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Effect of dietary levels of cooked kapok (*Ceiba pentandra*) seed meal on growth performance and carcass characteristics of weaner rabbits

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Target Audience*:* Animal nutritionist, feed millers, Rabbit farmers and Researchers

Abstract

A 56-day feeding trial was conducted to investigate the effect of feeding varying levels of cooked kapok seed meal (CKSM) on the performance and carcass characteristics of weaner rabbits. Forty 5-week old rabbits with average weight 514.10±0.78g were randomly divided into five groups of 8 rabbits per treatment in a completely randomized design. Each group was randomly assigned to one of the diets containing 0, 25, 50, 75 and 100% CKSM. On the 56th day of the experiment, four rabbits from each treatment group were randomly selected for carcass and internal organs evaluation. Results of growth performance revealed no significant differences (P>0.05) across the treatment groups for all the parameters evaluated. Feed cost/kg decreased as the levels of CKSM increased in the diet. Rabbits fed 0%CKSM had the highest (P<0.05) feed cost (₦123.35/kg), while rabbit fed 100% CKSM had the least (₦98.35/kg). Result of carcass, internal organs characteristics and blood profile did not show any significant differences (P>0.05). Digestibility of all the nutrients was not affected (P> 0.05) by the dietary levels of CKSM. It was concluded that CKSM could replace soybean meal up to 100% in weaner rabbit diet without any adverse effect on performance, carcass characteristics and internal organ weights.

Key words: cooked kapok seed meal, performance, carcass, organ weights, rabbits

Description of Problem

One of the fastest ways of ameliorating animal protein shortage in the developing countries is the production of fast maturing animals like rabbit. It has immense potentials over other livestock species but high cost of feed is one of the major challenges facing the subsector. Efforts towards reducing the cost of feed should include harnessing the potentials of relatively cheaper, non-conventional materials, which do not have direct competition between human beings and animals (1). Kapok (*Ceiba pentandra*) seed is one of the numerous non -conventional feedstuffs that can be used in rabbit diet. It is a tropical tree of the order *Malvales* and the family *Malvaceae* (2). The raw 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 (3). Kapok seed meal has been found useful in feeding poultry and rabbits (3, 4) but its use in the feeding of monogastric animals is limited by the anti-nutritional factors. An earlier study conducted showed reduction in feed intake, poor feed

conversion ratio and adverse effects on internal organ weights of weaner rabbits fed raw kapok seed meal hence there is the need for processing (4). Moist heating (boiling or cooking) have been reported to be effective in reducing anti-nutrients in non- conventional feedstuffs (5). This study was therefore conducted to evaluate the potential of using cooked kapok seed meal and its effects on the growth performance and carcass characteristics of weaner rabbits.

Materials and Methods

Location of the study area

The study was conducted at the Rabbit Research Farm of the Department of Animal Science and Range Management, Modibbo Adama University of Technology, Yola Adamawa State. The town lies between latitude 7^{o} and 11^{o} N and longitude 11^{o} and 14^{o}E. Temperature in this climatic region is high in February, March and April because of high radiation, which is evenly distributed throughout the year. 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. Mean monthly temperature range from 26.7^{o}C in the South to 27.8^{o}C in the North Eastern part of the State (6).

Source and processing of kapok seed meal

Kapok seeds were procured within Shelleng town and its surrounding villages in Adamawa State. The seeds were cleaned and subjected to cooking using previous work (7). The seeds were placed in a jute bag and introduced into a metallic pot and allowed to cook for 30 minutes with no water remain in the pot. This is to control leaching and possibility of hydrolysis of some nitrate. The seeds were then sundried on a concrete floor for seven days.

Experimental diets, animal management and design

Forty (40) weaner rabbits with an initial average weight of 514.10±0.78g were sourced within the study area and assigned to five dietary treatments. Each treatment was replicated four times with two rabbits per replicate in a completely randomized design trial. They were housed in a cages (150cm x100cm x120cm) fitted with aluminum feeders and drinkers to prevent spillage and feed wastage. The animals were treated against internal and external parasites using Endovef® at the dose of 0.3 mg/kg subcutaneously and also treated prophylactally against coccidiosis with Amprole 200® according to the manufacturer's prescription. Five experimental diets were formulated during the eight weeks of study in which diet 1 contains 0% coiled kapok seed meal (CKSM) while diets 2, 3, 4 and 5 contained 25%, 50%, 75% and 100% cooked kapok seed meal, respectively as shown in Table1.

