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Effect of Feeding Raw and Differently Processed Kapok (*Ceiba pentandra*) Seed Meal on the Growth Performance and Carcass characteristics of Weaner Rabbits

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***Target Audience:** Animal nutritionist, Rabbit farmers, Feed Miller, Researchers.*

Abstract

The study was conducted to determine the effect of feeding raw and differently processed kapok seed meal on the growth performance, carcass characteristics, internal organ weights and blood profile of weaner rabbits. Forty eight weaner rabbits were randomly assigned to six dietary treatments containing 0% kapok seed meal (T1), 10% RKSM (T2), 10% CKSM (T3), 10% TKSM (T4), 10% FKSM (T5) and 10% SKSM (T6) in a completely randomized design. Each treatment group had 8 rabbits replicated four times with 2 rabbits per replicate. The proximate composition of raw and differently processed kapok seed meal showed that crude protein contents ranged between 22.59±0.04 - 34.82±0.11%, while the crude fibre values varied between 9.28±0.89 - 17.45±0.06%. Cooked and fermented kapok seed meal had significantly (P <0.05) higher metabolisable energy content than raw and other processed kapok seed meals. Cooked kapok seed meal had lower values in all anti-nutritional factors, with trypsin inhibitor completely deactivated by cooking, fermenting and toasting. The result of the growth performance showed that final body weight and total feed intake of rabbits in control diet and CKSM were significantly (P<0.05) higher than that of rabbits in RKSM, FKSM, TKSM and SKSM groups. Rabbits on RKSM had the lowest final body weight gain, total feed intake, daily weight gain, average daily feed intake and poor feed conversion ratio (FCR) values compared to the processed kapok seed meal group. FCR ranged from 3.92±0.92 in CKSM to 4.70±0.31 in RKSM diets. Rabbits fed CKSM showed significantly (P<0.05) better FCR. Differences (P<0.05) were found in carcass, dressed, liver, liver, lungs, kidney weights. It was concluded that rabbits fed diets containing cooked kapok seed meal had the best growth performance and carcass characteristics. It could be suggested that cooking was the most efficient processing method in reducing anti-nutritional factors in kapok seed.

Keywords: Kapok seed, Processing Methods, Anti-nutritional factor, Growth performance, Rabbits

Description of Problem

Majority of the developing countries are facing rapid growth in human population with resultant increase in demand for animal protein which is in short supply (1). The increase in prices of feedstuffs especially protein and energy sources and its scarcity are important constraints affecting livestock production sector in developing countries such as Nigeria. It is therefore necessary to search for alternative sources that are cheap and readily available. The use of non-conventional feedstuffs in livestock diets is generally recommended (2, 3, 4, and 5). A non – conventional feedstuff that is examined in this study is the kapok seed. Kapok is a tropical tree of the order *Malvales* and the family M*alvaceae* (6, 7). The raw kapok seed has been reported to contain on a dry matter basis 20-35% crude protein, 20-26% crude fibre, 5-9% ether extracts, 5-7% total ash and 29 -31% nitrogen free extracts (8, 9). It also contains appreciable amount of minerals such as calcium, potassium and sodium (10). However, according to several researchers (11, 12, 13, 14 and 15), the seeds contain anti-nutritional factors such as tannin, trypsin inhibitors, cyanogenic glycosides, haemagglutinin inhibitors, phytates and oxalates which has remain the impeding factor affecting its utilization.

In a study conducted by (11) on the partial replacement (3-9%) of sunflower meal with raw kapok seed meal in growing and finishing broiler diets, the result shows no significant (P>0.05) difference on feed intake, growth rate and feed efficiency. However, in an inclusion level higher than 10% raw kapok seed meal depressed growth rate by 35% (11). Inclusion of raw kapok seed meal in the diets of laying hen and quails had deleterious effects on egg quality (16, 17). (18) also reported reduction in feed intake, poor feed conversion ratio and adverse effects on internal organs weight of weaner rabbits when they fed raw kapok seed meal beyond 10% inclusion. The need of processing kapok seed before its incorporation into livestock diets is therefore indispensable. Various processing methods, such as soaking, toasting, boiling, cooking, and fermenting have been reported to reduce the level of anti-nutritional factors in non-conventional feedstuffs (19, 20, 21). This study was conducted to evaluate the effect of different processed kapok seed meal on the growth performance, carcass and internal organ weights, haematological and biochemical indices of weaner rabbits

Materials and Methods

Study site

The study was conducted at the Rabbit Unit Teaching and Research Farm of the Department of Animal Science and Range Management, Modibbo Adama University of Technology Yola.Yola is located between latitudes 7^{o} and 11^{o}N and longitudes 11^{o} and 14^{o}E.Maximum temperature in the state can reach up to 40^{o}C particularly in April, while minimum temperature can be as low as 18^{o}C between December and January (22)

Processing of kapok seed.

