Effects of duration of cooking whole or crushed African Locust Bean (*Parkia Filicoidea*, Welw) seeds on the levels of some Anti-Nutritional Factors and growth performance of young rabbits

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Abstract

Chemical analyses and a growth trial were carried out to determine the effect of duration of cooking whole or crushed African locust bean seeds on the proximate compositions, levels of some anti-nutritional factors and growth performance of young rabbits. Samples of whole or crushed African locust bean seeds subjected to 30, 45 or 60 minutes duration of cooking respectively, were analysed for proximate composition and levels of some anti-nutritional factors. In a completely randomized design, a 56-day feeding trial was also conducted using 63 young rabbits of mixed breeds with an average initial weight of 415.00g to evaluate the effect of cooking whole or crushed African locust bean seeds at 100°C for 30, 45 or 60 minutes on growth performance. The diets were formulated to be iso-nitrogenous (20% CP). Diet 1 with raw African locust bean seeds served as the control. The animals were offered feed and water *ad libitum*. At the end of the growth trial, 5 rabbits per treatment were selected and slaughtered for carcass analysis. The results showed that cooking African locust bean seeds whole or crushed for 30, 45 or 60 minutes had no significant ($P>0.05$) effect on the proximate composition. However, cooking the seeds, either whole or crushed resulted in a significant ($P<0.05$) decrease in trypsin inhibitors activity (TIA), phytic acid, tannin and hydrocyanic acid content of the raw seeds. Feed intake, average daily weight gain and feed conversion ratio were significantly ($P<0.05$) improved as the duration of cooking increased. The cost per unit gain decreased significantly ($P<0.05$) as the duration of cooking increased from 30 to 60 minutes. It was concluded that raw African locust bean seeds contain some levels of anti-nutritional factors which could limit their nutritional value in monogastric diet. Cooking whole or crushed African locust bean seeds at 100°C for 60 minutes was considered optimum for young rabbits. There was no significant ($P>0.05$) advantage of crushing before cooking.

Key words: Locust bean, anti-nutritional factors, growth, young rabbits.

Introduction

In Nigeria, one of the major problems facing the livestock industry is that of increasing unavailability of the conventional feed stuff. The competition between human and monogastrics

for available grains has further forced prices up, thereby threatening the potential for increasing animal protein production, which is in short supply. The average protein supply per day is about 56.6g, a value that is considerably low

compared to the 65g per head per day recommended by Yousuf (1983) and FAO (1988). Low protein intake especially among the poor rural populace of the developing countries resulted in reduction of nutritional status in the population.

The high cost of conventional feed ingredients which consequently resulted in low protein intake is responsible for the keen interest in the search for cheaper feed ingredients as a substitute by nutritionists over the years. One of such important but lesser known legume protein source is the African locust bean seed (*Parkia filicoidea* welw). The African locust bean seed is obtained from the African locust bean tree, a perennial tropical legume that is widely distributed all over the natural grass land of Northern Nigeria (Platt, 1980). The raw seed is high in protein (30% CP) and its amino acid composition compares well with those of decorticated groundnut seed and soya bean (Oyenuga, 1968 and Kingsley, 1995). It is exceptionally high in lysine and arginine but low in sulphur amino acids such as methionine and cystine.

However, like other tropical legumes, its usefulness as feed for livestock may be limited as a result of the presence of some anti-nutritional factors (Kingsley, 1995). The presence of these anti-nutritional substances has been associated with growth depression in many species (Birk, 1988). It has been established that cooking and other processing methods of grain legumes exerted beneficial effect by destroying the anti-nutritional factors inherent in legume grains (Balogun *et al*, 2001). Since the discovery of the beneficial effects of heat treatment on the nutritional value of raw legume grains, the challenge had been to determine the appropriate level of heat treatment for optimum utilization.

While a cooking duration of 24 hours (Oyenuga, 1968) and 6-10 hours (Kingsley, 1995) was required for the processing of African locust bean seed into a traditional food condiment called "dawa dawa" or 'iru' (Odunfa, 1985), the duration of cooking required to reduce the anti-nutritional factors to a threshold level for livestock consumption is still been studied. The study was therefore designed to determine the optimum duration of cooking whole or crushed African locust bean seeds on the proximate composition, levels of some antinutritional factors and on growth performance of young rabbits. It also aimed at determining whether crushing the African locust bean seeds will shorten the duration of cooking required in the processing of the African locust bean seeds or not.

