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Carcass Characteristics and Sensory Evaluation of Meat From Growing Rabbits (*Oryctolagus cuniculus*) Fed Diets Containing Varying Levels of Fermented Lebbeck (*Albizia lebbeck*) Seed Meal

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Target Audience: *Rabbit Farmers, Animal scientist, Nutritionists, Animal Scientist*

Abstract

Following a 12 weeks feeding trial with growing rabbits (Oryctolagus cuniculus) fed diets containing varying levels of fermented Lebbeck (Albizia lebbeck) seed meal, forty-five (45) mixed breeds of rabbits aged between 6-8 weeks with an average initial weight of 588.87g were used to determine the carcass characteristics and sensory evaluation. Five experimental diets were formulated such that fermented Albizia lebbeck seed meal was included to replace groundnut cake at 0, 5, 10, 15 and 20 % on weight to weight basis using completely randomized design (CRD). The rabbits were randomly allotted to five treatments in three replicates with 9 rabbits per treatment and 3 per replicate. The rabbits were also offered fresh Amaranthus hybridus ad libitum daily. The results showed significant reduction of saponin from 90.0-12.33 (86.30%), Tannin from 2.12-0.00 (100%), Cyanide 63.66-0.43 (99.32%), Flavonoid 0.24-0.00 (100%) and Alkaloid 1.28-0.00 (100%) after fermentation. Feeding fermented Albizia lebbeck seed meal however, resulted in non-significant differences (P>0.05) in dressed weight irrespective of inclusion level. The overall acceptability of both the cooked and fried meat also showed no significant difference (P > 0.05) in all the dietary groups. It is therefore recommended that fermented Albizia lebbeck seed meal (FALSM) can be used to replace groundnut cake up to 20 % in rabbit diet with optimum carcass yield.

Keywords: Rabbits; Albizia lebbeck seed; carcass characteristics

Description of problem

In Nigeria, as in most developing countries, the daily dietary intake of animal protein (4.5g) falls grossly short of the recommended 35g of animal protein per person/day (1). This observed low animal protein consumption may be attributed to the declining animal production occasioned by high cost of feeds which usually accounts for up to 70% of the total cost of production (2). A possible and most appropriate remedy for the shortage of animal protein for human consumption lies in the production of fast maturing animals like rabbits; this is because livestock like cattle, pigs, goats and sheep take longer period to mature. Shortage of quality animal feeds, particularly in developing countries of Africa has been attributed to seasonal variation and availability of qualitative pasture, and competition with man for cereals and legumes (3). This has necessitated investigations of the possibility of incorporation of several alternative sources of feeding materials into animal diets (4). Recent studies have shown that some alternative sources of feeding materials have better feeding quality for livestock. For instance, substitution of fish meal up to 33% with processed mucuna grains in poultry ration is

reported to result in heavier and less breakable eggs (5).

Rabbits are highly prolific animals with short gestation period of 29-32 days and can attain mature weight within a short period of time. Rabbits also have the ability to survive on forage, animal by-products and crop by-products. The zeal for rabbit production in Africa amongst a wide range of people creates the need for alternative cheap sources of feed to replace or supplement cereals in rabbit diet in order to make rabbit production profitable (6).

Lebbeck (*Albizia lebbeck)* yields pod of between 15-30 cm long and 2.5-5.0 cm broad containing six to twelve seeds. Leaves are free of tannins and is low in soluble phenolic compounds. Flowers contain no adverse constituents. Pods contain saponins which may limit intake but appear to have no other adverse effect (7). There is a claim of toxicity in the seed (8). Toasted *Albizia lebbeck* seed meal fed to broiler chickens resulted in high mortality at 10-20 % inclusion level. This may be due to the cumulative effects of the anti-nutritional substances in the seeds which could be an indication that the toasting process was not appropriate enough to eliminate the anti-nutritional substances as postulated by (9), that most legumes have- anti-nutrients which needed more than one treatment application. The objective of this study therefore, was to determine the level at which groundnut cake (GNC) can be replaced by fermented *Albizia lebbeck* seed meal (FALSM) for optimal carcass yield and organoleptic qualities in rabbits

Materials and Methods

Experimental Site

The experiment was carried out in the Rabbi try Unit of the Niger State Veterinary Clinic, Minna. Minna lies between latitude 9^0 3N and longitude 6^0 31E of the equator. The annual rainfall is between 1200 mm-1300mm and a mean temperature of between 38^0 C – 40 ^{0}C (10).