Table 1. Percentage Composition of Experimental Diets

	Inclusion levels of cooked kapok seed meals				
Ingredients	D1 (0%)	D2 (25%)	D3 (50%)	D4 (75%)	D5 (100%)
Maize	49.00	49.00	49.00	49.00	49.00
Cooked kapok seed meal	0.00	6.25	12.50	18.75	25.00
Maize offal	13.00	13.00	13.00	13.00	13.00
Soybean meal	25.00	18.75	12.50	6.25	0.00
Fishmeal	2.00	2.00	2.00	2.00	2.00
Groundnut haulms	7.00	7.00	7.00	7.00	7.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50	0.50
*Premix	0.50	0.50	0.50	0.50	0.50
Total	100	100	100	100	100
Determined analysis					
Dry matter	90.67	90.30	91.29	90.67	91.15
Crude protein	17.57	17.54	17.58	17.50	17.56
Ether extracts	5.04	5.03	5.61	5.09	5.08
Crude fibre	9.36	9.06	9.45	9.32	9.30
Ash	7.33	7.62	7.91	7.67	7.49
Nitrogen free extracts	51.37	51.05	50.74	51.09	51.72
ME Kcal/kg	2881.96	2868.68	2906.14	2873.48	2897.26
Feed cost/kg	123.35	117.10	110.85	104.60	98.35

*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 3mg; Riboflavin 6mg; Pyrodoxine 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.

Data collection

Growth performance

The initial weights of the experimental animals after one week of acclimatization were recorded. Body weights were taken weekly while feed intake was recorded daily for a period of eight weeks. Feed intake was estimated by providing a known quantity of feed to each experimental group twice daily between 8.00hrs in the morning and 16.00hrs in the afternoon. The left over feeds were collected the next day and weighed. The leftover of feed was then subtracted from the weight of the initial quantity of feed offered; the difference recorded and subsequently divided by number of rabbits per replicate to give the average daily feed intake. Feed conversion ratio (FCR) was calculated as the ratio of feed intake to weight gain.

Carcass and internal organs measurement

At the end of 56 days, four rabbits were randomly selected from each treatment and fasted for 24.00hrs to reduce the gut content and contamination of the carcass. Thereafter the rabbits were weighed, slaughtered, de-pelted and eviscerated to obtain the carcass weight. The pelt and internal organs were weighed separately using electronic sensitive scale (G and G group INC USA). The dressing

percentages were determined (8).

Blood sample collection and analysis.

Blood samples were collected from four rabbits per treatment on the 56th day of the experiment for determination of haematological and biochemical components as described in (9). The jugular vein was punctured to collect 5mls of blood into sterile universal bottle containing 1.0mg/ml ethyl diaminetetracetic acid (EDTA) as anticoagulant and was to determine the haematological component according to the method described cited in (9, 10). Another 5mls was also collected into a labelled sterile sample bottles without coagulant to determine the biochemical components using the methods cited in (9.10).

Digestibility study

Four rabbits per treatment (one from each replicate) were randomly selected and transferred to metabolic cages. Two days adaptation period was observed and the feacal sample were collected for a period five days. The faeces were collected using metallic sheet suspended under each metabolic cage and sun dried. 10% representative of the faecal samples were analyzed for proximate composition.

Nutrient digestibility was calculated using the formula below:

$$\text{Nutrient digestibility} = \frac{Nutrient\ intake - Nutrient\ in\ faecal}{Nutrient\ intake} \times 100$$

Chemical analysis

The proximate composition of the raw and cooked kapok seed meals, experimental diets, anti-nutritional factors (ANFs) and faecal samples were determined using the standard procedure of analysis (11).

Statistical analysis

Data collected were subjected to one–way analysis of variance (ANOVA) using the completely randomized design (12). Means were separated using Duncan's Multiple Range Test (13).

