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Effect of Graded Levels of Toasted Lima Bean (*Phaseolus lunatus*) Meal in Weaner Rabbit Diets

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Abstract: Twelve rabbits were used to determine the effect of graded levels of toasted lima bean meal in weaner rabbit diets in a completely randomized design (CRD) experiment. There were four treatments in the experiment. Each was replicated thrice. Diet 1 (control) was lima bean-free while diets 2, 3 and 4 contained 25%, 30% and 35% levels of toasted lima bean meal, respectively. The experiment spanned 56 days, during which data were collected from the animals. There were significant ($P<0.05$) differences in the growth performance parameters except for feed-to-gain ratio. The highest mean feed intake (42.35g) was obtained with diet 1 (0%) and was significantly ($P<0.05$) different from diet 4 (35%) toasted lima bean meal only (35.61g). The mean weight gain followed similar pattern. There was no significant ($P>0.05$) difference in feed-to-gain ratios. The lowest ratio (2.34) was obtained with diet 2 (25%). Following are 2.36, 2.47 and 2.62 in diets 1, 3 and 4, respectively. Gross margin was highest (N1760.16) in diet 3. Next are N1757.35, N1744.38 and N1703.57 in diets 2, 1 and 4, respectively. There was no significant difference ($P>0.05$) among the values for cut-parts and organ weights. Considering the growth performance, carcass quality, organ weight and gross margin, it is concluded that toasted lima bean meal could be included up to 30% in weaner rabbits diet.

Key words: Graded levels, toasted lima bean meal, rabbit diets

Introduction

Animal protein is very important for body nourishment, tissue development and repair (of worn-out tissues), and healthy living (Taiwo *et al.*, 2003). Though these roles are well understood, many Nigerians do not take enough products of animal origin (Igwebuike *et al.*, 1999; Esonu, 2000; Onyimonyi and Ene, 2003) to furnish the body with the level of animal protein required for good health. Onyimonyi and Ene (2003) reported that the average consumption of animal protein in this country is 4.5g/head / day as against a minimum requirement of 35g/head /day recommended by the Food and Agricultural Organization of the United Nations. This is partly, due to concentration of animal production on a few species and high cost of animal products.

Taiwo *et al.* (2003) submitted that one of the ways out of this nutritional crisis is intensification of livestock production. Specifically, Ukachukwu *et al.* (1999) and Odubote and Akinokun (1991) advocated intensive rabbit production. The rabbit has a lot of advantageous attributes (Cheeke *et al.*, 1986, Aduku and Olukosi, 1990). It has high feed conversion efficiency, prolificacy short generation interval, relatively short gestation period, etc.

Moreover, the meat from rabbit has been described as tasty and nutritious and contains comparatively low fat, sodium and cholesterol (Lukefahr and Goldman, 1990). The meat is therefore suitable for consumption by high blood pressure and coronary heart disease patients. Like other monogastric animals, feed cost constitutes about 70% total cost of rabbit production. This has been blamed on the stiff competition for the available grains between man and animals (Oyawoye and Nelson, 1999) which has shut up the cost of the traditionally utilized or conventional energy and protein feedstuffs such as maize, groundnut cake, soybean meal, etc. It is therefore expedient to direct attention towards the under-utilized tropical legumes (Arijeniwa and Igene, 2002), one of which is the Lima bean (Phaseolus lunatus).

Lima bean has desirable agronomic and nutritional characteristics (Oyawoye and Ogunkule, 1998). According to NAS (1979) and Akinmutimi (2001), it is widely available and thrives in lowland tropical rain forest areas and on poor soils where most crops cannot grow well. Lima bean has a crude protein content of about 22% and yields between 3000kg and 5000kg of seeds per hectare (NAS, 1979).

However, like other tropical legumes, lima bean seed contains some anti-nutritional factors, which limit its utilization in animal feeding. These include phytins and tannins (Kay, 1979; Akinmutimi, 2001), hydrogen cyanide and trypsin inhibitors (Ologhobo and Fetuga, 1983).