Kapok seeds were obtained from a local market in Shelleng, Adamawa State Nigeria. The seeds were screened from stones and dirts, then processed using four different processing methods (cooking, toasting, soaking and fermenting) as previously described by (23). During toasting; the seeds were toasted in a metallic frying pan for 30 minutes with constant stirring to maintain uniform heating until the whitish endosperm turns to light brown. Soaking was achieved by placing the seeds in a container filled with tap water for 48hours, thereafter removed and sun dried. Fermentation was achieved by cooking the seeds in tap water for 30 minutes, decant and placed in an air tight container for 48hours to allow natural fermentation. Cooking was achieved by introducing kapok seeds into a metallic cooking pot at the point of boiling. The seeds were cooked for 30 minutes at 100^{0}C thereafter it was decanted and sundried on a concrete floor for seven days.

Experimental animals and management

Forty eight 5-weeks old weaned rabbits with an initial average weight of 523.00±1.20g were allotted into six dietary treatments. Each dietary treatment group had eight rabbits (four replicates with two rabbits per replicate). Each replicate was housed in a standard cage of 150cm x100cm x120cm in a three tier hutch system raised 120cm above the floor. Aluminum sheets and wire mesh were fitted for collection of faecal droppings. Rabbits were provided with feed and water *ad libitum* throughout the period of the experiment.

Experimental diets

Six experimental diets were formulated containing 0% kapok seed meal, 10% raw kapok seed meal (RKSM), 10% cooked kapok seed meal (CKSM), 10% toasted kapok seed meal (TKSM), 10% fermented (FKSM) and 10% soaked kapok seed meal (SKSM) representing T1,T2, T3, T4, T5 and T6 groups as shown in Table 1

Data collection

Growth performance

Data on growth performance were collected according to the method described by (24). At the beginning of the experiment, the rabbits were weighed to obtain their initial body weight and then weighed on a weekly basis to determine the weight gain. Feed intake was estimated by providing a known quantity of feed to each experimental group twice daily between 8am in the morning and 4pm in the afternoon. The left over feeds were collected the following day and weighed. The leftover of feed was then subtracted from the weight of the initial quantity of feed offered; the difference recorded and divided by number of rabbits per replicate as feed intake while feed conversion ratio was calculated as the feed intake per unit rate of weight gain.

Carcass and internal organ evaluation

On 56thday, 4 rabbits were randomly selected from each treatment (one per replicate) and were fasted overnight to reduce the gut contents (18). Before they were slaughtered, rabbits were weighed to obtain their live body weights. Pelts of the slaughtered rabbits were removed with sharp knife and internal organs were also weighed and expressed as percentage live weights.

Chemical analysis

Experimental diets, raw and processed kapok seed meals were analyzed for proximate composition using the methods described by (25). Metabolizable energy was calculated using the formula described by (26). Nitrogen free extracts was determined by the differences of the sum of all the proximate composition from 100%. Total oxalate was determined according to (27) procedure. Phytate was determined using the method described by (28). Saponin was determined using the method of (29) as modified by (30), while tannin was determined using the method of (31).

Statistical analysis

Data were subjected to One-way Analysis of Variance (ANOVA) procedures of (32). Means were separated by Duncan post-hoc test of the same software.