Results and Discussion

Proximate composition of raw and cooked kapok seed meal

The results of proximate composition of raw and cooked kapok seed meal are presented in Table 2. Dry matter (DM) content of the raw kapok seed meal (RKSM) was 89.51% and significantly ($P<0.05$) increased to 90.76% after cooking. Significant higher ($P<0.05$) crude protein (CP) content of 34.82% was observed in the cooked kapok seed meal (CKSM) and lower in RKSM (22.59%). Crude fibre (CF) content significantly decreased from 17.45% in RKSM to 10.14% in CKSM, while ether extract (EE) was significantly higher in CKSM (10.05%) when compared to 6.65 % in RKSM. Nitrogen free extract was highest 32.89% in RKSM and reduced significantly ($P<0.05$) to 31.46% when the seed was subjected to cooking. The metabolisable energy values for RKSM and CKSM were 2658.65and 3050.95 Kcal/kg respectively. All the values for anti- nutritive factors determined which included phytate, trypsin inhibitors, phenol, haemagglutin, oxalate, flavonoid, saponin and tannin in the raw kapok seed meal were significantly ($P<0.05$) higher

The higher crude protein (CP) level of the CKSM observed implied absence of leaching of some nitrogenous compound during the period of cooking. The study agreed with the findings that sorrel seed when subjected to cooking gave a slight increase in the crude protein level in the seed meal (14). Absence of leaching during the period of cooking could be as a result of cooking the seed in a jute bag which resulted to non hydrolysis of some. The study however showed lower CF after cooking. This could be attributed to the destruction of cellulose content by the processing methods and consequently reduction in fibre content.

However, ash content observed in CKSM is an indication that the processing method employed did not affect the concentration of minerals in the meal. The presence of ANFs determined confirmed earlier report that raw kapok seed contain such anti-nutritional factors (3, 4, 15). Generally, there was reduction in the values of ANFs in phytate, trypsin inhibitors, phenol, haemagglutin, oxalate, flavonoid, saponin and tannin when the seed was subjected to cooking. This suggests the ability of cooking as an effective method of reducing ANFs in kapok seed meals.

Table 2 Proximate Composition Raw and Cooked Kapok Seed Meals

Composition	RKSM	CKSM	MEAN	SED
Dry matter	89.51	90.76	90.14	1.20*
Crude protein	22.59	34.82	28.71	0.32*
Crude fibre	17.45	10.14	13.80	1.15*
Ether extract	6.56	10.05	8.31	0.25*
Ash	6.53	7.78	7.15	1.89*
NFE	36.38	26.72	31.55	0.56*
ME kcal/kg	2658.68	3050.95	2854.82	2.76*
Anti- nutritive factors (mg/100g)				
Tannin	2.52	0.95	1.74	0.45*
Saponin	1.30	0.67	0.98	1.89*
Alkaloid	3.34	0.87	2.11	1.90*
Phytate	1.27	0.89	1.08	0.17*
Trypsin inhibitors	17.97	0.00	8.98	0.98*
Phenol	2.48	0.81	1.64	0.05*
Haemagglutin	1.69	0.20	0.95	0.21*
Oxalate	1.12	0.72	0.92	0.45*
Flavonoid	2.95	0.97	1.96	1.78*

Means in the same row bearing different superscripts differ significantly (P<0.05),
RKSM = Raw kapok seed meal
CKSM = Cooked kapok seed meal
SED = Standard error differences

The growth performance parameters of weaner rabbits fed graded levels of CKSM

The growth performance parameters of weaner rabbits fed graded levels of CKSM are presented in Table 3. The results showed similarity (P>0.05) across the dietary treatments for all the parameters evaluated. Final body weights (FBW) were within the range of 1444.15±0.02 to 1478.45±1.08g for rabbits on 75 and 0% CKSM based. Total feed intake (TFI) ranged between 3101.93±0.45g to 3114.49±0.06g. Average daily feed intake (ADFI) ranged from 55.39±0.05g in 75% CKSM to 55.61g in 100% CKSM while average daily weight gain (ADWG) was between 16.61±0.03g in 75% CKSM to 17.18±0.34g in 0% CKSM. Feed conversion ratio (FCR) was not influenced by varying levels of CKSM. Feed cost decreased as the levels of CKSM increases in the diet. Rabbits fed 0%CKSM had the highest (P<0.05) feed cost (₦123.35/kg), while rabbit fed 100%

CKSM had the least (₦98.35/kg). The value of feed cost saving increased as the level of CKSM increased in the diets.