Materials and Methods

Source and Processing of Parkia Seeds

The *parkia* seeds used for this study were procured from Sabon Gari local market in Zaria, Kaduna State.

To process the seeds, batches of 5kg *Parkia* seeds were either crushed and cooked for 30, 45 and 60 minutes or cooked whole for 30, 45 and 60 minutes, respectively. Each duration of cooking represented a treatment. For each cooking time, 20 litres of water was first brought to boiling point, in a 30 litre aluminium pot, at a temperature of 100°C and the seeds were then poured into the boiling water. From this point, the specified time for cooking was taken. At the end of the period of cooking, excess water was drained off. The cooked seeds were sun dried for 5 days and then milled in a hammer mill before incorporation into the experimental diets.

Proximate Analysis

The dry matter content was determined based on the weight loss after 24 hrs in an oven at

100°C. Nitrogen content was determined by the Kjeldahl method of A.O.A.C. (1990) and crude protein (CP) calculated as $N \times 6.25$. The ash content was determined as the residue remaining after incinerating the sample at 600°C for 3 hours in a Muffle furnace. The A.O.A.C. (1990) methods were employed for ether extract (EE) and crude fibre (CF) determinations.

Anti-Nutritional Factor Determination

The trypsin inhibitor activity (TIA) on sample extracts was determined according to the method of Kakade *et al.* (1974) with the modification described by Liu and Markakis (1989). Phytic acid was also determined using the method of Sutardi and Buckle (1985). After defatting and extracting with 5% ethyl ether and ethanol respectively, tannic acid was estimated using the method of Earp *et al.* (1981). The hydrocyanic acid content of raw and cooked *Parkia* seeds were determined using the procedure of Cooke and Maduagwu (1978) as modified by Ikediobi and Fashagba (1985).

Experimental diets

The compositions of the experimental diets are presented in Table 3. The proximate composition of the experimental diets is also presented in Table 4. Diet 1 contained raw *Parkia* seeds and served as the control. Diets 2, 3 and 4 contained whole *Parkia* seeds cooked at 100°C for 30, 45 and 60 minutes, respectively. Diets 5, 6 and 7 contained crushed *Parkia* seeds cooked at 100°C for 30, 45 and 60 minutes, respectively. The experimental diets were isonitrogenous (20% CP). All the dietary treatments were fortified with vitamins and minerals. The chemical analyses of the experimental diets (Table 4) were carried out at the Biochemistry Laboratory of Animal Science Department, Ahmadu Bello University, Zaria, in accordance with the procedures outlined by A.O.A.C. (1990).

Experimental design and housing

Sixty-three young rabbits of mixed breeds with an average initial weight of 415.00g obtained from Animal Science Department Rabbitry Unit, Ahmadu Bello University, Teaching and Research Farm, Zaria were used for the study. Ivomec was used to treat the animals against endoparasites before the commencement of the trial. The rabbits were randomly allotted to pens on the basis of initial live weights to the seven dietary treatments in a complete randomized design.

All animals were held individually in standard cages equipped with feeding and watering facilities. The experiment was carried out at the Animal Science Department rabbitry unit, Ahmadu Bello University Teaching and Research Farm, Zaria.

Management of animals and data collection

The rabbits were fed and water *ad libitum* through out the period of the experiment. The animals were fed at 8.00 am every morning. Left over feed was weighed once a week and the amount of feed intake calculated. The animals were also weighed once in a week and the weight gains determined. At the end of the experiment, average daily feed intake, weight gain, feed conversion ratio and cost per kg gain were computed.

Carcass analysis

At the end of the 56-day feeding trial, five rabbits from each treatment were selected on the basis of treatment average weight for carcass evaluation at Animal Products Laboratory, Department of Animal Science, Ahmadu Bello University, Zaria. The skinning method of processing following starving the animals of feed and water over night was used. The animals were bled and skinned by hanging them on a hook and the fur-skin pulled downwards after being cut at the neck to make for easy pull. Evisceration

was then carried out. The spleen, lungs, heart, kidney, pancreas and liver were excised and weighed. The carcass weights, head, leg, tail, thigh, shoulder and loin weights were also taken. The lengths of intestines were measured using a measuring tape. The weights of the organs and prime cuts were expressed as the percentage of the carcass weight.