Source and Preparation of Test Ingredients

Mature and dry pods were harvested from *Albizia lebbeck* trees between the period of June and July, 2014 from various locations in Minna municipal township..

Raw seeds of *Albizia lebbeck* were separated from the pods by threshing in a mortar using pestle. The procedure used for fermentation of sheanut meal by (11) was used to ferment *Albizia lebbeck* seed with the following modifications: Bore hole water was used to soak *Albizia lebbeck* extracted seeds for two days (48 hours) using plastic bucket with a cover as a container, after which plastic basket serve as a filter to separate water from the seeds. Two black polythene bags were used to put the wet seeds and securely tied with a rope to create anaerobic condition thereby; preventing exchange of gases between the fermenting material and the environment for another two days (48 hours). The polythene bag was placed on top of a clean plank to prevent contact with the ground. The fermented *Albizia lebbeck* seeds were then sun dried on polythene sheets spread on a concrete floor to prevent adulteration with stones and other materials. Dried seeds were taken thereafter to the grinding machine to be grounded before incorporation into the ration on weight for weight substitution with groundnut cake.

Experimental Design

A completely randomized design (CRD) was used for the experiment. Forty-five (45) mixed breeds of rabbits aged between 6-8 weeks with an average initial weight of 588.87 g were randomly allotted to 5 dietary treatments (Diet 1-5) with three replicates per treatment. Thus, there were nine rabbits per treatment and three rabbits per replicate. Diet 1 (Control diet) had 0 % *Albizia lebbeck* seed

meal (ALSM), Diet2 had 5 %, ALSM inclusion, Diet 3 had 10 % ALSM inclusion, Diet 4 had 15 % ALSM inclusion and Diet 5 had 20 % ALSM inclusion. The inclusion levels are as indicated in Table 1

Management of Experimental Animals

The experimental animals were sourced from the Rabbit Multiplication Centre, Ministry of Livestock and Fisheries Resources, Bosso, Minna, Niger State. The rabbits were moved into cages which were raised 20cm above the ground, measuring 48cm×120cm×82cm (width× length ×height). The cages were provided with wire mesh floor which permit faeces and urine to drop. They were allowed one week acclimatization period. The animals were provided with a feeder and drinker in each cage compartment. Each drinker was attached to the wire mesh to prevent wastage and wetting of the feed. A total of 80g of concentrate/animal/day was offered on dry matter basis. 40 g was offered in the morning (8.00am) and the remaining 40 g was offered in the evening (4.00pm). The Amaranthus *was offered ad libitum.* Daily left over feed was recorded and subtracted from the feed offered to determine the daily feed intake. Water was given *ad-libitum. Ivomectin* ^{R} injection was given subcutaneously at the rate of 0.2 ml/rabbit as a prophylactic treatment against internal and external parasites, *Vitalyte* ^{R} plus was administered orally as anti-stress while *Neoceryl* ^{R} plus was also administered orally against gram-negative and gram-positive bacteria. *Coccimix* ^{R} was given orally as anti coccidia while *Sulphadimidine* ^{R} was administered orally against possible gastro intestinal disorder (Diarrhea).The rabbits were weighed to know their initial weight at the onset and at the end of the feeding trial which lasted 12 weeks.