It was observed that inclusion of varying levels of cooked kapok seed meal (CKSM) had no significant effect on growth performance of weaner rabbits. This result agreed with the findings that weaner rabbits fed with cooked *mucuna* seed meal did not exhibit differences in growth performance (16). The average daily feed intake of rabbits recorded were lower than 64.19 to 75.86 g/day (17) but higher than 23.78g to 24.04g and 47.4g to 50.1 g/day–(18;19) However, the values obtained are within the range of 55.07 - 56.50 g/day documented in literature for rabbit fed tropical seed meal(20 and 21) The average daily weight gain recorded are within the range of 16.19 to 20.11 g/day reported by (16,17,18,19) who fed weaner rabbits with pigeon pea seed meal, jack bean, mucuna seed meal and African locust bean, respectively. The non-significant differences in growth performance observed in this study could be attributed to effective reduction of anti- nutritional factors in kapok seed meals as a result of cooking, which however could not cause variation in growth of weaner rabbits. The findings however suggested that the diets contained adequate nutrients that could meet the requirement of the rabbits. Feed cost/kg decreased as the levels of inclusion of CKSM increased. Several studies have shown that increase in the levels of pigeon pea, Africa locust bean and lablab seed in rabbit diets led to reduction in feed cost/kg (17, 22, 23). Rabbits on 0% CKSM had the highest ($P<0.05$) feed cost (₦123.35/kg), while rabbit on 100% CKSM had the least (₦98.35/kg). Similar findings were reported in separate studies when cooked pigeon pea and lablab seed meals were fed to weaner rabbits respectively (17, 23). The result showed that 100% CKSM was more economical for feeding rabbits than using soybean meal. This is because kapok seed are cheaper than soyabean (₦100/kg kapok and ₦200/kg soybean). The value of feed cost saving was higher in rabbits fed 100% CKSM indicating much money could be saved when 100 % CKSM is included in weaner rabbit.

Table 3: Growth Performance of Weaner Rabbits Fed Cooked Kapok Seed Meal

	Inclusion levels of cooked kapok seed meals					
Parameters	D1 (0%)	D2 (25%)	D3 (50%)	D4 (75%)	D5 (100%)	SEM
Initial body wt. (g/rabbit)	516.25±0.34	513.56±0.34	513.83±0.50	513.97±0.21	512.89±0.89	1.33^{ns}
Final body wt. (g/rabbit)	1478.45±1.80	1477.58±1.56	1452.81±0.08	1444.15±0.02	1448.05±0.45	17.54^{ns}
TBWG(g/rabbit)	962.19±0.02	963.99±0.10	938.97±0.34	930.18±1.23	935.15±0.34	16.96^{ns}
ADWG (g/rabbit)	17.18±0.34	17.21±0.35	16.76±0.56	16.61±0.03	16.69±0.04	5.08^{ns}
Total feed intake (g/rabbit)	3114.05±0.02	3104.19±1.06	3108.15±0.04	3101.93±0.45	3114.49±0.06	31.08^{ns}
ADFI (g/rabbit)	55.60±0.56	55.42±0.57	55.50±0.58	55.39±0.05	55.61±0.59	0.09^{ns}
Feed conversion ratio	3.23±0.45	3.22±0.05	3.31±0.05	3.33±0.05	3.33±0.03	0.04^{ns}
Feed cost/kg (₦/Kg)	123.35±0.05^{a}	117.10±0.02^{b}	110.85±1.89^{b}	104.60±0.23^{b}	98.35±0.39^{c}	0.09*
Cost of total feed intake (₦/Kg)	383.65±0.56^{a}	363.01±0.89^{b}	314.64±0.02^{c}	324.26±0.67^{d}	305±0.45^{e}	3.19*
Feed cost (₦/Kg gain)	399.60±1.90^{a}	378.14±0.57^{a}	369.50±0.58^{b}	348.66±0.68^{b}	325.39±0.49^{c}	3.37*
Cost saving	0	21.46±0.89^{b}	8.64±1.85^{d}	20.83±0.68^{c}	23.27±1.06^{a}	3.67*

Means in the same row bearing different superscripts differ significantly ($P<0.05$),
NS= not significant ($P>0.05$), SEM = Standard error mean
TBWG = Total body weight gain
ADWG = Average daily weight gain
ADFI = Average daily feed intake
FCR =Feed conversion ratio.

