PRELIMINARY OBSERVATIONS ON THE USE OF DRY UREA TREATMENT AND TOASTING FOR IMPROVING THE NUTRITIVE VALUE OF JACKBEAN *Canavalia ensiformis* FOR YOUNG BROILER CHICKS

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ABSTRACT

Raw unprocessed jackbean contains 28 - 30% crude protein but also contains toxic elements that limit its use as feed ingredient for monogastric animals. A 21 - day feeding trial was conducted to determine the effect of dry urea treatment prior to toasting on its nutritive value for young broiler chicks. One of two batches of raw jackbean was mixed with 2.5% of its weight of crushed urea and allowed to stand for 10 days and then toasted. The other batch was toasted without urea application. The two treated jackbean meals were used to compound broiler starter diets at 10 and 20% dietary levels, respectively, and along with control diet fed to groups of 40 young broiler chicks for 21 days. Hydrolysis of urea by the urease of the jackbean was completed in six days. Urea treatment/toasting slightly reduced crude protein content of jackbean, but diets containing it at both 10% and 20% compared favourably with the control. Raw toasted jackbean significantly ($P < 0.05$) depressed performance of the young broiler chicks at 20% dietary level.

Key words: Jackbean, dry urea treatment, broilers.

INTRODUCTION

The Nigerian livestock sub-sector has been facing serious problems since mid 1982. Prices of feed ingredients have increased by about 1500 - 2000% within the last 10 years, resulting in a crisis situation that has adversely affected livestock production in the country, particularly the non-ruminants - poultry and swine production. The soybean and groundnut

currently play key roles in the feeding of non-ruminants in Nigeria. However, with the increasing need for more and cheaper protein sources, coupled with the relatively high costs of imported ingredients, it has become very important to turn attention to exploitation of other novel legumes indigenous to the tropics.

Jackbean (*Canavalia ensiformis*) has been identified as an indigenous legume which has shown high potential for exploitation as protein and energy sources for livestock and poultry in view of its high seed yield and protein content and quality. In fact, jackbean yields of 2.5 - 3.0 tons/hectare have been reported in Plateau and Bauchi States of Northern Nigeria, respectively (Okonkwo, 1992; Adegbola, 1991), and in Zambia (Addison, 1957). Jackbean, however, 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, 1975; Jaffe, 1980), which has been reported to have negative effects on nutrient digestion and absorption (Liener, 1986; Sandholm, *et al.* 1976).

Research on development of jackbean as possible protein feed for the Nigerian poultry industry was started at the Federal University of Technology, Owerri, in 1985. Our earlier attempts at improving the jackbean so as to render it valuable as a protein and energy supplement for poultry have shown that heat treatment alone could not significantly destroy the anti-nutritional factors in it (Udedibie and Nwaiwu, 1987; Udedibie and Madubuike, 1988; Udedibie and Nkwocha, 1990). However, ensilage of jackbeans in urea solution prior to boiling produced good results

TABLE 1: COMPOSITION OF THE TREATMENT DIETS

Feed Ingredients (%)	Control	Heated Raw JB		Urea/heated JB***	
		10%	20%	10%	20%
Maize	50.00	45.00	40.00	45.00	40.00
SBM	19.00	14.00	9.00	14.00	9.00
Jackbean	-	10.00	20.00	10.00	20.00
Spent grains	10.00	10.00	10.00	10.00	10.00
Blood meal	3.00	3.00	3.00	3.00	3.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Palm kernel cake	8.00	8.00	8.00	8.00	8.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25
Vit/trace mineral premix*	0.25	0.25	0.25	0.25	0.25
L-lysine	0.25	0.25	0.25	0.25	0.25
DL-Methionine	0.25	0.25	0.25	0.25	0.25

Chemical Compositions (% of dm)

Crude Protein	23.1	23.4	23.3	23.0	23.2
Crude fibre	6.42	6.21	6.30	6.46	6.50
Ether Extract	5.82	5.92	5.46	5.26	5.44
Calcium	1.34	1.28	1.26	1.27	1.28
Phosphorus	0.72	0.63	0.64	0.66	0.65
DL-Methionin + Cystine**	0.53	0.56	0.58	0.54	0.56
L-Lysine**	0.98	1.02	1.12	1.02	1.12
ME (Kcal/g)**	2.82	2.81	2.83	2.81	2.81

*To provide the following per kg diets vit. A, 10,000 i.u.; vit. D₃, 1500 i.u.; vit. E, 3 i.u.; vit. k, 2mg; ribofl., 3mg; panthothemic acid, 6mg; niacin, 15mg; choline, 5mg; vit. B₁₂, 0.08mg; folic acid, 4mg; Mn, 8mg; Z_n, 0.5mg; iodine, 1.0mg; C_o, 1.2mg; Cu, 10.mg; Fe, 20mg; iodine, 1.0mg; Co, 1.2mg; Cu, 10.mg; Fe, 20mg.

**Calculated values

***JB = Jackbean

(Udedibie and Nkwocha, 1990). Urea is a strong protein denaturing agent and jackbean has strong urease activity (Summer, 1926). This method is, however, costly and laborious but it has indicated that some biochemical changes with urea or other chemical agents are necessary against the thermostable toxic substances in the jackbean before application of heat treatment.

This preliminary trial was therefore designed to determine the effect of dry urea treatment of raw jackbean prior to high temperature treatment on its nutritive value for young broiler chicks.

MATERIALS AND METHODS

The jackbeans used for this study were produced at the sub-station of National Root Crops Research Institute (NRCRI) at Vom, Plateau State. The jackbeans were milled and then divided into two. One-half was thoroughly mixed with 2.5% of its weight of urea which had already been milled into powdery form and then stored in a bag; samples of the urea-treated and raw jackbeans meals were analyzed for proximate composition (AOAC, 1970) on the day of treatment and for crude protein every other day thereafter. On the 10th day, both the raw and urea-treated jackbean meals were subjected to toasting, using the local garri toasting method, until they became crispy. Duration and temperature of toasting were fluctuating and therefore not determined.