Statistical analysis

Data generated from the study were analysed using Analysis of Variance and where statistical significance were observed, the means were compared using the Duncan's Multiple Range Test according to SAS (1995).

Results and Discussion

Proximate and Anti-nutritional Factor Assay Study

The proximate compositions of raw, cooked whole or crushed African locust bean seeds at varying duration of cooking are presented in Table 1. Duration of cooking and crushing of the seeds before cooking had no significant ($P>0.05$) effect on the proximate composition. There was a slight non-significant ($P>0.05$) decrease in the crude protein as the duration of cooking increased and this may be partly due to leaching of soluble protein into the processing water. This agrees with Kingsley (1995) who reported that cooking reduced the protein content of raw oil bean. The crude protein value (30.06%) obtained for the raw *Parkia* Seed is close to the value of 30.4%CP reported by Fetuga *et al* (1974). The ether extract, crude protein, fibre also decreased non-significantly ($P>0.05$) with increase in duration of cooking.

The results of the effects of duration of cooking *Parkia* Seeds on the levels of anti-nutritional factors are presented in Table 2. It was generally observed that heat treatment of raw *Parkia* Seeds resulted in reduction of the antinutritional factors.

This supported Liener and Kakade, 1980 who reported that most anti-nutritional factors in legume seeds can be reduced by proper application of heat.

A significant decrease ($P<0.05$) in trypsin inhibitor activity (TIA) was observed as the duration of cooking, either whole or crushed *Parkia* Seeds increased. This value was reduced to 5.79, 3.22 and 1.58mg per 100g sample for the raw seeds that were cooked whole for 30, 45 and 60 minutes, respectively and 6.58, 3.95 and 1.58mg per 100g sample when the seeds were crushed before cooking for 30, 45 and 60 minutes, respectively. There was an initial destruction of trypsin inhibitor activity with about 40.49% of activity been destroyed within 30 minutes of cooking for the whole seeds and 32.37% destruction within 30 minutes of cooking for the crushed seeds before cooking. The highest destruction of trypsin inhibitor activity (83.76%) was obtained at 60 minutes of cooking for both methods of processing and this agreed with Bawa *et al* (2003) who reported a similar destruction (83%) when lablab seeds were cooked for 60 minutes. There was, however, no significant difference ($P>0.05$) between the TIA values obtained for both whole or crushed *Parkia* seeds cooked for 60 minutes.

Duration of cooking significantly ($P<0.05$) affected the phytic acid content of *Parkia* seeds. There was a corresponding decrease in the concentration of phytic acid with an increase in the duration of cooking and this was reduced from 7.27mg per 100g for the raw seeds to 5.08, 4.73 and 4.27/100g sample for the whole seeds cooked at 30, 45 and 60 minutes and 5.65, 4.62 and 4.00/100g sample for the crushed seeds before cooking at 30, 45 and 60 minutes, respectively. The rate of destruction or loss of phytic acid agreed with the results of Sutardi and Buckle (1985) who reported that the loss of

Table 1: Chemical Composition of whole or crushed raw African Locust Bean seeds cooked at 100°C for different durations, % DM basis

Parameter	Treatments							SEM
	1 Control (Raw)	2 Cooked Whole (30 Mins)	3 Cooked Whole (45 Mins)	4 Cooked Whole (60 Mins)	5 Crushed and Cooked (30 Mins)	6 Crushed and Cooked (45 Mins)	7 Crushed and Cooked (60 Mins)	
Dry matter (DM) %	91.81	91.72	92.21	92.09	91.63	91.84	91.59	42.51 NS
Crude protein (CP)	30.06	29.38	29.00	28.16	30.00	28.75	28.38	55.63 NS
Crude fibre (CF) %	7.41	7.27	5.45	7.42	7.18	7.13	7.12	11.23 NS
Ether extract (EE) %	11.11	10.00	10.98	10.40	10.45	10.42	10.34	13.42 NS
Ash %	5.54	5.67	5.86	4.96	6.83	6.96	5.17	0.78 NS
NFE %	45.88	47.68	48.71	49.06	45.54	46.74	48.99	22.63 NS

SEM: Standard Error of Means NS - Non significant difference ($P>0.05$) at 5% level
Each value represents the mean of three determinations.