Table 1: Ingredients and Percentage Composition of Experimental Diets

	Dietary treatments					
Ingredients	T1(Control)	T2 (RKSM)	T3 (CKSM)	T4 (FKSM)	T5(TKSM)	T6 (SKSM)
Maize	54.0	54.0	54.0	54.0	54.0	54.0
Kapok seed meal	0.00	10.0	10.0	10.0	10.0	10.0
Wheat offal	15.0	10.0	10.0	10.0	10.0	10.0
Groundnut cake	19.7	16.5	16.5	16.5	16.5	16.5
Fish meal	2.00	1.00	1.00	1.00	1.00	1.00
Groundnut haulms	6.00	5.20	5.20	5.20	5.20	5.20
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25	0.25
Determined analysis %						
Dry matter	90.36	90.48	90.13	90.25	90.29	90.43
Crude protein	17.24	17.13	17.15	17.15	17.12	17.16
Crude fibre	10.08	10.03	10.07	10.03	10.09	10.03
Ether extracts	4.21	4.19	4.14	4.14	4.12	4.10
Ash	7.75	7.14	7.53	7.55	7.13	7.19
NFE	51.08	51.99	51.24	51.38	51.83	51.95
**ME kcal/kg	2792.2	2818.8	2788.9	2793.9	2807.1	2811.2

*Vitamin-mineral premix provider per kg the following: Vit. A 1500 IU; Vit.D_3 3000 IU; Vit.E 30 IU; Vit. K 2.5mg; Thiamine B_1 3mg; Riboflavin B_2 6mg; Pyrodoxine B_6 4mg; Niacin 40 mg; Vit. B_{12} 0.02mg; Pantothenic acid 10mg;Folic acid 1mg; Biotin 0.08mg; Chloride 0.125mg; Mn 0.0956g; Antioxidant 0.125g; Fe 0.024g; Cu 0.006g; Se 0.24g; Co 0.24.
****Metabolizable Energy = ME (kcal/kg) = 37 x % CP + 81 x % EE + 35.5 x % NFE. Calculated according to the formula of (27)

Results and Discussion

Proximate composition and anti- nutritional factors in raw and processed kapok seed meals

Table 2 shows the proximate and anti-nutritional factors in raw and differently processed kapok seed meals. The dry matter (DM) content was not significantly influenced by the processing methods. Crude protein (CP) showed significant (P<0.05) differences across dietary treatments. Fermented kapok seed meal (FKSM) and cooked kapok seed meal (CKSM) had the highest CP. Soaked kapok seed meal (SKSM) and toasted kapok seed meal (TSKM) were significantly different (P<0.05) from raw kapok seed meal (RKSM). The values of crude fibre (CF) were significantly higher in RKSM and TKSM when compared to other processing methods. The result also showed that, as the content of ether extracts (EE) decreased among the processing methods, ash content increased. Nitrogen free extracts (NFE) and metabolizable energy (ME) were significantly influenced by the processing methods. The results of all the anti-nutritional factors (ANF) determined were higher in the RKSM than those of the processed kapok seed meal than those of the processed kapok seed meal. Among the processing methods employed; cooking and fermentation recorded higher reduction in the concentration of anti-nutritional factors.

The higher CP content recorded in CKSM and FKSM could be attributed to heat applied during cooking and absences of leaching and vaporization of some nitrogenous compound during fermentation. These results are in agreement with (33 and 34) who in their separate studies reported increase in CP of raw kidney bean and soybean seed meals subjected to cooking and boiling. However this finding disagreed with (34) who obtained a decrease in amount of CP in differently processed baobab seed beans than in raw seed beans. The study also revealed that the CF content of FKSM, SKSM and CKSM were significantly reduced by the processing methods. The reason for this could be attributed to the destruction of cellulose content by the processing methods and consequently reduction in fibre content among the processing methods. The CF values observed were higher than the value of 5.4 - 7.5% reported by (34) for raw and differently processed soybean seed meal but within the range of 2.23 – 16.45% reported for tropical seeds (35 and 36). The result accords the finding of (37) who reported reduction in CP in sword beans when subjected to different processing methods. The significant decrease in EE and increase in ash contents among the processing methods could imply negative correlation between EE and ash contents. However, higher ash content observed in processed kapok seed meal is an indication that the processing methods employed increased the concentration of minerals in the meal as reported by (23). The values of metabolizable energy were lower when compare to some other alternative protein sources such as *Canavalia spp*. (4.48 kcal/g), velvet bean (4.49 kcal/g), castor oil seed (5.93 kcal/g), linseed cake (5.2 kcal/g) and lima beans (4.12 kcal/g) (38, 39).

