

## **Kigelia Africana Fruit and Leaf Meals: Chemical Compositions and Effect on Growth Performance of Rabbits**

**Aliyu K.I.**

*Department of Animal Science, University of Abuja, Abuja, Nigeria*

*Karimat.aliyu@uniabuja.edu.ng or tanwaaliyu@gmail.com*

**Phone number:** +2348062698258

**Target audience:** Rabbit farmers/researchers, farmer located in areas where the tress is predominant

### **Abstract**

*Kigelia africana* fruit (KAF) and leaf (KAL) meals were investigated, and subsequently on 108 (8weeks old) rabbits in a feeding trial that lasted for 12 weeks. The experiment was conducted at the University of Ilorin Teaching and Research Farm, where all management practices were strictly adhered. The rabbits were randomly allotted to nine (9) treatment groups in a factorial 2×4 plus control design. Levels of KAL and KAF were independently fed at 0%, 5%, 10%, 15% and 20% inclusions. Data were collected on growth parameters during this period. Some chemical analyses of KAF and KAL were also investigated. The chemical analysis revealed that ash (18.90%), glucose(17.83mg/g), Calcium(214.15ppm), Phosphorus(7.33ppm) and Zinc(21.59ppm) were significantly ( $p<0.05$ ) higher in the fruit than in the leaf. The results of feeding KAF and KAL on the growth performance of rabbit shows that the daily weight gain (28.54g) and final weight (2397.25g) were higher ( $p<0.05$ ) in rabbit fed KAF. Rabbits on 15% inclusion levels of KAF and KAL had the best daily weight gain (30.39g and 29.20g), final weight (2578.75g and 2452.50g) and feed conversion ratio (5.52 and 5.39). It can be concluded that KAF and KAL are both rich in nutrients; however, fruits are richer in some selected minerals. It can be included in rabbit diets up to 15% for optimal performance.

**Key words:** *Kigelia africana*; fruit; leaf; minerals; growth performance

### **Description of Problem**

Rabbits are obtainable in almost every part of the world with no taboo attached to its consumption. They are excellent converter of less quality feed to meat (Iribeck, 2001), hence can be produced with less quality feed material. Its fast-growing potential and short gestation period make it suitable for addressing the problem of animal protein shortage as human population increases. Adequate nutrition is one of the important components of animal production responsible for growth, development and

multiplication. Feeding accounts for a higher percentage of cost of production in animal enterprise however, non-conventional feed stuff with little or no competition with human can be used in order to reduce this cost. Like ruminants, rabbits have ability to utilize fibrous feed materials that are cheaper in price and still able to convert it to quality meat, this is possible due to some bacterial present in their hind gut (Taiwo *et al.* 2005). The high cost of feed can be reduced with inclusion of non-conventional materials from ethnobotanical plants. Ethnobotanical

trees such as *Kigelia africana* can supply the feed materials which can be utilized by animals while reducing the cost of production since it is almost free in areas where the trees are predominant. It grows commonly in tropical west, east and central African regions particularly in low plains in Nigeria (Owolabi and Omogbai, 2007). Its fruit weighs between 4 - 10 kg and hangs from a long and fibrous stalk, it can also be found in open woodland (Owolabi and Omogbai, 2007; Abioye *et al.*, 2003 and Ogbeche *et al.*, 2002). The tree is widely grown as an ornamental plant for its decorative flowers and unusual fruit. The seed, fruit and the leaf of this plant have been reported to contain reasonable amount of crude protein, crude fibre, vitamin and mineral, (Aliyu and Adeyina, 2022; Eliton *et al.*, 2011) which may be beneficial to animals if appropriately included in their diet. The need to investigate this plant in animal production becomes important for assessment of levels of safe use for optimal productivity.

## **Materials and Method**

### **Brief description of the study area**

The experiment was conducted at University of Ilorin Teaching and Research farm, located at 8.4859° N, 4.6746° E. It is characterized with tropical savanna climate with distinct wet and dry seasons. Temperatures are generally high year-round, with the hottest month being March. The wet season lasts from April to October, with peak rainfall between June and September.