Proximate Analyses of *Albizia Lebbeck* Raw and Fermented Seeds

Samples of raw and fermented *Albizia lebbeck* seeds were taken to the Animal Production Laboratory and Water Aquaculture and Fisheries Technology Laboratory of School of Agriculture and Agricultural Technology at Federal University of Technology, Gidan-Kwano Campus in Minna, for proximate analysis while anti-nutritional factor analysis was done at National Cereal Research Institute, Baddegi Niger State using the method described by (12). Feed samples and faecal sample were analyzed for Crude Protein (CP), Crude Fibre (CF), Ash, Fat (Ether Extract) and Nitrogen Free Extract (NFE) using the methods of (13).

Carcass Evaluation

At the end of the 12 weeks feeding trial, three rabbits from each treatment were selected, weighed, starved overnight to clear the gut, stunned and slaughtered by severing jugular vein. During evisceration, the internal organs and other gut contents were removed and weighed; the dressed carcass and internal organs were weighed and expressed as percentage of the live weight.

$$\text{Dressing \%} = \frac{\text{Dressed carcass weight}}{\text{Live weight}} \times 100$$ (14)

Sensory Evaluation

Meat samples (100 g) were taken from thigh and fore limbs of each of the 15 rabbits and 5g of salt was added to the meat before being subjected to boiling and frying. Samples of meat from each treatment group was collected after manually removing the flesh from the bone, cut into chops of an average of 40g and labeled for identification. The meat was cooked in water at a temperature of 100˚C for 15 minutes in a pot using a gas cooker as described by (15). Twenty trained panelists were used in the assessment procedure. They were instructed to chew a sample from each treatment, and score based on parameters stated on the scoring sheets; colour, flavour, texture, juiciness and tenderness. Bottled water

was served to the panelists to rinse their mouth after tasting each sample to reduce flavour carryover. The panelists scored each sample on a seven- point hedonic scale as used by (16).

Data Analysis

All data collected were analysed using SPSS version 20.0 statistical software for windows (17) such that data were subjected to one way analysis of variance (ANOVA) and the difference in means were separated using Duncan's Multiple Range Test Duncan (18).

Results

The anti-nutritional substances in raw and fermented *Albizia lebbeck* seeds are shown in Table 2. The result showed a saponin content of 90 mg/g in raw *Albizia lebbeck* seed and only 12.33 mg/g in fermented seed representing 86.33 % reduction. Phytate in raw seed was 2.03 mg/g but 1.18 mg/g in the fermented seed implying 41.87 % reduction due to fermentation. Oxalate was 0.45 mg/g in raw seed and 0.33 mg/g in fermented seed resulting in 26.67 % difference. The Cyanide (HCN) content of the raw seed was reduced by 99.32%. Tannin, flavonoid and Alkaloid in raw seeds were completely removed after fermentation.

The proximate analyses of raw and fermented *Albizia lebbeck* seeds are presented in Table 3. Fermentation led to reduction in the moisture content of the seed from 11.16 mg/g in raw seeds to 6.17 mg/g in fermented seeds. Similar reductions were observed in crude fibre and NFE. However, fermentation brought about increase in the levels of crude protein, ash and fat

Carcass evaluation of rabbits (*Oryctolagus cuniculus*) fed diets containing varying levels of fermented (*Albizia lebbeck)* seed meal expressed as percentage live weight Table 4. The live weight of rabbits fed 10 % FALSM and 15 % FALSM were statistically similar but significantly higher ($P< 0.05$) than other treatment groups. The Live weight was heaviest in the control group ($p<0.05$) dressing weight, dressing percentage, fore and hind limbs were not significantly affected by treatment imposed. The weight of cervico thoracic region was highest ($p<0.05$) but similar in other groups. It was observed that as the inclusion level of fermented *Albizia lebbeck* seed meal increased the cervico thoracic region weight decreased ($p>0.05$). The lumbar sacral region, neck, tail and skin were not significantly affected ($P > 0.05$) by treatment but the control group recorded the highest values in these parameters. There were significant differences ($P< 0.05$) in the weight of head, blood weight, fore legs and hind legs. The weight of hind legs and head of rabbit on control diet were significantly ($P< 0.05$) higher than those fed 20 % fermented *Albizia lebbeck* seed meal. However, abdominal fat, heart, lungs, liver, kidney, spleen and gall bladder were not significantly ($P > 0.05$) affected by level of fermented Albizia lebbeck seed. The dietary levels of *Albizia lebbeck* had a significant ($P < 0.05$) effect on the length of the intestine which increased with inclusion levels. Rabbits fed 20 % inclusion of fermented *Albizia lebbeck* seed meal in diet had significantly ($P<0.05$) longer intestine than those fed with 0, 5 and 10 % respectively.