Arijeniwa and Igene (2002) reported significant decline ($P<0.05$) in feed intake and weight gain and poor feed and protein efficiencies in weaner rabbits placed on diets with 30% level of raw lima bean. Based on this report, there arises the need to explore ways of improving the nutritive value of lima bean. One of such

Table 1: Composition of experimental diets

Ingredients	D 1 (0%)	D 2 (25%)	D3 (30%)	D4 (35%)
Maize	56	40.53	37.44	34.35
Soybean meal	20	10.47	8.56	6.65
Lima bean	-	25	30	35
PKC	19.5	19.5	19.5	19.5
Blood meal	1	1	1	1
Bone meal	3	3	3	3
Salt	0.25	0.25	0.25	0.25
Vitamin. premix	0.25	0.25	0.25	0.25
Total	100	100	100	100
CP (%)	17.75	17.86	17.87	17.89
ME (Kcal/kg)	2894.17	2765.15	2739.37	2719.6

Kg of premix contains vitamin A (5,000,000 IU), vitamin D_3 0001U), vitamin E (16,000mg), vitamin K_3 (800mg), vitamin B_1, vitamin B_2 (22,000mg), calcium pantothenate (4,600mg), vitamin B_6 (2000mg), vitamin B_{12} (10mg), folic acid (400mg), biotin (32mg), choline chloride (200,000mg), manganese (4000mg), iron (40,000g), zinc (32,000mg), copper (3400mg), iodine (10mg), cobalt (120mg), selenium (48mg), anti-oxidant (18000mg).

Table 2: Proximate composition of experimental diets and test feedstuff (raw and toasted lima bean meal)

Constituents	T_1	T_2	T_3	T_4	Raw	Toasted
Dry matter	89.69	89.97	90.01	90.12	90.9	91.71
Crude protein	17.27	17.66	17.87	18.02	23.58	22.92
Ether extract	3.89	4.45	4.12	4.15	1.64	1.35
Crude fibre	4	4.19	4.4	4.65	5.09	4.8
Ash	8	8.95	9.71	9.86	4.18	4.5
NFE	56.5	55.12	53.92	53.46	56.41	58.15
Gross energy (kcal/kg)	2995	2981	2900.5	2580.5	4416.5	4294.5

Table 3: Percentage residual anti-nutrients in the toasted lima bean

Anti-nutritional factor	Raw	Toasted	% Residual	% Reduced
Tannin (%)	0.71	0.495	69.72	30.28
Hydrogen Cyanide (mg/kg)	44.40	14.045	31.63	68.37
trypsin inhibitor (Tiu/mg)	21.39	0.00	0.00	100.0
phytin (%)	0.895	0.810	90.50	9.50

a-c treatment means in the same row not followed by the same superscript are significantly ($P<0.05$) different from one another.

ways is toasting (a process of dry heat application). Ojo (1988) toast-tried lima bean and recommended toasting as the best processing technique among other conventional methods of detoxification of lima bean. Toasting therefore, attracts attention in this study.

The objectives of this work are to evaluate the effect of graded levels of dietary inclusion of toasted lima bean in weaner rabbit diets and to determine the cost effectiveness thereof.

Materials and Methods

Experimental site: The experiment was conducted at the Rabbitry Unit of the Livestock Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. Umudike is located 5°29 and 7°33 North and South of the equator and about 122m above the sea level. Annual rainfall is about 2169.8mm, relative humidity in the wet season is about 72%; monthly ambient temperature is between 17°C and 30°C.