Table 2: Proximate composition of raw and processed kapok seed meals

	Processing methods					
Parameters(%DM)	RKSM	FKSM	CKSM	TKSM	SKSM	SEM
Dry matter		91.43±0.56	90.76±0.13	90.81±0.04	83.77±0.67	0.82^{ns}
Crude protein	22.59±0.04^{c}	32.90±0.78^{a}	34.82±0.11^{a}	29.26±0.06^{b}	28.40±0.12^{b}	0.04*
Crude fibre	17.45±0.06^{a}	9.28±0.89^{d}	10.140.03±^{c}	18.33±0.33^{a}	12.37±0.54^{b}	0.13*
Ether extracts	10.05±0.06^{a}	7.76±0.12^{c}	6.56±0.23^{d}	9.56±0.03^{b}	7.65±0.06^{c}	0.06*
Ash	6.53±0.09^{b}	7.53±0.01^{a}	7.78±0.17^{a}	7.12±0.45^{a}	7.50±0.03^{a}	0.07*
NFE	43.38±0.67^{b}	40.53±1.09^{c}	40.70±0.91^{c}	35.73±0.34^{d}	44.08±1.34^{a}	0.40*
*ME kcal/g	3180.00±0.17^{b}	3240.00±0.44^{a}	3260.00±0.38^{a}	3120.00±0.46^{c}	3230.00±0.33^{a}	0.03*
Anti-nutritive factors (mg/100g)						
Tannin	2.52±0.05^{a}	0.65±0.01^{c}	0.26±0.06^{d}	0.89±0.01^{b}	0.95±0.07^{b}	0.01*
Saponin	1.30±0.04^{a}	0.55±0.09^{d}	0.40±0.02^{e}	0.76±0.12^{b}	0.67±0.07^{c}	0.07*
Alkaloid	3.34±0.03^{a}	0.42±0.02^{c}	0.17±0.11^{d}	0.14±0.05^{e}	0.87±0.01^{b}	0.09*
Phytate	1.27±0.04^{a}	0.70±0.11^{c}	0.61±0.03^{d}	0.78±0.04^{c}	0.89±0.21^{b}	0.80*
Trypsin inhibitors	17.97±0.71^{a}	0.00^{c}	0.00^{c}	0.00^{c}	0.34±0.12^{b}	0.09*
Phenol	2.48±0.04^{a}	0.30±0.25^{c}	0.22±0.01^{d}	0.24±0.05^{d}	0.81±0.02^{b}	0.08*
Haemagglutin	1.69±0.52^{a}	0.14±0.02^{d}	0.12±0.02^{e}	0.27±0.14^{b}	0.20±0.05^{c}	0.04*
Oxalate	1.12±0.02^{a}	0.12±0.99^{c}	0.11±0.01^{c}	0.14±0.05^{c}	0.72±0.04^{b}	0.05*
Flavonoid	2.95±0.56^{a}	0.72±0.26^{c}	0.37±0.03^{e}	0.68±0.04^{d}	0.97±0.10^{b}	0.01*
Total gossypol	1.98±0.07^{a}	0.16±0.01^{e}	0.22±0.1^{d}	0.73±0.08^{c}	0.89±0.02^{b}	0.08*
Free gossypol	0.20±0.01^{a}	0.17±0.04^{b}	0.10±0.09^{c}	0.09±0.01^{d}	0.12±0.06^{c}	0.02*

Means within the same row with different subscripts differ significantly (p<0.05)*, ns= not significant (p>0.05), SEM= Standard error,

