; Co, 125 mg.

** Calculated value

Table 3 : Effect of Raw and Cooked jackbean on the performance of weaner rabbits

	Dietary inclusion levels					
	Control	Raw jackbeans		Cooked jackbeans		SEM
	0 %	10 %	20 %	10 %	20 %	
Initial body weight (g)	940	950	900	900	910	0.02
Final body weight (g)	1800[a]	1750[a]	1580[b]	2020[a]	1830[a]	2.02
Average daily feed intake (g)	59.33	65.01	64.11	65.52	63.02	1.22
Average daily gain (g)	20.48[a]	19.05[ab]	16.19[b]	26.67[a]	21.90[a]	1.45
Feed conversion ratio (g feed/g gain)	2.89	3.41	3.96	2.46	2.87	0.38
Organs * *(% body weight)*						
Heart	0.25	0.20	0.21	0.24	0.24	0.004
Kidney **	0.54	0.53	0.51	0.54	0.53	0.04
Liver	2.46	2.35	2.89	2.36	2.48	0.08
Lung	0.47	0.63	0.72	0.67	0.65	0.005
Spleen	0.007	0.04	0.04	0.04	0.04	0.009
Carcass value (%)	62.5	62.0	59.6	62.5	61.4	0.33

[a b] Means within a row with different superscripts are significantly different (P<0.05)
* Wet weight ; ** Average of a pair ;

rabbit would have enhanced the availability of most of the nutrients of the raw jackbean to the rabbit or moderate the toxic substances in it. The results of this trial suggest that raw jackbean could not be tolerated by weaner rabbits beyond 10 % dietary level. The mode of action of the microbes in the caecum of the rabbit on the toxic and inhibitory substances in the raw jackbeans cannot totally and readily be explained, however the poor performance of the rabbits beyond 10 % dietary level could probably be that the caecotrophic habit of the rabbit could not alter or modify these toxic and inhibitory substances in the raw jackbeans. On the other hand, cooking improves the dietary inclusion level up to 20 %. Again the mode of action of boiling for 40 minutes on the toxic and inhibitory substances in jackbean cannot totally and readily explained. It is know that heat denatures proteins, thereby destroying their biological activities especially the thermolabile ones. Although the chemical changes and solubilized nitrogenous compounds arising from boiling was not determined, the improved performance of the birds on cooked jackbean treatment could probably be that lots of the toxic and inhibitory substances leached out and were denatured during cooking.

Received : January 9th, 1996
Accepted : May 22nd, 1996

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