Table 2: Anti-nutritional factor content of raw, whole or crushed African locust beans seeds cooked at 100°C for varying time periods and their percent destructions.

Parameter	Treatments							SEM
	1 Control (Raw)	2 Cooked Whole (30 Mins)	3 Cooked Whole (45 Mins)	4 Cooked Whole (60 Mins)	5 Crushed and Cooked (30 Mins)	6 Crushed and Cooked (45 Mins)	7 Crushed and Cooked (60 Mins)	
TIA, mg/100g	9.73 ^a	5.79 ^c	3.22 ^d	1.58 ^e	6.58 ^b	3.95 ^d	1.58 ^e	0.26
Percent destruction of TIA(%)	-	40.49	66.91	83.76	32.37	59.40	83.76	
Phytic acids, mg/100g	7.27 ^a	5.08 ^c	4.73 ^d	4.27 ^e	5.65 ^b	4.62 ^c	4.00 ^f	0.13
Percent destruction of phytic acid (%)	-	30.12	35.00	41.27	22.28	36.45	45.00	
Tannin mg/100g	16.96 ^a	7.25 ^b	4.42 ^d	4.17 ^d	6.83 ^b	6.00 ^c	4.31 ^d	0.15
Percent destruction of tannin (%)	-	57.25	73.94	75.41	59.73	64.62	74.60	
Cyanide, mg/100g	0.034 ^a	0.032 ^b	0.030 ^c	0.025 ^d	0.029 ^c	0.026 ^d	0.024 ^e	0.0006
Percent destruction of cyanide (%)	-	5.88	11.76	26.47	14.71	23.53	29.41	

Note: a,b,c,d,e,f, Means in the same row with different super scripts differ significantly ($P<0.05$)
SEM = Standard Error of Means
TIA = Trypsin Inhibitor Activity

phytic acid was due to oil solubility in processing water during cooking. In comparison with the trypsin inhibitor activity, the rate of destruction of phytic acid was quite slow when the seeds were cooked for both methods of processing for 30 minutes. However, there was a slight increase in the rate of destruction when duration of cooking increased to 45 or 60 minutes across the dietary treatments. Only about 22.28-30.12% of the phytic acid were eliminated after 30 minutes of cooking, while about 32.37-40.49% and 57.25-59.73% of both trypsin inhibitor activity and tannic acid respectively had been destroyed within this length of cooking time. This observation shows phytic acid as being heat stable which may be due to a strong covalent linkage between the oxygen atoms and the phosphate radicals within the phosphate structure (De Boland et al 1975). Bawa *et al.* (2003) in a similar study with lablab seeds reported that 30 minutes of cooking at 100°C did not achieve appreciable significant reduction in the phytic acid content as compared to trypsin inhibitor activity and hydrogen cyanide.

Parkia seeds contain tannin which were significantly ($P>0.05$) reduced by cooking. The loss of tannin with increase in cooking time could be due to oil solubility in water which was observed also in raw African oil bean seed (Kingsley, 1995). This is in agreement with the reports of other authors who observed that cooking reduced significantly the tannin content of Soyabean (Kaankuka *et al.*, 1996), lima beans (Ologhobo, 1980) and cowpea (Oke. *et al.*, 1996). In this study, about 75% destruction of tannic acid was achieved after 60 minutes of cooking. The highest concentration of tannic acid (16.96mg/100g) was obtained for the raw *Parkia* seeds while the lowest value (4.17mg/100g) was obtained for *Parkia* seeds cooked whole for 60 minutes. Destruction of tannin increased as cooking time increased for both methods of

processing.

There was a significant ($P<0.05$) reduction of cyanide in the raw seeds and the rate of destruction increased with increase in duration of cooking time. This significant loss in the cyanide level was due to the volatile nature of hydrocyanic acid as it has a boiling point of 26°C (Oke *et al.*, 1996). Balogun *et al.* (2001) observed that most anti-nutritional factors in legume seeds are destroyed after cooking the seeds for a minimum of 30 minutes. Bawa *et al.* (2003) also reported a similar result, when lablab seeds were subjected to boiling at 100°C for 30 minutes.