Carcass characteristics and internal organ weight of weaner rabbits fed CKSM

The effect of cooked kapok seed meal on carcass characteristics and internal organ weights of weaner rabbits is shown in Table 4. The result revealed that there was no significant variations (P<0.05) in all the parameters evaluated. Dressed weight was numerically higher in rabbits fed 25% CKSM (58.06±0.81%) while the lowest value was observed in rabbit fed (53.32±0.02%). The kidney value ranges from 1.62±0.04% in 50% CKSM to 1.81±0.03% in 25% CKSM base diets. The liver and lungs were within the ranges of 1.32±0.01 – 1.41±0.01 and1.63±0.56 – 1.75±0.20 respectively. Similarly the results also indicated that small intestine and large intestine lengths had the values ranging from 122.45±0.46cm in 0 and 50%CKSM base diet to 128.70±0.56% in 75% CKSM and 82.98±1.45cm in 100 % CKSM to 85.75±0.06cm 50% CKSM. Similar report has shown no significant response of carcass characteristics when boiled pigeon seed meal was fed to rabbit rabbits (24). The dressing percentage and dressed weight of rabbit are very important parameters in assessing quality of rabbit meat. Since carcass yield is an indicator of better utilization of ratio (25), it therefore implies a better utilization of the diet by the weaner. The internal organs measurements were also similar across dietary treatments indicating the effectiveness of cooking in reducing the anti-nutritive factors in kapok seed meal. It has been reported that, if there is any major effect of anti- nutritive factors, organs such as kidney, liver would be affected since they are the major detoxification organs (26, 27).

Table 4: Carcass characteristics and internal organs weights of weaner rabbits fed cooked kapok seed meal

	Inclusion levels of cooked kapok seed meals					
Parameters	D1 (0%)	D2 (25%)	D3 (50%)	D4 (75%)	D5 (100%)	SEM
Live weight (g)	1430.22±1.56	1429.35±0.02	1404.58±0.67	1395.92±0.45	1399.89±0.78	16.90 ^{ns}
Slaughter wt. (g)	1330.34±0.89	1329.80±0.08	1308.68±0.56	1295.98±0.01	1299.96±1.00	13.12 ^{ns}
Dressed weight (g)	764.26±0.10	830.61±1.04	751.25±0.04	830.61±0.67	746.10±0.05	7.84 ^{ns}
Dressing %	53.47±0.89	58.06±0.81	53.49±0.03	54.72±0.56	53.32±0.02	1.96 ^{ns}
Pelt weight (g)	71.88±0.18	72.47±0.46	73.01±0.67	73.01±0.57	70.77±0.04	5.52 ^{ns}
Internal organs (% live weight)						
Heart	1.08±0.67	1.98±0.07	1.96±0.06	1.94±0.56	1.97±0.12	0.04 ^{ns}
Liver	1.35±0.06	1.32±0.01	1.38±0.04	1.41±0.01	1.41±0.34	0.03 ^{ns}
Lung	1.63±0.56	1.70±0.01	1.59±0.03	1.68±0.02	1.75±0.20	0.05 ^{ns}
Kidney	1.60±0.01	1.81±0.03	1.62±0.04	1.69±0.06	1.75±0.07	0.45 ^{ns}
Stomach wt. (g)	42.99±1.00	43.64±0.34	44.14±0.56	41.28±0.59	44.47±0.57	1.44 ^{ns}
Ceacal length (cm)	6.84±0.12	6.86±0.50	6.08±0.45	6.34±0.12	6.45±0.56	0.06 ^{ns}
Small intestine wt.	17.48±1.00	14.66±0.46	15.31±0.34	14.05±0.45	16.17±0.50	2.20 ^{ns}
L. I intestine (cm)	88.42±0.09	86.78±0.46	85.75±0.06	86.50±1.45	82.98±1.45	3.53 ^{ns}
S.I Length (cm)	122.45±0.46	123.49±0.67	122.45±0.06	128.70±0.56	124.13±0.06	6.21 ^{ns}
L. I wt. (g)	14.84±1.05	12.56±1.00	15.76±1.78	14.69±0.20	13.23±0.34	3.53 ^{ns}

NS= not significant (P>0.05), SEM = Standard error mean

L.I = large intestine

S.I = small intestine

Haematological and biochemical indices of weaner rabbits fed graded levels of cooked kapok seed meal