The effect of dietary graded levels of fermented *Albizia lebbeck* seed meal in diet on organoleptic qualities of boiled rabbit meat are shown in Table 5. The result shows no significant difference ($P > 0.05$) in colour, tenderness and overall acceptability among the dietary groups. However, significant differences ($P< 0.05$) were observed in juiciness and flavor in favour of the control group over rabbits fed 15 and 10 % fermented *Albizia lebbeck* seed meal respectively.

The effect of dietary graded levels of fermented *Albizia lebbeck* seed meal in diet on organoleptic qualities of fried rabbit meat are presented in Table 6. The result shows no

significant difference (P > 0.05) in all the parameters measured across the dietary groups. However, rabbits with fermented Albizia lebbeck recoded slightly higher values in most parameters measured.

Discussion

Significant performance in terms of live weight of rabbits fed fermented *Albizia lebbeck* seed meal over the control group could be due to positive effect of fermentation on the test ingredients. The dressing percentage values recorded in this experiment are higher than those reported by (19) and (20) as 47.8 - 49.6 and 42.05 -48.38 % respectively. The decrease in weight of cervical thoracic region as the level of fermented *Albizia lebbeck* seed meal increases could be due to negative effect of Albizia *lebbeck* on the cervico thoracic region. The lumbar sacral region, neck, tail and skin that were not significantly (P>0.05) influenced by the dietary treatments, could mean that the test ingredient can be effectively used to replace groundnut cake. The length of intestine that was significantly (P < 0.05) different across the dietary treatments, maybe attributed to level and degree of digestibility of fibre content in the diet. This observation was not in agreement with the work of (21) who reported that as the crude fibre increased the intestine increased in length.

The non-significant difference (P >0.05) observed in this work in the organoleptic qualities of fried meat, was in agreement with (22).The authors carried-out an organoleptic properties of rabbits cooked by five different methods and the cooking methods did not have any significant effect (P > 0.05) on the eating quality of rabbit meat. It also agrees with (16), in their study on effect of graded dietary levels of neem seed kernel cake on carcass characteristics of weaned rabbits. They reported that sensory attributes of pressure cooked meat with or without salt were found similar. The significant effect (P < 0.05) observed on the juiciness and flavour of the boiled meat in favour of the control group over those rabbits fed 20 % could be attributed to the effect of fermented *Albizia lebbeck* seed meal in the diet.

Conclusion and Applications

Based on the results of this work it was concluded that:

1. Fermentation process was found to be effective in the reduction of some anti-nutritional factors in *Albizia lebbeck seed meal.*
2. All the treatment groups of rabbits fed above 5% fermented *Albizia lebbeck* seed meal in the diet resulted in significant increase in live weight over those fed 0 % (control).
3. Up to 20% inclusion of fermented *Albizia lebbeck* seed meal can replace ground nut cake in the diet of growing rabbits for optimum carcass yield and organoleptic qualities**.**

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Table 1. Gross composition of diets for growing rabbits (*Oryctolagus cuniculus*) fed varying inclusion levels of fermented *Albizia lebbeck* seed meal