### **Collection of experimental test ingredient and diet preparation**

*Kigelia africana* fruit and leaf used for this experiment were collected within Ilorin,

Kwara State, Nigeria. They were properly washed and allowed to drain. The fruits were finely chopped and air dried. The dried fruit and leaf were milled with a bore milling machine in to a powder form. Experimental diets of varied levels (5%, 10%, 15% and 20%) of *Kigelia africana* fruit and leaf meal were compounded independently with a common control (Table 1 is used as display for both). The diets were formulated to meet the nutrient requirements of rabbits recommended by NRC (2000).

### **Proximate and quantitative analysis of selected minerals in *Kigelia africana* fruit and leaf meals**

Powdered samples of both fruit and leaf were taken to the laboratory for proximate and some mineral analyses. The method described by Association of Official Analytical Chemists (A.O.A.C, 2005) was used for these analyses. The samples were ashed at 550°C. The ash was boiled with 10 ml of 20% hydrochloric acid in a beaker and then filtered into a 100 ml standard flask. This was made up to the mark with deionized water. The minerals were determined from the resulting solution using Atomic Absorption Spectrophotometer (AAS Model SP9). All values were expressed in ppm (mg/100 g).

### **Experimental animals, management and feeding trial**

The experiment was conducted at the University of Ilorin Teaching and Research Farm. One hundred and eight 10-weeks old rabbits were randomly allotted to nine (9) treatment groups of twelve rabbits per treatment, in a factorial 2×4+1 design. The first factor was plant parts consisting of two levels of fruit and leaf while the second factor

was inclusion levels comprising of 5%, 10%, 15%, and 20% plus 0% which served as the control common to both fruit and leaf. The nine (9) treatment groups were fed with

levels of fruit and leaf meals of *Kigelia africana* plant independently at 0%, 5%, 10%, 15% and 20% inclusion as shown in Table 1.

**Table 1. Composition of Experimental Diets Supplemented with *Kigelia africana* Fruit Meals**

Ingredients (%)	Control	5% Fruit	10% fruit	15% Fruit	20% fruit	5% Leaf	10% Leaf	15% Leaf	20% leaf
Maize	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Soybean	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Meal									
Wheat	12.00	14.00	10.00	10.00	5.00	14.00	12.00	9.00	11.00
Offal									
Maize offal	7.00	5.00	5.00	7.00	11.00	10.00	5.00	10.00	5.00
Rice husk	27.00	22.00	21.00	14.00	10.00	21.00	19.00	12.00	10.00
Fish Meal	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
KAM	0.00	5.00	10.00	15.00	20.00	5.00	10.00	15.00	20.00
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Dicalcium phosphate	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Lysine	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Premix	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Analyzed Nutrients</b>									
Ether Extract (%)	4.50	4.0	3.89	5.0	4.56	5.0	4.54	4.90	4.98
Calculated Energy (Kcal/kg)	2,417.10	2,366.83	2,286.66	2,247.39	2,212.82	2,349.67	2,308.83	2,200.50	2,200.16

\*KAM= *Kigelia africana* meals

Before the commencement of the experiment, the rabbits were acclimatized for a period of two weeks. They were housed individually and had access to feed and water *ad libitum*. Thereafter, the initial body weights were noted in grams for each rabbit. Daily feed intake of individual rabbit was monitored by subtracting feed refused from feed offered using a weighing scale. Feed conversion ratio was later calculated for each rabbit at the end of the feeding trial. The

experiment lasted for ten (10) weeks and these experiments were conducted with approval of ethical review committee of University of Ilorin with the protocol identification code: UERC/AGR084..

#### Statistical Analysis

All data obtained was subjected to statistical analysis using the analysis of variance (ANOVA) procedure following a Factorial Design (SAS, 2012) and the levels of

significance was determined using the Duncan's Multiple Range Test.

### Results and Discussion

The results of chemical analysis conducted on *Kigelia africana* fruits and leaf meals are presented in Table 2. There was no

significant difference ( $p>0.05$ ) among the means of all the parameters (crude protein, crude fibre, ether extract, and dry matter) investigated. However, the ash and glucose contents were significantly ( $p<0.05$ ) higher in the fruit than leaf.