Growth performance of weaner rabbits fed differently processed kapok seed meals

The growth performance of weaner rabbits fed differently processed kapok seed meal is shown in Table 3. The rabbits fed the control diet (4281.80±0.20g/rabbit and cooked kapok seed meal (4105.00±0.50g/rabbit) had significantly (P<0.05) higher feed intake for the rabbits fed fermented (3777.20±2.60), toasted (3851.10±3.20), soaked (3594.40±2.80) and raw kapok seeds (2982.11±2.30g/rabbits). Final body weight and total body weight gains differ significantly (P<0.05) from one another. Rabbits fed control diet and CKSM had significantly (P<0.05) higher than those on fermented, toasted and soaked kapok diet which were similar but significantly higher than those on RKSM. Feed conversion ratio (FCR) ranged from 3.92±0.92 - 4.70±0.31. Rabbits fed CKSM had the best FCR (3.92). Rabbits fed control diet (1.49±0.02) and CKSM (1.48±0.01) recorded significantly higher protein efficiency ratio (PER) than those fed fermented, toasted and soaked kapok meal. However, the PER of rabbits on fed fermented (1.35±0.0), toasted (1.37±0.01) and soaked kapok (1.38±0.34) diets were similar and significantly (P<0.05) higher than those on RKSM (1.24±0.05). The low feed intake of the rabbits fed RKSM could be due to the presence of anti-nutritional factors, which lowered the palatability of rabbits fed RKSM. Studies have shown that presence of anti-nutritional factors such as tannins, saponins in the diets results in poor palatability and consequent decrease in feed intake due to its astringent properties (18 and 39). (40, 41) reported that phytate also reduces the bioavailability of divalent cations as a result of insoluble complexes formation which are not available to monogastric animals. This implies that rabbits fed RKSM had low efficiency in the absorption of dietary minerals, protein digestibility and digestive enzymes in the gastro-intestinal tract as a result of high concentration of phytate. Trypsin inhibitors and haemagglutinins have been reported in reducing protein digestibility resulting in poor utilization of available nutrients (18; 42). This result agreed accordance with that of (41) who reported significantly (P>0.05) lower total feed intake and impaired nutrient utilization when broiler chickens were fed raw *Cajanus cajan* seed meal. Better performance recorded in rabbits fed CKSM diet compared to other diets could be attributed to the processing method. Moist heating (cooking and boiling) has been reported to reduce the anti-nutritional factors, thereby improving the nutritional content of legume seeds (43).

The significantly higher protein efficiency ratios of rabbits fed control diet and CKSM showed that the protein content of these diets were more efficiently utilized by the rabbits when compared to those fed raw, fermented, toasted and cooked kapok diets. This accounts for their significantly higher final body weights and total weight gains.

Table 3. Growth Performance of weaned rabbits fed differently processed Kapok seed meal

	Processing methods						
Parameter	T1(Control)	T2(RKSM)	T3 (CKSM)	T4(FKSM)	T5 (TKSM)	T6 (SKSM)	SEM
Initial weight(g/rabbit)	522.73±4.89	522.69±4.93	522.75±4.23	522.76±4.90	520.39±4.11	522.71±4.55	5.75[ns]
Final weight (g/rabbit)	1584.20±7.00[a]	1161.00±2.80[d]	1568.90±0.77[a]	1428.90±0.30[b]	1428.10±0.50[b]	1376.20±0.70[c]	46.2[*]
TWG (g/rabbit)	1106.40±2.60[a]	638.31±1.48[c]	1046.75±4.38[a]	905.40±4.86[b]	904.30±0.24[b]	853.50±0.87[b]	47.7[*]
ADWG (g/rabbit)	18.95±0.76[a]	11.39±0.68[d]	18.69±2.04[a]	16.16±0.76[b]	16.40±2.51[b]	15.24±2.04[c]	0.85[*]
TFI (g/rabbits)	4281.80±0.20[a]	3000.11±2.30[c]	4105.00±0.50[a]	3777.20±2.60[b]	3851.10±3.20[b]	3594.40±2.80[b]	159[*]
ADFI (g/rabbit)	76.46±0.34[a]	53.57±1.63[b]	73.30±1.50[a]	67.45±2.90[b]	68.76±2.01[ab]	64.80±0.88[b]	2.85*
Protein intake (g/rabbit)	738.18±0.31[a]	513.91±0.04[c]	704.00±0.08[a]	670.45±1.45[b]	659.30±1.09[b]	616.79±0.23[b]	1.09[*]
Protein efficiency	1.49±0.02[a]	1.24±0.05[c]	1.48±0.03[a]	1.35±0.05[b]	1.37±0.01[b]	1.38±0.34[b]	0.67[*]
FCR	4.03±0.34[b]	4.70±0.31[a]	3.92±0.92[c]	4.17±0.56[b]	4.34±0.45[b]	4.36±0.12[b]	0.35[s]

Means within the same row with different subscripts differ significantly (p<0.05)*, ns= not significant (p>0.05), SEM= Standard error, TWG =Total weight gain, ADWG= Average daily weight gain, TFI= Total feed intake, ADFI=Average daily feed intake, FCR= Feed conversion ratio

Carcass characteristics and internal organ weights of weaner rabbits fed raw and differently processed kapok seed meals