Treatments	**Ingredients**				
	Diet1(0%)	**Diet 2 (5%)**	**Diet 3(10%)**	**Diet 4(15%)**	**Diet 5(20%)**
Maize	56.26	56.26	56.26	56.26	56.26
Rice offal	15.50	15.50	15.50	15.50	15.50
Groundnut cake	18.73	17.79	16.86	16.58	14.98
Albizia lebbeck	0.00	0.94	1.87	2.15	3.75
Fish meal	4.11	4.11	4.11	4.11	4.11
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	0.30	0.30	0.30	0.30	0.30
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.30	0.30	0.30	0.30	0.30
Salt	0.50	0.50	0.50	0.50	0.50
*Vitamin Premix	1.00	1.00	1.00	1.00	1.00
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Metabolizable energy					
Kcal/kg (ME)	2667.39	2616.09	2564.42	2513.11	2465.07
Calculated CP(%)	17.13	17.28	17.48	17.68	17.87

Composition of Vitamin premix : Vit A 10,000000IU,Vit D_1 2000,000IU,Vit E 20,000mg, Vit k_1 2,000mg Vit B_1 3,000mg, Vit B_2 5,000mg, Niacin 45,000mg, Calcium pantothenate 10,000mg, Vit B_6 4,000mg, Vit B_{12}, 20mg, Choline chloride 300,000mg, Biotin 1000mg, Manganese 50mg, Iron 300,000mg, Zinc 120,000mg, Copper 80,000mg, Iodine 15,000mg, Cobalt 300mg, Selenium 120mg, Antioxidant 120,000mg.

Values in parenthesis represent inclusion level of fermented Albizia Lebbeck

Table 2: Some anti-nutritional substances in raw and fermented Albizia *lebbeck* seeds

Components (%)	Raw seeds	Fermented seeds	% Reduction
Saponin	90.00	12.33	86.33
Phytate	2.03	1.18	41.87
0xalate	0.45	0.33	26.67
Tannin	2.12	0 .00	100.00
Cyanide(HCN)	63.66	0.43	99.32
Flavonoid	0.24	0.00	100.00
Alkaloid	1.28	0.00	100.00

Table 3: Proximate analyses of raw and fermented *Albizia lebbeck seeds and GNC*

Ingredient	% Moisture	% ASH	%CP	%CF	% Fat	% NFE
Raw Seed	11.16	2.00	23.45	18.00	5.00	40.39
Fermented Seed	6.17	6.40	26.93	16.67	7.48	36.35
GNC	7.71	5.05	46.4	8.0	11.25	29.30

GNC=Groundnut cake; CP = Crude protein; CF = Crude fibre; NFE = Nitrogen free extract

Table 4: Carcass evaluation of rabbits (*Oryctolagus cuniculus*) fed diets containing varying inclusion levels of fermented *Albizia lebbeck* seed meal expressed as percentage live weight