**Table 2: Chemical Composition of *Kigelia africana* Fruit and Leaf Meals**

Parameters	KAF	KAL	P value
Dry Matter (%)	90.55±1.16	91.38±0.94	0.388
Ash (%)	18.90±2.05 <sup>a</sup>	7.40±2.75 <sup>b</sup>	0.004
Ether Extract (%)	3.58±1.22	3.66±1.99	0.96
Crude Protein (%)	7.73±2.79	9.12±0.98	0.49
Crude Fibre (%)	27.38±2.10	22.02±3.36	0.11
Glucose(mg/g)	17.83±0.36 <sup>a</sup>	3.52±0.00 <sup>b</sup>	0.0001

\*KAF= *Kigelia africana* fruit, KAL= *Kigelia africana* leaf, a, b – means with different superscripts are significantly different along the row

The results of selected minerals (calcium, phosphorus, zinc and iron) present in the fruit and leaf of *Kigelia africana* are presented in Table 3. The mean values of Calcium, Phosphorus and Zinc were significantly ( $p<0.05$ ) higher in the fruit than the in leaf. Whereas, there was no significant difference in values obtained for Iron (Fe) in both fruit and leaf.

Minerals are important in the diet of growing animals as they help in building of the body both structural and physiological. Calcium and Zinc have been described as vital in maintaining the immune system and optimal functionality of male reproductive health. In this study, Phosphorus, calcium, zinc and iron are more available in the fruit than in the leaf. Eliton *et al.* (2011) reported higher values for phosphorus and calcium in the seed of this fruit. This might mean that the minerals are more concentrated in the seed

than the entire fruit. Considering the importance of these minerals in animal health and reproductive performance *Kigelia africana* fruit and leaf can be used in animal feed to supply amount needed by animals.

The results of observed growth performance of rabbits fed different inclusion levels of KAL and KAF are presented in table 4. The KA parts were significant factor for final weight, daily weight gain and feed conversion ratio. The daily weight gain and final weights significantly ( $p<0.05$ ) increased in rabbit fed fruit than those on the leaf. However, feed conversion ratio were significantly increased ( $p<0.05$ ) in rabbits fed leaf compared with those on the fruit. The KA inclusion levels was a significant factor ( $p<0.05$ ) for the final weight, daily weight gain and feed intake. There was a significant increase in final weight, daily weight gain and feed intake (at 20%) with increasing

**Table 3: Composition of Selected Minerals in *Kigelia africana* Fruit and Leaf Meals**

Parameters	KAF	KAL	P value
Calcium (ppm)	214.15±2.24 <sup>a</sup>	16.27±6.85 <sup>b</sup>	0.0001
Phosphorus (ppm)	7.33±0.28 <sup>a</sup>	2.13±0.06 <sup>b</sup>	0.001
Zinc (ppm)	21.59±9.29 <sup>a</sup>	2.51±0.44 <sup>b</sup>	0.011
Iron (ppm)	4.02±0.55	2.44±0.59	0.12

\*KAF= *Kigelia africana* fruit, KAL= *Kigelia africana* leaf, a, b – means with different superscript are significant along the row

level of the meals. No significant difference ( $p>0.05$ ) was observed in the feed conversion ratio at all levels. The lowest and highest feed intake was recorded in 5% and 20% respectively, and this indicated that the value increased with increasing level of the treatments. The details of interaction for the significant parameters are presented in the interaction table.