Growth Performance Study

The results of the growth performance of the rabbits are presented in Table 5. The results indicated a significant ($P<0.05$) effect of dietary treatments on feed intake, weight gain, final live weight, feed efficiency and cost per gain.

The rabbits fed cooked *Parkia* seed meal diets had a significantly ($P<0.05$) better final live weight than those fed the raw *Parkia* seed meal diets. The difference between treatments for the rabbits fed cooked whole *Parkia* seed diets and those on crushed *Parkia* seed diets were however not significantly different ($P>0.05$). The final live weight followed the same trend with that of weight gain and feed intake.

Rabbits fed either whole or crushed *Parkia* seeds before cooking had significantly ($P<0.05$) higher feed intake than those fed raw *Parkia* seed diet. The observed significant depression in feed intake by young rabbits fed raw *Parkia* seed diet could be as a result of anti-nutritional factors (Table 2) which might have imparted an undesirable taste to the diet, thus, lowering the palatability and acceptability of the diets by the animals. Most of the anti-nutritional factors in legume grains are known to be heat labile (Liener

Table 3: Composition of the experimental diets

Ingredients	Diets						
	1	2	3	4	5	6	7
Maize	47.88	47.88	47.88	47.88	47.88	47.88	47.88
Maize offal	10.00	10.00	10.00	10.00	10.00	10.00	10.00
African locust	33.07	33.07	33.07	33.07	33.07	33.07	33.07
Blood meal	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Limestone	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Vitamin-mineral premix	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Salt	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Total	100	100	100	100	100	100	100

CALCULATED ANALYSIS

Crude Protein %	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Metabolizable							
Energy (Kcal/kg)	1785.45	1785.45	1785.45	1785.45	1785.45	1785.45	1785.45
Crude Fibre %	5.42	5.42	5.42	5.42	5.42	5.42	5.42
Calcium %	1.41	1.41	1.41	1.41	1.41	1.41	1.41
Phosphorus %	0.66	0.66	0.66	0.66	0.66	0.66	0.66
Lysine %	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Methionine %	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Cystein %	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Meth. + Cyst %	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Ca: P %	2.14	2.14	2.14	2.14	2.14	2.14	2.14
Ether extract %	2.70	2.70	2.70	2.70	2.70	2.70	2.70
Cost/kg of diet (N)	22.68	23.18	23.48	23.78	23.18	23.48	23.78

Vitamin/mineral premix contributed the following per kg of diet:

Vitamin A, 12000 I.U.; Vitamin D₃, 1,2000 I. U; Vitamin E, 3.6 U; Vitamin K, 1.8mg; Vitamin B₁₂, 3.6mg;

Nicotinate, 19/8mg; Calcium-d- Pantothenate, 9.6mg;

Biotin, 0.36mg; Vitamin B₆, 0.012mg; Choline chloride, 120mg; Chlortetracycline, 4.8mg; Manganese, 24mg; Iron, 48mg; Zinc, 96mg; Copper, 60mg; Iodine, 1.8mg; Cobalt, 48mg.

and Kakade, 1980). It is therefore, likely that the decrease in the concentration of the dietary anti-nutritional factors with increase in the duration of cooking of whole or crushed *Parkia* seeds was responsible for the significant ($P<0.05$) increase in the amount of feed intake.

Dietary treatments resulted in marked growth

differences. with rabbits on the raw *parkia* seed diet having the least average daily weight gain of 6.78g/day that was significantly ($P<0.05$) lower than the value (12.21 – 16.90g/ day) for the other dietary treatments. This was in agreement with other authors who observed poorer weight gains of monogastric animals fed raw legume seeds (Olupona *et al.* 1999 and Amaefule and Obioha,

2001). The relatively low feed intake coupled with the inability of the animals to digest and absorb *Parkia* seed proteins in the raw state, as a result of antinutritional factors, could be responsible for the depressed weight gain observed in animals fed the raw parkia seed diets. Cooking the seeds either whole or crushed resulted in destruction of antinutritional factors (Table 2). Consequently, weight gains of the animals were significantly ($P < 0.05$) better especially at 60 minutes duration of cooking where about 83% of the trypsin inhibitor was destroyed. Rabbits fed *parkia* seeds cooked whole at 30, 45 and 60 minutes, gained about the same weight with their counterparts that were fed *parkia* seeds crushed and cooked for 35, 45 and 60 minutes, respectively. This could be an indication that crushing the seeds before cooking may not have significant ($P > 0.05$) effect on performance of the animal than cooking whole.