PARAMETERS	**Diet 1 (0%)**	**Diet 2 (5%)**	**Diet 3(10%**	**Diet 4(15%)**	**Diet 5(20%)**	**SEM**	**LS**
Live weight (g)	1300^{c}	1416.7^{b}	1516.7^{a}	1491.3^{a}	1375.0^{b}	21.96	*
Dressed weight (g)	1083.3	1050.0	1316.7	1166.7	1116.7	41.25	NS
Dressing (%)	83.33	74.06	87.02	78.15	81.21	2.55	NS
Retail cut parts (%)							
Fore limbs(%)	9.74	7.88	7.73	8.46	8.35	0.35	NS
Hind limb (%}	13.72	11.66	12.36	11.96	12.27	0.40	NS
CT R (%)	9.05^{b}	10.89^{a}	8.51^{b}	8.26^{b}	8.03^{b}	0.33	*
L S R (%)	17.31	16.30	15.91	15.49	15.76	0.45	NS
Neck (%)	4.59	5.13	4.91	4.40	4.26	0.15	NS
Tail (%)	0.31	0.26	0.37	0.27	0.28	0.19	NS
Skin (%)	9.87	9.34	9.62	9.31	9.81	0.30	NS
Carcass by- products							
Head (%)	9.69^{a}	8.56^{ab}	8.96^{ab}	8.63^{ab}	8.05^{b}	0.21	*
Blood weight (%)	16.67^{ab}	25.42^{a}	10.59^{b}	30.31^{a}	21.41^{ab}	2.41	*
Fore legs (%)	0.92^{b}	1.12^{a}	0.80^{c}	0.69^{cd}	0.64^{d}	0.01	*
Hind legs (%)	2.15^{a}	2.02^{a}	1.62^{ab}	1.44^{b}	1.45^{b}	0.10	*
Abdominal fat (%)	0.72	1.06	0.54	0.72	0.75	0.12	NS
Organ weight							
Heart (%)	0.31	0.28	0.27	0.28	0.30	0.01	NS
Lung (%)	0.56	0.47	0.41	0.47	0.42	0.02	NS
Liver (%)	2.67	2.66	2.76	2.67	3.33	0.15	NS
Kidney (%)	0.90	0.82	0.70	0.86	0.82	0.03	NS
Spleen (%)	0.08	0.07	0.05	0.09	0.10	0.01	NS
Gall bladder (%)	0.08	0.07	0.05	0.06	0.06	0.01	NS
Intestine (cm)	14.38^{b}	15.30^{b}	15.84^{b}	18.06^{ab}	19.15^{a}	0.56	*

Means with the same superscript (s) within rows are not significantly different at 5 % level of probability
SEM = Standard Error Mean LS = Level of significance NS = Not significant
*=Significant at (P<0.05) CTR=Cervico thoracic region LSR=Lumber sacral region

Table 5: Effect of dietary graded levels of fermented *Albizia lebbeck* seed meal on organoleptic qualities of boiled rabbit meat.

PARAMETERS	Diet 1 (0%)	Diet 2 (5%)	Diet 3(10%	Diet 4(15%)	Diet 5(20%)	SEM	LS
Colour	5.15	5.25	4.55	4.70	4.70	0.11	NS
Tenderness	5. 56	5.50	4.95	5.15	5.35	0.13	NS
Juiciness	5.70^{a}	5.25^{ab}	4.45^{b}	4.65^{b}	5.20^{ab}	0.15	*
Flavour	5.60^{a}	5.25^{ab}	4.65^{ab}	4.55^{b}	5.35^{ab}	0.15	*
Overall Acceptability	6.00	5.55	5.50	5.40	6.05	0.11	NS

ab -Means with the same superscript (s) within rows are not significantly different at 5 % level of probability.
FAL=Fermented *Albizia lebbeck* seed meal SEM = Standard Error Mean
LS = Level of significance NS = Not significant * = Significant at P<0.05
Values in parenthesis represent inclusion level of fermented Albizia Lebbeck

Table 6: Effect of dietary graded levels of fermented *Albizia lebbeck* seed meal on organoleptic qualities of fried rabbit meat.

PARAMETERS	Diet 1 (0%)	Diet 2 (5%)	Diet 3(10%	Diet 4(15%)	Diet 5(20%)	SEM	LS
Colour	6.00	5.70	5.70	5.60	5.75	0.12	NS
Tenderness	5. 50	5.15	5.60	5.10	5.65	0.12	NS
Juiciness	5.10	5.00	5.25	5.05	5.10	0.14	NS
Flavour	5.10	5.65	5.60	4.95	5.40	0.13	NS
Overall Acceptability	5.65	5.50	6.10	5.55	5.90	0.12	NS

Means with the same superscript (s) within rows are not significantly different at 5 % level of probability.
FALSM=Fermented *Albizia lebbeck* seed meal LS=Level of significance NS = Not significant * = Significant at ($P < 0.05$)
Values in parenthesis represent inclusion level of fermented Albizia Lebbeck