The carcass characteristics and internal organ weights of weaner rabbits fed raw and processed kapok seed meals are presented in Table 4. The result showed significant differences across the dietary treatments. The dressing percentages ranged from 41.45±0.60 % in SKSM to 56.31±0.30% in CKSM and were significantly (P<0.01) affected by the dietary treatments. There were significant (P<0.01) differences in the organ weights among the treatment groups. Rabbits fed RKSM recorded relative highest lungs (3.14±0.13), liver (2.61±0.05) and kidney (4.01±0.52) weights. The results for large intestine length, small intestine weight and length were all significantly (P<0.01) different across the treatment groups. Rabbits fed RKSM recorded heaviest small and large intestine weights and longer intestinal lengths. The dressing percentage were similar to the range of 56.26- 58.35% reported by (44 and 48) but higher than 48.57 -54.83% reported by (49) for tropical rabbits. The significant (P<0.01) effects on the weight of the lung, liver and kidney agreed with the reports of (44, 50 and 51) who observed variation in internal organ weights of rabbits fed alternative source of protein in the tropics. Rabbits fed RKSM recorded relative higher lungs, liver, and kidney weights. This is an indication that there is element of toxic substance present in the diet. In feeding trials, liver or kidneys are used to study toxicity rates.

Higher weight would arise because of an increased in the metabolic rate of these organs in an attempt to convert toxic elements or anti-nutritional factors to non-toxic metabolites (52). The higher weights of liver and kidney in rabbit fed RKSM could be attributed to this increase in the metabolic rate. Higher weights and elongation of small intestine of rabbits fed RKSM could be as a result of impact of anti-nutritive factors, which inhibit proper digestion of the diet as such, resulted into accumulation of too much of the feed consumed in the small intestine and resulted into its elongation.

Table 4 Carcass characteristics and internal organ weights of weaned Rabbits fed differently processed Kapok seed meal.

	Processing methods						
Parameter	T1(Control)	T2(RKSM)	T3 (CKSM)	T4(FKSM)	T5 (TKSM)	T6 (SKSM)	SEM
Dressing %	$53.65^{a}\pm4.98$	41.45 ± 3.61^{c}	56.31 ± 2.71^{a}	51.17 ± 1.56^{b}	40.70 ± 1.89^{c}	43.70 ± 1.40^{c}	3.22^{**}
Pelt weight (g/rabbit)	96.70 ± 1.60^{a}	75.73 ± 0.11^{c}	94.48 ± 1.44^{a}	96.27 ± 1.67^{a}	89.73 ± 3.90^{a}	91.92 ± 2.78^{a}	5.35^{**}
Internal organs (% live weight)							
Heart	0.97 ± 0.09^{b}	1.52 ± 0.13^{a}	0.84 ± 0.10^{b}	0.89 ± 0.11^{b}	0.72 ± 0.10^{b}	1.00 ± 0.20^{a}	0.06^{**}
Liver	0.32 ± 0.04^{c}	2.61 ± 0.05^{a}	0.32 ± 0.05^{c}	$0.33\pm.04^{c}$	0.38 ± 0.05^{c}	0.51 ± 0.08^{b}	2.85^{**}
Lung	1.78 ± 0.09^{c}	3.14 ± 0.13^{a}	2.31 ± 1.20^{b}	2.08 ± 0.03^{b}	2.39 ± 0.91^{b}	2.76 ± 2.76^{b}	0.36^{**}
Kidney	2.11 ± 0.47^{c}	4.01 ± 0.52^{a}	1.09 ± 0.84^{d}	1.89 ± 0.35^{d}	1.77 ± 0.33^{d}	3.47 ± 0.23^{b}	0.36^{**}
Stomach	3.01 ± 0.16^{b}	3.68 ± 0.91^{a}	2.85 ± 0.40^{c}	3.02 ± 0.57^{b}	2.66 ± 0.16^{c}	2.94 ± 0.20^{c}	0.16^{**}
Small intestine	0.90 ± 0.17^{b}	1.85 ± 0.36^{a}	1.17 ± 0.20^{b}	0.93 ± 0.03^{b}	1.11 ± 0.12^{b}	1.58 ± 0.05^{a}	0.10^{**}
Large intestine	0.70 ± 0.07^{d}	1.25 ± 0.10^{a}	0.90 ± 0.09^{bc}	0.87 ± 0.07^{bc}	0.95 ± 0.08^{bc}	1.08 ± 0.18^{b}	0.05^{**}
Caecal	0.95 ± 0.11^{b}	1.45 ± 0.06^{a}	1.09 ± 0.19^{b}	0.83 ± 0.14^{c}	0.83 ± 0.03^{c}	1.05 ± 0.05^{b}	0.05^{**}
Small intestine Length (cm)	177.95 ± 8.49^{bc}	206.49 ± 6.90^{a}	185.77 ± 0.19^{b}	170.02 ± 3.90^{c}	176.11 ± 3.82^{bc}	186.28 ± 0.66^{b}	3.02^{**}
Large intestine Length (cm)	92.84 ± 3.89^{b}	102.92 ± 5.30^{a}	83.47 ± 0.37^{b}	86.92 ± 3.90^{b}	93.40 ± 2.89^{b}	90.80 ± 5.42^{b}	3.25^{**}
Caecal Length (cm)	36.48 ± 5.98^{b}	60.14 ± 4.34^{a}	34.31 ± 4.78^{b}	36.3 ± 2.34^{b}	37.42 ± 2.78^{b}	42.61 ± 2.56^{b}	3.23^{**}