The feed conversion result followed the same trend with that of rate of gain. Generally, feed conversion improved with increase in duration of cooking *parkia* seeds. Rabbits fed the raw *parkia* seed diet had significantly ($P < 0.05$) poorer feed conversion than those on other dietary treatments. Since the dietary treatments were

similar in composition except for the duration of cooking of the *parkia* seeds (Table 3), it is likely that the poor feed conversion observed on rabbit fed raw and 30 minutes cooked whole *parkia* seeds could be due to the presence of protease inhibitors which might have interfered with the action of protease enzymes on the dietary protein. The improved rate of feed conversion with increase in duration of cooking further support the view that most of the antinutritional factors are heat labile. Cooking *parkia* seeds whole or crushed in the present study, did not show any significant effect ($P > 0.05$) on the rate of feed conversion.

Rabbits fed raw *parkia* seed diets had higher cost of feed per unit weight gain despite the fact that it had the least cost per kg compared to other diets (Table 3). This observation is similar to the report of other workers (Bamgbose and Adenomonu, 2002 and Ewura et al., 2003). The result of cost per unit gain obtained in this study could be linked to poor tissue deposition by animals when fed raw legume seeds. The significantly lower ($P > 0.05$) cost per unit body weight gain for rabbits fed *parkia* seeds cooked crushed or whole for 45 and 60 minutes suggest that *parkia* seeds need to be cooked beyond 45 minutes for

Table 4: Chemical composition (DM) of experimental diets containing raw and whole or crushed African Locust Bean seeds cooked at 100°C for different durations fed to young rabbits.

Parameter	Diets						
	1 Control (Raw)	2 Cooked Whole (30 Mins)	3 Cooked Whole (45 Mins)	4 Cooked Whole (60 Mins)	5 Crushed and Cooked (30 Mins)	6 Crushed and Cooked (45 Mins)	7 Crushed and Cooked (60 Mins)
Dry matter (DM) %	91.88	91.29	92.02	91.91	91.64	92.29	92.37
Analyses % of DM							
Crude protein (CP) %	24.25	22.81	22.50	23.06	22.25	22.56	23.06
Crude fibre (CF) %	4.41	5.95	4.38	4.39	5.17	4.89	5.51
Ether Extract (EE) %	6.57	5.48	5.76	6.59	6.81	5.93	6.50
Ash %	6.77	6.80	6.67	5.76	5.53	7.43	7.77
NFE %	58.00	58.96	60.69	60.20	60.24	59.19	57.16

Table 5: Performance of young rabbits fed raw whole or crushed African Locust Bean Seed Meal Diets

Parameter	Treatments							SEM
	1	2	3	4	5	6	7	
	Control (Raw)	Cooked Whole (30 Mins)	Cooked Whole (45 Mins)	Cooked Whole (60 Mins)	Crushed and Cooked (30 Mins)	Crushed and Cooked (45 Mins)	Crushed and Cooked (60 Mins)	
Initial weight (g)	417.50	417.50	412.50	412.50	417.50	415.00	412.50	74.222
Final weight (g)	930.00 ^a	1017.50 ^a	1030.00 ^a	1130.00 ^a	1020.00 ^a	1027.00 ^a	1135.00 ^a	0.043
Daily feed intake (g/day)	41.21 ^a	56.60 ^a	68.50 ^a	70.50 ^a	54.31 ^a	58.90 ^a	71.50 ^a	14.56
Daily weight gain (g/day)	6.78 ^b	12.21 ^a	14.94 ^a	16.38 ^a	11.32 ^b	12.86 ^b	16.90 ^a	25.85
Feed conversion Ratio (FCR)	6.07 ^a	5.04 ^b	4.58 ^b	4.25 ^c	4.79 ^b	4.58 ^b	4.25 ^c	1.02
Cost per kg gain in weight	137.66 ^c	116.82 ^b	107.53 ^a	101.06 ^a	111.03 ^b	107.53 ^a	100.55 ^a	18.45
Mortality	0	0	0	0	0	0	0	0

Means with the same letter are not significantly different at P=0.05 level of significant.