The improved growth performance observed in rabbits fed different levels of *Kigelia africana* fruit and leaf- based diets indicate the efficiency of these feed stuffs in rabbit feeding. The highest feed intake (162.65g) was observed at 20% leaf inclusion, this is higher than 136.3 to 149.9 g reported by Gidenne *et al.* (2009) and 78.7 g reported by Baba (2003) who used a fibre-based diet in feeding rabbits. This is an indication that the nutrients, especially the fibre which happened to be the highest was efficiently utilized by the rabbits since they are often referred to as pseudo-ruminants. The increased feed intake could be due to the quality of the feed itself. According to Aliyu and Adeyina, (2022) *Kigelia africana* plant contains numerous phytochemicals which have been reported to have the ability to enhance the flavour and palatability of feed, they act as feed antioxidant; thereby improving feed consumption and

subsequently weight gain. The study of Aliyu and Adeyina (2022) reported that the most available phytochemical in *Kigelia africana* fruit and leaf meals was flavonoids, which has been reported by many researchers to have the ability to promote the intestinal morphology (such as villus height and width) and absorptive function in growing animals (Awad *et al.* 2011; Viveros *et al.* 2011). It helps in their rapid proliferation, thereby increasing the surface area capable of greater absorption of nutrient, the effects of which can subsequently be seen in body weight gain of the animals. In addition, the vitamin C (Aliyu and Adeyina, 2022) present in the fruit and leaf may also contribute to the increased feed intake recorded in this study as earlier study reported the effect of this vitamin on feed consumption (Takahashi and Akiba, 2000) who also reported increased feed intake in broilers fed Vitaamin C.

The daily weight gain, final live weight and feed conversion ratio of rabbits on the treatments were improved compared with the control with 15% inclusion having the highest mean. The daily weight gain increased with an increase in the dietary levels of *Kigelia africana* fruit and leaf meals without any adverse effect on their survivability. The daily weight gains of the experimental rabbits (25.94 to 30.69g) were

higher than 19.65 to 23.07 g reported by Houndonougbo *et al.* (2012) who fed palm-press fibres-based diet and 16.7 g reported by Kpodekon *et al.* (2005). The variation observed could be due to the effect of feed intake, gut proliferative impacts of phytochemicals (especially flavonoids) which has been reported for its ability to improve absorption of nutrients leading to weight gain in animal. More so, *Kigelia africana* fruit and leaf have been reported to contain some vitamins (Aliyu and Adeyina, 2022) and mineral which work synergistically to achieve a better growth and good health of animals. The final weight recorded from this study is

higher than those reported by previous researchers (Hamouda *et al.* 1990; Bovera *et al.* 2011; Houndonougbo *et al.*, 2012 and Adeyina *et al.*, 2016). The increased final weight observed from this study could be due to the quality of feed, efficient utilization of nutrient, duration of feeding, general health and age of the rabbits.

The feed conversion ratio of feed per body weight gain is within the range reported in previous study, this is an indication that the rabbits were able to utilize the available nutrients in the feed to gain more weight. The values obtained from this study is however higher than 3.78 to 4.64 reported by Hounongbo *et al.* (2012).

Table 4: Growth Performance of Rabbits fed *Kigelia africana* Fruit and Leaf Meals

KA Parts	Initial weight (g)	Final weight (g)	Daily weight gain (g)	Feed intake (g)	Feed conversion ratio
Fruit	570.00	2397.25 <sup>a</sup>	28.54 <sup>a</sup>	151.42	5.46 <sup>b</sup>
Leaf	557.50	2319.28 <sup>b</sup>	27.61 <sup>b</sup>	150.81	5.62 <sup>a</sup>
P value	0.41	<.0001	0.01	0.06	0.05
<b>KA Inclusion (%)</b>					
0	575.00	2147.50 <sup>b</sup>	25.57 <sup>b</sup>	155.57 <sup>b</sup>	5.54
5	543.75	2213.75 <sup>b</sup>	26.35 <sup>b</sup>	148.80 <sup>c</sup>	5.74
10	568.75	2451.88 <sup>a</sup>	29.19 <sup>a</sup>	152.60 <sup>b</sup>	5.54
15	568.75	2515.63 <sup>a</sup>	29.95 <sup>a</sup>	150.48 <sup>c</sup>	5.46
20	562.50	2462.50 <sup>a</sup>	29.32 <sup>a</sup>	157.25 <sup>a</sup>	5.44
P value	0.93	<.0001	<.0001	<.0001	0.11
Parts*Inclusion	NS	*	*	*	NS
P value	0.94	<.0001	0.02	<.0001	0.0003
SEM	7.19	13.30	0.25	0.42	0.05