Experimental Animals Procedure and Management: Twelve weaner rabbits of Chinchilla breed averaging 0.34kg were used for the study. They were housed in 50cm X 50cm X 50cm wooden hutches floored and covered on the sides with 0.3mm wire mesh. The rabbits were randomly assigned to four treatments having three replicates with a rabbit per pen in a completely randomized design experiment. The raw lima bean was purchased from Idanre, Ondo State of Nigeria. The beans was toasted to brownness (10 minutes), milled and incorporated into the experimental diets. The rabbits were then assigned to these diets (Table 1). Feed and water were given *ad libitum* throughout the period of the experiment, which lasted for 56 days. Data were collected for feed intake and weight gain from where feed-to-gain ratio was computed. Gross margin was calculated according to Sonaiya *et al.*, (1986). Carcass quality and organ weight were evaluated as described by Ojewola and Longe (1999).

Chemical and statistical analysis: The diets, raw and toasted lima bean meal were analyzed for proximate composition and gross energy according to AOAC (1990). The raw and toasted lima bean meal were analyzed for levels of anti-nutritional factors such as tannin, hydrogen cyanide, trypsin inhibitors and phytin, at the institute of Agricultural Research and Training (IAR and T), Ibadan according to Maga (1982), Knowles *et al.*, (1980), Kakade *et al.* (1974) and Lucas and Markaka (1975) respectively.

From this, the percentages of residual tannins, HCN, trypsin inhibitors and phytin were calculated. Data on

Table 4: Growth performance of weaner rabbits fed graded levels of toasted lima bean meal

Parameters	0%	25%	30%	35%	SEM
Initial weight (g)	358.33	325	336.67	325	9.811
Final weight (g)	1325	1228.00^{b}	116.67^{bc}	1075.00^{c}	36.37
Feed intake/rabbit/day	42.35^{a}	37.80^{ab}	36.52^{ab}	34.61^{b}	1.205
Weight gain /rabbit/day	16.49^{a}	16.13^{ab}	14.83^{ab}	13.27^{b}	0.538
Feed-to-gain ratio	2.36	2. 34	2.47	2.62	0.08
Gross margin (N)	1744.38	1757.35	1760.16	1703.57	0.577

a-c treatment means in the same row not followed by the same superscript are significantly (P<0.05) different from one another.

Table 5: Mean weight of cut-parts of weaner fed graded levels of toasted lima bean meal expressed as percentage dressed weight

Cut-parts	0%	25%	30%	35%	SEM
Thigh	25.58	21.98	24.51	21	0.854
Drumstick	7.69	10.9	10.53	9	0.479
Forearm	7.69	8.31	7.65	7.07	0.805
Shoulder	9.62	10.99	10.03	10.03	0.433
Breast-cut	15.38	14.29	15.38	14.29	0.332
Back-cut	42.31	38.46	38.09	37.72	1.084
Dressing (%)	48.64	44.67	47.03	48.29	0.751

Table 6: Mean weight of organs of weaner rabbits fed graded levels of toasted lima bean meal (expressed as percentage dressed weight)

Organ	0%	25%	30%	35%	SEM
Liver	5.28	6.07	6.71	6.76	0.287
Heart	0.45^{c}	0.70^{a}	0.59^{b}	0.65^{b}	0.037
Spleen	0.15^{b}	0.12^{b}	0.24^{a}	0.05^{c}	0.026
Kidney	0.94	2.58	1.81	1.97	0.141
Lungs	1.27	1.65	1.23	1.49	0.117
Dressing %	48.64	44.67	47.03	48.29	0.751

a-c treatment means in the same row are significantly (P<0.05) different from one another.

feed intake, weight gain, feed-to-gain ratio, gross margin, carcass and organ characteristics were collected and subjected to analysis of variance (ANOVA) according to Steel and Tornie (1980) and Duncan's Multiple Range Test (Duncan, 1955).

Results and Discussion

The proximate composition of experimental diets and the test ingredient is as revealed in Table 2. The values obtained were closely related to the value calculated and they fall within the range of nutrient requirements for weaner rabbits. The proximate composition of both raw and toasted lima bean especially crude protein and energy content confirms lima bean as a potential feedstuff (Akinmutimi, 2001).