Means within the same row with different subscripts differ significantly ($p<0.01$) **, ns= not significant ($p>0.05$), SEM= Standard error Mean

Haematological and biochemical values of weaner rabbits fed differently processed kapok seed meal

The haematological and biochemical indices of weaner rabbits fed differently processed kapok seed meal are presented in Table 5. Haemoglobin (Hb) varied significantly (P<0.01) among treatment groups. The values obtained in control diet, CKSM, FKSM, TKSM and SKSM are within the normal range of 9.4 -17.4 g/dl for rabbits reported by (53 and 54) except RKSM which recorded lower Hb value. The lower Hb observed in RKSM implies that the dietary proteins were not of high quality. (55) attributed low Hb in rabbits to effects of anti-nutrients in the treatment diets. The PCV values for the control diet (38.95±0.30%), CKSM (37.78±1.30%), FKSM (39.85±0.40%), TKSM (39.18±0.10%) and SKSM (33.00±0.80%) are within the normal range for rabbits (33.0-50.0%) while RKSM was lower than the normal range. Reduction in the concentration of PCV suggests presence of a toxic factor such as haemagglutinin, which had adverse effect on blood formation (56). The quantity of haemagglutinin in the raw kapok seed meal may perhaps have been responsible for the observation of the reduction in PCV. The PCV values obtained for various dietary treatments could be viewed as the efficiency of the various processing methods employed in reducing the anti-nutritional composition and the higher the value, the more efficiency the method. This finding agreed with the finding of (57) who reported reduction in the concentration of haemagglutinins when pigeon pea was subjected to different processing methods.

White blood cells (WBC) differed significantly (P<0.01) among processing methods. The values obtained were within the normal range of 5 - 8 x 10^3/mm^3 in rabbits except RKSM that recorded higher value of 8.31±0.31x 10^3/mm^3. High WBC count is usually associated with microbial infection or the presence of foreign body or antigen in the circulating system. The neutrophil values obtained were significantly different (P<0.01) the value of RKSM exceeded the normal range 35 -55.00% for rabbits (53 and 54). Conversely, the lymphocyte concentrations, except for rabbits fed RKSM were within normal range (25.00- 50%) reported by (53 and 54).

Blood urea though varied significantly (P<0.01) for all treatment groups, but is within the normal range (30.0 - 37.3mg/dl). Higher value was observed in rabbit fed RKSM diet. Studies have attributed high blood urea levels to poor protein quality or excess tissue catabolism associated with protein deficiency (58). Total protein (TP) showed significant differences (P<0.01) in all dietary treatments. However, the TP value of rabbits on RKSM diet was lower than the 5.5-8.0 normal range for rabbits, suggesting that the rabbits on RKSM diet survived at the expense of body reserves as a result of loss of weight. However, it is possible that the dietary protein was not fully utilized by the rabbits on RKSM diet probably because of accumulated anti-nutrients in the raw kapok seed, which did not facilitate total protein availability.

Table 5. Haematological and biochemical indices of weaned Rabbits fed differently processed Kapok seed meal.