The results of the haematological parameters of weaner rabbits fed graded levels of cooked kapok seed meal (CKSM) presented in Table 5. The parameters measured were similar across the dietary treatments (P>0.05).Packed cell volume (PCV) were within the range of 40.46±1.90 to 49.08±1.45% for rabbits on 0 and75% CKSM. Haemoglobin (Hb) ranged between 11.09±0.35g/dl to 11.99±1.09g/dl. White blood cell (WBC) ranged from 8.05±0.12g $\times 10^6/mm^3$in 50% CKSM to $8.84\pm1.90\times10^6/mm^3$in 100% CKSM while red blood cell (RBC) was between $7.13\pm1.34\times10^6/mm^3$ in 50% CKSM to $7.42\pm1.04\times10^6/mm^3$ in 0% CKSM. The results of the serological indices of weaned rabbits fed experimental diets also revealed there were no differences in cholesterol, total protein, albumin, globulin and urea contents across the treatment groups. However, the content of glucose was significantly ($P < 0.05$) influenced by the inclusion levels of CKSM. The glucose level of rabbits fed the control diet (81.26±2.10mg/dl) were similar ($P < 0.05$) to those fed 50 (82.25±0.45mg/dl and 75% (84.94±0.35mg/dl CKSM inclusion levels but ($P < 0.05$) lower than those fed 25% and 100% levels of CKSM

The values of packed cell volume (PCV), haemoglobin concentration (Hb), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean cell haemoglobin concentration (MCHC) and red blood cell count (RBC) obtained in this study fall within the physiological range reported by (28,29). PCV and Hb are nutritional status indicators which have been reported which have reported as to influence by the diets fed to the animals (29).The values obtained for all the treatment groups for these parameters indicated nutritional adequacy of the diets since values did not indicate malnutrition or under-nutrition (4). This shows that CKSM inclusion in the diets of weaner rabbits had no detrimental effect on the blood composition. The similarity in values of these parameters is an index of good physiological, pathological and nutritional status of rabbits fed CKSM (30). The WBC counts are within the normal range (28). This is an indication that the use of CKSM in rabbit diet is safe since WBC is one of the indices that indicates the state of health of the animal (30). The non-significant differences in biochemical indices such as total protein, albumin, globulin, cholesterol and urea across the dietary treatments showed the adequacy of nutrients in the diets as documented by (31). Similarity of the serum albumin content of rabbits also indicates the presence of a healthy and functioning liver, since hypoalbuminaemia is associated with the presence of liver disease (32). It also indicates a proper protein: energy balance in the diets and absence of parasitic infections (32). The serum glucose values did not show any pattern even though differences were significant ($p<0.05$). Observed differences in glucose values may be due to the difference in the body physiological function of the individual animal.

Table 5: Haematological and biochemical indices of weaned rabbits fed differently processed kapok seed meal

	Inclusion levels of CKSM					
Parameter	D1 (0%)	D2 (25%)	D3 (50%)	D4 (75%)	T6 (100)	SEM
PCV (%)	40.46±1.90	40.53±1.02	43.97±1.03	49.08±1.45	47.68±1.89	1.10^{ns}
Haemoglobin (g/dl)	11.94±0.34	11.99±1.09	11.09±0.34	11.86±1.34	11.25±0.34	0.36^{ns}
RBC ($\times10^6$/mm^3)	7.42±1.04	7.32±0.46	7.13±1.34	7.38±1.78	7.16±0.45	0.27^{ns}
MCV(µm^3)	51.94±2.00	56.15±1.45	56.85±0.36	59.13±2.10	52.89±1.39	1.96^{ns}
MCH (Pq)	15.94±0.45	15.56±0.49	15.69±0.45	16.44±1.45	15.79±1.69	0.68^{ns}
MCHC (%)	25.59±1.45	24.88±0.34	25.01±1.56	24.75±0.56	26.86±1.89	2.20^{ns}
WBC ($\times10^6$/mm^3)	8.11±1.00	8.31±1.78	8.05±0.12	8.20±0.57	8.84±1.90	0.11^{ns}
Lymphocyte %	45.85±0.34	46.20±1.56	42.09±1.79	43.33±0.12	48.08±1.21	0.85^{ns}
Eosinophil %	2.15±0.32	2.19±1.10	2.12±0.50	2.41±1.43	2.30±0.24	0.23^{ns}
Neutrophils %	41.85±1.40	46.69±0.35	41.76±1.45	42.45±0.56	41.92±1.23	0.46^{ns}
Biochemical indices						
Cholesterol(mg/dl)	65.25±1.45	68.97±1.78	63.48±1.67	65.52±0.13	64.56±1.08	0.47^{ns}
Total protein (g/dl)	6.10±0.34	6.13±0.88	6.00±1.09	6.22±1.67	6.18±0.45	0.11
Albumin (g/dl)	3.60±0.11	3.32±0.02	3.19±0.15	3.29±0.36	3.26±1.12	0.08
Globulin (g/dl)	2.50±0.11	2.81±0.10	2.81±0.01	2.93±0.45	2.95±1.45	0.18
Urea (mg/dl)	35.02±0.78	34.81±1.56	34.05±1.02	33.38±0.89	35.18±1.56	0.49
Glucose (mg/dl)	81.26 ± 2.10^b	86.12 ± 1.80^a	82.25 ± 0.45^b	84.94 ± 0.35^b	87.19 ± 0.05^a	0.48^*