The percentage residual anti-nutrients in the toasted lima bean is as shown in Table 3. There was general reduction in the quantity of anti-nutrients as a result of toasting. Trypsin inhibitor had 100% reduction followed by hydrogen cyanide with 68.37%, followed by tannin with 30.28% reduction and the least reduction occurred in phytin with 9.50%. This shows thermolability of trypsin inhibitors and hydrogen cyanide and thermostability of tannin and phytin (Osagie *et al.*, 1996; Ologhobo *et al.*, 1992; Akinmutimi, 2004).

For growth performance, there were significant (P<0.05) differences for all the parameters measured except for feed-to-gain ratio.

Feed intake: There was no significant (P>0.05) difference in feed intake among the rabbits fed diets containing the toasted lima bean meal. The rabbits fed the control diet (0% toasted lima beam meal) had a significantly (P<0.05) higher feed intake than those on the 35% toasted lima bean meal only. There was a downward trend in feed intake with increase in dietary level of toasted lima bean meal. This could be attributed to the effect of a corresponding increase in residual anti-nutritional factors (Udedibie and Carlini, 1998) (Table 3). For example, tannin has been reported to reduce feed intake by causing poor palatability of the diet containing it (Aletor and Fasuyi, 1997). The non-significant decrease in feed intake up to 30% shows the superiority of toasted lima bean meal to the raw one which has been reported to effect poor feed intake at 30% dietary level of inclusion (Arijeniwa and Igene, 2002).

Weight gain: This followed similar trend to feed intake. The decline in weight gain being only significant at 35% dietary level toasted lima bean meal could be partly due to low feed intake (D'mello *et al.*, 1985) and partly due to poor nutrient utilization as a result of residual anti-nutritional factors referred to earlier. Reduction in weight due to hydrogen cyanide has been reported by Akinmutimi (2004). Earlier on, Aletor and Fasuyi (1997) explained that its detoxification requires organic sulphur donors inform of methionine and cysteine, thereby precipitating, methionine deficiency in an otherwise balanced diet. It is this deficiency that causes poor weight gain (growth).

Also tannin has been reported to bind with the proteins of saliva and mucosa membrane (D'mello and Devandra, 1995), forming complexes that are not readily digestible. The cumulative effect is poor growth.

Feed-to-gain Ratio: There was no significant (P>0.05) difference among the treatment means of rabbits fed graded levels of toasted lima bean meal. The slight numerical differences may still be due to the effect of residual anti-nutritional factors (Table 3).

Gross margin: The highest gross margin (N1760.16) was obtained with rabbits placed on 30% toasted lima bean diet. This was followed by N1757.35 with those in diet 2 (25%), N1744.38 with those in diet 1 (0%) and N1703.57 with those in diet 4 (35%). The high gross margin got in diets 2 and 3 could be a result of favourable weight gain, moderate feed cost and better market price for the rabbits placed on these diets. Diet 3 has the highest cost-effectiveness.

Table 5 shows the mean cut-part weights expressed as percentage dressed weight of the rabbits fed graded levels (0%, 25%, 30%, and 35%) of toasted lima beam meal. There was no significant (P>0.05) difference among the cut-part weights. This implies that any of the test diets could be chosen if the cut-parts is considered only.

The mean organ weights of weaner rabbits fed 0%, 25%, 30%, and 35% levels of toasted lima bean meal are shown in Table 6. There was no significant difference (P>0.05) in organs of the rabbits placed on the different levels of the test diets, except for the values of heart and spleen. These values did not follow specific pattern that could be attributed to the effect of the test diets. This implies that any of the diets is acceptable.

Conclusion: Considering the growth performance, carcass quality, organ weight and gross margin, it is concluded that toasted lima bean meal could be included up to 30% in weaner rabbits diet.

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