	Processing methods						
Parameter	T1(control)	T2(RKSM)	T3(CKSM)	T4(FKSM)	T5(TKSM)	T6 (SKSM)	SEM
PCV (%)	38.95±0.3^{a}	30.58±0.8^{c}	37.78±1.3^{b}	39.85±0.4^{a}	39.18±0.1^{a}	33.00±0.8c	0.39**
Haemoglobin (g/dl)	9.94±0.63^{b}	8.79±0.42^{c}	9.99±0.61^{b}	11.86±1.0^{a}	9.72±0.78^{b}	9.25±0.34^{b}	0.34**
RBC (×10^6/mm^3)	7.82±0.44^{a}	5.82±0.16^{c}	6.63±0.35^{b}	7.22±0.15^{ab}	6.91±0.66^{b}	7.23±0.30^{ab}	0.19**
MCV(μm^3)	49.93±2.8^{c}	52.51±1.56^{c}	57.01±1.0^{a}	55.22±1.5^{b}	57.09±5.3^{a}	42.93±2.3^{d}	1.41**
MCH (Pq)	12.73±0.9^{c}	15.09±0.4^{b}	15.10±1.3^{b}	16.44±1.5^{b}	17.04±1.5^{a}	12.79±0.0^{c}	0.56**
MCHC (%)	25.53±1.7^{c}	28.76±1.2^{ab}	26.48±2.0^{bc}	29.75±2.3^{a}	29.91±2.1^{a}	29.86±1.5^{a}	0.94**
WBC (×10^6/mm^3)	6.11±0.32^{b}	8.31±0.34^{a}	6.05±0.11^{b}	6.20±0.14^{b}	6.39±0.28^{b}	6.84±0.13^{b}	0.11**
Lymphocyte %	36.17±9.2^{b}	42.97±0.3^{a}	41.30±0.6^{a}	36.33±.03^{b}	37.68±0.9^{b}	38.08±0.4^{b}	2.05**
Eosinophil %	2.15±0.2^{b}	3.39±0.33^{a}	1.52±0.15^{c}	2.41±0.10^{b}	1.64±0.09^{c}	3.30±0.28^{a}	0.10**
Neutrophils %	41.50±0.7^{c}	56.25±.08^{a}	40.60±0.6^{cd}	39.54±0.6^{d}	4.37±0.38^{c}	48.47±1.0^{b}	0.40**
Biochemical indices							
Cholesterol(mg/dl)	45.81±0.6^{a}	39.14±0.3^{a}	43.58±1.1^{b}	45.41±1.5^{a}	43.60±0.4^{b}	40.64±0.7^{c}	0.46**
Total protein (g/dl)	6.28±0.20^{b}	5.33±0.32^{c}	6.40±0.25^{ab}	6.62±0.20^{ab}	6.79±0.19^{a}	6.58±0.43^{b}	0.14**
Albumin (g/dl)	3.45±0.25^{ab}	2.45±0.14^{c}	3.17±0.12^{b}	3.66±0.40^{a}	3.349±0.2^{ab}	3.46±0.3^{ab}	1.14**
Globulin (g/dl)	3.58±0.20^{a}	2.69±0.13^{b}	3.66±0.20^{a}	3.63±0.23^{a}	3.63±0.8^{a}	3.57±0.38^{a}	0.11**
Urea (mg/dl)	30.44±0.6^{c}	39.36±0.3^{a}	31.36±1.1^{c}	30.60±0.4^{c}	3.52±0.80^{c}	35.28±0.7^{b}	0.36**
Glucose (mg/dl)	83.11±1.0^{b}	79.24±0.2^{c}	85.25±0.4^{a}	83.94±0.6^{ab}	82.67±2.0^{b}	71.19±1.0^{d}	0.55**

Means on the same row with Means on the same row with different subscripts are significantly different (p<0.01)*, SEM= Standard error, PCV= Packed cell volume RBC=Red blood cell, MCH= Mean corpuscular haemoglobin WBC= While blood cell MCHC= Mean corpuscular haemoglobin concentration.

Conclusion and Application

1. Among the processing methods employed, cooking gave the better method in reducing anti- nutrient composition of kapok seed meal.
2. CKSM at 10% did not adversely affect the growth performance, carcass and internal organ weight, haematological and biochemical indices
3. Cooking as a method of reducing the Anti- nutritive factors in RKSM can be adopted even at rural level

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