a,b,c Means on the same row with subscripts are significantly different ($p<0.05$)*, SEM= Standard error, PCV= Packed cell volume RBC=Red blood cell, MCH= Mean corpuscular haemoglobin WBC= While blood cell MCHC= Mean corpuscular haemoglobin concentration.

Nutrient digestibility of weaner rabbits fed CKSM

Table 6 shows the results of the nutrient digestibility of weaner rabbits fed CKSM. Dry matter digestibility (DMD) showed no significant difference across the dietary treatments (P>0.05). Rabbits fed 0% CKSM recorded numerically higher value (79.73±0.89%). Similarly, apparent crude protein digestibility (CPD) and crude fibre digestibility (CFD) showed no significant difference across the dietary treatments (P>0.05). The values of CP and CF ranged from 76.45±0.56 - 78.34±0.01% and 70.34±0.57-71.89±0.56% respectively. Ether extracts digestibility (EED) was higher in 25% CKSM (80.67±0.21%) Digestibility of NFE ranged from 74.30±0.45% in 0% CKSM to 76.67% in 25% CKSM and 75% CKSM.

There were no significant differences (P>0.05) among the parameters evaluated for digestibility. The result suggest that inclusion of varying levels of cooked kapok seed meal in weaner rabbit diets did not have any significant effect on the digestibility of nutrients which agreed with the finding of other workers (18,33,34) It could be suggested therefore that cooking played a significant role in reducing the anti-nutritional factors in the raw kapok seed that have been documented to cause reduction in nutrient digestibility and absorption of nutrients in the gastro intestinal tracts which consequently result into digestive losses (17, 35).

Table 5: Nutrient digestibility of weaner rabbits fed cooked kapok seed meal

	Inclusion levels of cooked kapok seed meals					
Parameters	D1 (0%)	D2 (25%)	D3 (50%)	D4 (75%)	D5 (100%)	SEM
Dry matter	78.73±0.89	74.95±0.01	76.89±0.56	74.86±0.50	77.75±0.07	0.79 ns
Crude protein	77.74±0.03	77.89±0.46	76.45±0.56	78.34±0.01	77.05±0.05	1.87 ns
Crude fibre	70.89±0.67	70.45±0.68	71.89±0.56	71.56±0.35	70.34±0.57	1.46 ns
Ether extracts	79.07±0.59	80.67±0.21	80.56±0.45	79.78±1.89	80.45±0.43	2.20 ns
Ash	79.75±0.67	74.99±0.34	78.53±0.78	76.12±0.98	79.35±0.89	1.58 ns
Nitrogen free extracts	74.30±0.45	76.67±0.47	73.67±0.67	76.45±0.45	76.57±0.98	2.41 ns

NS= not significant (P>0.05),SEM = Standard error mean

Conclusion and Application

1. It was found that CKSM can replace up to 100% soybean meal (25% of the diet) as an alternative plant protein source in weaner rabbits
2. The similarity among haematological and biochemical indices showed the absence of pathological abnormalities
3. It is therefore safe to use CKSM at recommended concentration and levels to replace soybean meal in rabbit's diets.

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