KA= *Kigelia africana*, SEM= Standard Error of Means, a, b, c – means with different superscript are significant along the row, \* – significant (p<0.05), NS – Not-significant (p>0.05)

**Table 4.a: Interactions between KA Parts and Inclusion Levels on Growth performance parameters**

Inclusion Levels (%)		0%	5%	10%	15%	20%	SEM
Parameters	KA Parts						
Feed Intake (g)	Fruit	145.57 <sup>c</sup>	147.75 <sup>dc</sup>	157.89 <sup>b</sup>	154.47 <sup>bc</sup>	151.86 <sup>cd</sup>	1.32
	Leaf	145.57 <sup>e</sup>	149.84 <sup>de</sup>	147.30 <sup>e</sup>	146.48 <sup>e</sup>	162.64 <sup>a</sup>	1.32
Weight Gain (g)	Fruit	25.94 <sup>cd</sup>	27.57 <sup>bc</sup>	28.93 <sup>ab</sup>	30.69 <sup>a</sup>	29.55 <sup>a</sup>	0.40
	Leaf	25.94 <sup>cd</sup>	25.13 <sup>d</sup>	29.45 <sup>a</sup>	29.20 <sup>ab</sup>	29.08 <sup>ab</sup>	0.40
Final Weight (g)	Fruit	2116.25 <sup>d</sup>	2316.25 <sup>bc</sup>	2430.00 <sup>ab</sup>	2578.75 <sup>a</sup>	2482.50 <sup>a</sup>	33.61
	Leaf	2116.25 <sup>d</sup>	2111.25 <sup>d</sup>	2473.75 <sup>a</sup>	2452.50 <sup>ab</sup>	2442.50 <sup>ab</sup>	33.61
FCR	Fruit	5.54 <sup>b</sup>	5.34 <sup>b</sup>	5.65 <sup>ab</sup>	5.52 <sup>b</sup>	5.27 <sup>b</sup>	0.12
	Leaf	5.54 <sup>b</sup>	6.14 <sup>a</sup>	5.43 <sup>b</sup>	5.39 <sup>b</sup>	5.61 <sup>ab</sup>	0.12

\*KA= *Kigelia africana*, FCR= Feed Conversion Ratio, a, b, c – means with different superscripts are significant along the row, SEM= Standard Error of Mean

### Conclusion and application

In conclusion, *Kigelia africana* fruit and leaf meals are rich in essential nutrients based on the results obtained from this study. These nutritional compositions are vital for growth and reproductive performance, the crude fibre percentages make them suitable in rabbit diet.

*Kigelia africana* meals can be included in rabbit diet up to 15% inclusion for meat production.

Further studies on histopathology and gut morphometry should be done to validate some of the claims made earlier.

### Acknowledgement

Special thanks to Mr. Mohammad Yunus of Ministry of Agriculture and Rural Development, Ilorin, Kwara State and Abdulrasheed Sa'adu for making collection

of test materials easy, and Dr. Salako A.O of Department of Animal Production, University of Ilorin for his assistance.

### References

1. Iribeck, N. A. (2001). How to feed the rabbit (*Oryctolagus cuniculus*) gastrointestinal tract. *Journal of Animal Science*, 79 (1) 343-346.
2. Taiwo, A.A., Adejuyigbe, A.D., Adebowale, E.A., Oshotan, J.S., & David, O.O. (2005). Performance and nutrient digestibility of weaned rabbits fed forages supplemented with concentrate. *Nigerian Journal Animal Production*, 32 (1-2): 74-78.
3. Owolabi, O.J. & Omogbai, E.K.I. (2007). Analgesic and anti-inflammatory activities of the ethanolic stem bark extract of