Table 6: Carcass Characteristics of rabbits fed raw, whole or crushed *Parkia* seeds

Parameter	Treatments							SEM
	1	2	3	4	5	6	7	
	Control (Raw)	Cooked Whole (30 Mins)	Cooked Whole (45 Mins)	Cooked Whole (60 Mins)	Crushed and Cooked (30 Mins)	Crushed and Cooked (45 Mins)	Crushed and Cooked (60 Mins)	
Pre-slaughter wt(g)	930.00 ^a	1017.50 ^a	1030.00 ^a	1150.00 ^a	1020.00 ^a	1027.00 ^a	1135.00 ^a	0.043
Carcass weight (g)	548.70 ^a	620.7 ^b	630.34 ^b	722.29 ^b	612.00 ^b	631.6 ^a	909.4 ^a	25.26
Dressing percentage (%)	59.0	61.0	61.2	62.8	60	61.5	62.5	9.03
Small intestine (cm)	255.5 ^{ab}	233.50 ^b	266.50 ^{ab}	266.0 ^{ab}	242.0 ^b	241.5 ^b	296.5 ^a	14.116
Large intestine (cm)	146.0 ^a	146.0 ^a	142.50 ^a	159.50 ^a	137.50 ^a	152.0 ^a	150.50 ^b	7.533
% of Empty Carcass wt								
Heart	0.36	0.32	0.24	0.35	0.57	0.32	0.28	0.17
Lungs	1.46	1.13	0.87	2.08	1.80	0.87	1.55	1.28
Kidney	0.61	1.61	0.79	1.38	1.63	1.19	1.13	0.66
Liver	6.65	5.96	4.28	4.85	6.54	5.07	5.29	3.09
Head	21.51	19.66	15.9	17.65	17.08	13.77	13.46	2.9
Leg	7.47	7.25	6.66	6.23	5.88	6.25	4.79	2.8
Thigh	40.55	36.25	26.1 ^a	29.08	34.31	24.78	31.72	9.6
Shoulder	40.46	35.85	21.5 ^a	27.42	34.23	22.32	29.39	8.6
Loin	28.16	23.36	14.6 ^a	17.65	21.24	13.38	20.51	6.8

a, b, c, d means in the same row with different super scripts differ significantly (P<0.05).

profit maximization.

No mortality was observed in the course of the experiment. This could be an indication that either the antinutritional substances in the raw *parkia* seeds were not lethal or the concentration was not high enough to kill the rabbits. Prolonged inclusion of raw unprocessed soyabeans in monogastric animals can cause acute toxicity and sometimes death (Pusztai *et al.*, 1983). The animals were only fed the experimental diet for

56 days. Further studies may be required to determine the effect of prolonged feeding of diet containing raw *parkia* seeds on the pathological condition of the animals.

Carcass Characteristics

The result of the carcass characteristics is presented in Table 6. The carcass weights of the rabbits were significantly ($P<0.05$) influenced by duration of cooking. The raw *Parkia* seeds gave the least carcass weight of 548.7g and the highest

carcass weight was obtained from the animals fed whole *Parkia* seeds cooked for 60 minutes. Rabbits fed raw *Parkia* seeds had a lower dressing percentage ($P < 0.05$) compared to those on the other dietary treatments. The dressing percentages of the whole or crushed *Parkia* seeds diets for the different duration of cooking were non-significant ($P > 0.05$).

The weight of various organs expressed as percentages of empty carcass weight do not show any significant ($P > 0.05$) effect due to dietary treatments.

Conclusion

It was concluded that cooking raw African locust bean seeds either whole or crushed at 100°C for 60 minutes is considered optimal for young rabbits. There may be no significant ($P > 0.05$) advantage of crushing before cooking.

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