The jackbean meals so prepared were then used for compounding broiler starter diets at 10% and 20% dietary levels, respectively; the control diet did not contain jackbean (Table 1).

Two hundred 14-day old broiler chicks of Anak breed were selected from a batch of chicks such that they weighed between 185 and 200gm each. The birds were then divided into five groups of 40 birds each and the groups randomly assigned to the five treatment diets. Each group was further sub-divided into two replicates of 20 birds and each replicate kept in a compartment measuring 2m x 4m. Feed

and water were provided liberally. Feed intake was recorded daily and the birds were weighed weekly. The compartments were heated using kerosine stoves and electric bulbs. Other routine poultry management procedures were maintained. The data collected were subjected to analysis of variance (Snedenor and Cockran, 1967). The trial lasted for 21 days.

RESULTS AND DISCUSSION

Chemical Composition of Treated Jackbean

The chemical composition of both the heated raw and urea-treated jackbean meal is shown in Table 2. Urea-treated jackbean meal lost about 7% of its original crude protein as against 1% by heated raw jackbean meal.

TABLE 2: PROXIMATE COMPOSITION OF HEATED RAW AND UREA-TREATED JACKBEAN*

	RAW JB	Urea-JB
	% of DM	
Crude Protein	27.92	26.31
Crude fibre	7.66	7.28
Ether Extract	3.04	3.06
Total Ash	3.55	3.62
Calcium	0.12	0.10
Phosphorus	0.63	0.64
Gross energy (Kcal/g)	4.68	4.57

*All values expressed on 100% dry matter basis.

Other nutrients were not seriously affected by the treatments. The action of the urease of the raw jackbean meal as monitored by nitrogen disappearance from urea-treated raw jackbean meal with time is shown in Table 3 and graphically in Figure 1. From the data on the table and figure, it appears that urease activity of the jackbean is rapid, with all the added urea completely hydrolyzed by the 6th day of storage. The smell of the resultant ammonia gas diminished as from the 6th day.

TABLE 3: EFFECT OF STORAGE ON PERCENT CRUDE PROTEIN CONTENT OF RAW AND UREA-TREATED JACK-BEAN MEALS.

Time (days)	Raw	Urea-treated
	Jackbean	Jackbean
Day 1	28.22	35.21
Day 3	28.26	34.02
Day 5	27.98	29.78
Day 7	28.00	26.47
Day 9	28.14	26.47
Day 11	28.08	26.46

Another important observation from the data was that by the 6th day of storage the crude protein content of the urea-treated jackbean dropped below the crude protein content of the raw jackbean meal. This indicated that the urease activity was possibly accompanied by some other biochemical degradation which resulted in some nitrogenous compound(s) in the jackbean losing their nitrogen.

Performance of Treatment Birds

Data on the performance of the young broiler chicks on the five treatment diets are shown in Table 4. There were no significant

($P > 0.05$) differences on the performance of the groups on the control, 10% heated raw jackbean, 10% and 20% urea-treated jackbean diets in terms of growth rate, feed intake and feed conversion ratio. Birds on 20% heated raw jackbean diet were significantly ($P < 0.05$) inferior in all the three parameters considered. Although one to three birds died within the groups, the distribution of the mortalities was such that dietary inclusion of jackbean could not be blamed for them.

The results of this trial have further confirmed our earlier observations that heat treatment alone is not adequate for effective detoxification of the jackbean (Udedibie and Madubuike, 1988; Udedibie and Nwaiwu, 1987). Earlier investigations at this station (Udedibie, 1990) and in Venezuela (Montilla *et al.* 1981) have shown that ensilage of jackbean in urea solution prior to boiling proved very effective in improving its nutritive value for both broilers and layers. This method appears expensive in terms of energy and labour cost involved. But it proved that for jackbean to become utilizable like other conventional protein supplements, the thermosable anti-nutritional factors in it must be subjected to some level of biochemical degradation before application of heat. Urea

TABLE 4: EFFECT OF DRY UREA TREATMENT/HEATING OF JACKBEAN ON THE PERFORMANCE OF YOUNG BROILER CHICKS.

Parameters	Dietary Levels of Jackbean (%)					
	0	Heated raw JB		Urea-treated JB*		SEM
		10	20	10	20	
Initial body wt. (g)	192.2	192.4	192.4	192.8	192.3	1.22
Final body wt. (g)	649.8	605.2	336.1 ^a	645.3	639.7	8.82
Growth rate (g/day)	21.8	19.7	6.84 ^a	21.6	21.3	0.16
Average Daily feed intake (g)	66.4	59.8	36.6 ^a	62.8	62.3	3.09
Feed conversion ratio (g feed/g gain)	3.05	3.04	5.38 ^a	2.90	2.93	0.21
Mortality	2	1	3	3	1	

^aMeans within rows with superscripts are significantly ($P < 0.05$) different.

*JB Means Jackbean.

Fig 1: Effect of storage on crude protein content of raw and dry urea - treated jackbean meals.

is a strong protein denaturing agent and lectins are mostly high molecular weight proteins. Interaction between the two must have affected the biological activities of the thermosable ones which otherwise would not have been denatured by usual heat treatment of feed-stuffs.

The results of this trial have shown that what urea solution can achieve in detoxification of jackbean can also be achieved by dry urea treatment of raw jackbean meal. This method bypasses the two wet phases encountered in the urea solution method. More work is however, still required in this direction to determine the optimal jackbean/urea ratio and level of heating. This of course will form part of our focus in future investigations.

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