- Kigelia africana*. *Afr. J. Biotechnol.* 6 (5):582-585.
4. Abioye, A.I.R., Duru, F.I.O., Noronha, C.C. & Okanlawon, A.O. (2003). Aqueous extract of the bark of *Kigelia africana* reverses early testicular damage induced by methanol extract of *Carica papaya*. *Nigerian Journal of Health and Biomed. Sci* 2(2). 81-87.
  5. Ogbeche, K.A., Ogunbiyi, Y.O. & Duru, F.I.O. (2002). Effect of Methanol extract of *Kigelia africana* on Sperm Motility and Fertility in Rats. *Nigerian Journal of Health and Biomed Sci*, 1 (2): 113-116.
  6. Aliyu K. I and Adeyina A. O (2022). Phytochemical, vitamin compositions and antioxidant potential of *kigelia africana* fruit and leaf meals. *Asian Journal of Advances in Research* 5(1): 664-667
  7. Eliton, C., Bruce, C. D. & Kennedy, E. (2011). *Kigelia africana* seed: Proximate, mineral, vitamin E, fibre, Amino acids and fatty acid composition. *International journal of food science and technology*, 46 (10): 2153-2158.
  8. A.O.A.C. (2005). Official Methods of Analysis. Association of Official Analytical Chemists. 19th Edn. Washington D.C
  9. SAS Institute Inc. (2012). SAS/STAT User's guide, version 8 for windows. SAS institute Inc., SAS campus drive, Cary, North.
  10. Gidenne, T., Travel, A., & Murr, S. (2009). "Limited intake and deliver mode of diet. Consequences on feeding behavior, digestion and carcass quality," in *Proceeding of the 13<sup>th</sup> Rabbitry Research Days, INRA-ITAVI*, pp. 43–46.
  11. Baba, L. (2003). "Comparison of growth performances of two batches of rabbits fed with meal and pellet diets," Bachelor of Science Report, University of Abomey Calavi, EPAC/UAC, Benin
  12. Awad, W.A, Ghareeb K, & Bohm J. (2011). Evaluation of the chicory inulin efficacy on ameliorating the intestinal morphology and modulating the intestinal electrophysiological properties in broiler chickens. *Journal Animal. Physiology and Animal Nutrition* 95(1): 65-72
  13. Viveros, A., Chamorro, S., Pizarro, M., Arija, I., Centeno, C., & Brenes, A. (2011). Effects of dietary polyphenolrich grape products on intestinal microflora and gut morphology in broiler chicks. *Poultry Science*. 90(3): 566–578.
  14. Takahashi, K., Masiko, T. & Akiba, Y. (2000). Effect of dietary concentration of xylitol on growth in male broiler chicks during immunological stress. *Poultry Science*, Volume 79, Issue 5, 1 May 2000, Pages 743–747.
  15. H o u n d o n o u g b o , M . F . , Chrysostome, C.A.A.M., Attakpa, S.E., Sezan, A., & Dehou, H.B. (2012). Growth Performance of Rabbits Fed Palm-Press Fibres-Based Diets. *International Scholarly Research Network ISRN Veterinary Science Volume*, Article ID 915729, pp5 doi:10.5402/2012/915729
  16. Kpod'ekon, M., Yousao, A.K.I., Djobbenou, I., & Djago, Y. (2005).

- "Growth and viability performance of rabbit kids fed with pellet feed," *African Review of Animal Health and Production*, vol. 3, no. 3-4, pp. 222–226.
17. Hamouda, M., Salwa, K., & El-Gaied, J. (1990), "Crossing of local rabbits with the Hyla strain: growth and reproductive performance in the first generation," *Mediterranean Options, Serie A*, vol. 8, pp. 103–108.
  18. Bovera, F., Lestingi, A., & Marono, S. (2011). "Effect of dietary mannan-oligosaccharides on *in vivo* performance, nutrient digestibility and caecal content characteristics of growing rabbits," *Journal of Animal Physiology and Animal Nutrition*, vol. 96, no. 1, pp. 130–136
  19. Adeyina, A.O., Ojetunji, C.T., Adeyina, O.A., Annongu, A.A., & Akanbi, A.S. (2016). Effect of cold aqueous extract of *Moringa oleifera* on reproductive parameters and relative organ weight in cockerels. *Wayamba journal of Animal Science*, 9, 1539-1548.