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Effect of *Kigelia africana* Leaf and Fruit Meals on Blood Parameters of Rabbits

***[1]Karimat Imam Aliyu & [2]Adebisi Oluwatoba Adeyina**

[1]Department of Animal Science, University of Abuja, Nigeria.

[2] Department of Animal Production, University of Ilorin, Nigeria

*Correspondence Author Email address: karimat.aliyu@uniabuja.edu.ng; tanwaaliyu@gmail.com

ABSTRACT

Experiments were conducted to evaluate the effect of *Kigelia africana* fruit (KAF) and *Kigelia africana* leaf (KAL) based diets on the on the blood indices of rabbits. The experiment which lasted for 12 weeks was done at the University of Ilorin Teaching and Research Farm. Blood samples were taken for determination of blood indices after the feeding period. There were significant interactions between fruit, leaf and inclusion levels on blood parameters ($p<0.05$). Considering the KA parts as a factor, Lymphocytes, Monocytes and Haemoglobin are the only significant parameters (61.0, 2.63 and 7.94 respectively). The inclusion level significantly ($p<0.05$) influenced the White Blood Cell (4.61-5.83), Heterophils (33.50-38.06), Monocytes (1.50-2.75), Haemoglobin (6.29-8.65), and Packed cell volume (27.81-37.69). The WBC was highest at 5% inclusion; however still fall within normal ranges for healthy rabbits. The serum biochemical analysis of the rabbits revealed that the KA part was not significant factor ($p>0.05$) for the biochemical parameters except Aspartate aminotransferase (AST) and Total Protein (TP) which were significantly ($p<0.05$) influenced. The AST was higher ($p<0.05$) in rabbit fed KAL meals (41.59-44.05) while TP was higher ($p<0.05$) in those on KAF meals (8.45-10.35) but fall within normal values reported in earlier studies. It can be concluded from the results obtained from this study that KA fruit and leaf meals can be used in rabbit feeding to improve performance without detrimental effects on the animals.

Keywords: Blood, Fruit, Leaf, *Kigelia africana*, Rabbit Serum.

1 INTRODUCTION

Rabbits can be seen in almost every part of the world without restrictions on consumption of its meat. Their ability to utilize less quality feed make them good converter (Maigida *et al*., 2018). They are fast growing animals with short gestation period; hence, suitable for addressing the problem of animal protein shortage. In animal production, feeding and nutrition are very important and most expensive aspect of production. This cost can be reduced with the use of non-conventional feed stuff. Like ruminants, rabbits have ability to utilize fibrous feed materials that are cheaper in price and still able to convert it to meat; with the help of some bacterial present in their hind gut (Joerg Mayer, 2024). Ethnobotanical trees such as *Kigelia africana* can be explored as 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. Its fruit weighs between 4 - 10 kg and hangs from a long and fibrous stalk (Abioye *et al*., 2003; Owolabi and Omogbai, 2007). The tree is widely grown as an ornamental plant for its decorative flowers and unusual fruit. The seed and the leaf of this plant have been reported to contain reasonable amount of crude protein, crude fibre, vitamin and mineral, (Eliton *et al*., 2011), which may be beneficial to animals if appropriately included in their diet. It is believed that *Kigelia africana* is well tolerated in humans and rodents, but there is little information about biological response of rabbits to the plant. This knowledge is important for assessment of levels of safe use, and specifically the nature of its effect (beneficial, neutral or harmful) as measured at the level of haematology and other biochemical investigations.

2 METHODOLOGY

2.1 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 into a powder form. Experimental diets of varied levels (5%, 10%, 15% and 20%) of *Kigelia africana* fruit and leaf meal were compounded independently (Tables I and II) with a common control. The diets were formulated to meet the nutrient requirements of rabbits recommended by NRC (1977).

Experimental animals, management and feeding trial

A total of one hundred and eight, eight weeks old rabbits were used for this experiment. They were randomly allotted to nine (9) treatment groups, in a factorial 2×4 plus control.

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The nine (9) treatment groups A, B, C, D, E, F, G, H and I consisted levels of fruit and leaf meals of *Kigelia africana* plant independently fed at 0%, 5%, 10%, 15% and 20% inclusions. Rabbits were housed individually and had access to feed and water *ad libitum*. The experiment lasted for twelve weeks.

Determination of Haematological, Serum Biochemical Indices

At the end of the feeding trial, blood samples were collected from eight rabbits per treatment before offering meal during the early hour. The rabbits were restrained in a rabbit restrainer and 3 mL of blood was collected through their ear vein using a sterilized disposable syringe and needle into sterilized plastic tubes containing ethylene-di-ethyl tetra-acetic acid (EDTA) as anticoagulant which was used for haematological evaluation. Haemoglobin (Hgb), packed cell volume (PCV), Erythrocyte count (RBC) and Leukocyte count (WBC) were determined using an auto-haematology analyzer (Axiom 7886A3). Blood corpuscular constants, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were all calculated using appropriate formula described by Jain, (1986). Another 5 mL of blood was collected into plain bottles for serum biochemical analysis. Serum creatinine was determined by modified Jaffe method (Blass *et al*., 1974), Serum Urea Nitrogen was determined by the method of (Chawla, 1999). Liver enzymatic activities including Alanine transaminase (ALT), aspartate transaminase (AST), and alkaline phosphates (ALP) were measured using spectrophotometric (Visible Spec 721, Axiom Med. U.K) methods as described by Reitman and Frankel (1957).

Statistical Analysis

All data obtained were 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. (Duncan 1955).

TABLE I: COMPOSITION OF EXPERIMENTAL DIET SUPPLEMENTED WITH *KIGELIA AFRICANA* FRUIT MEALS

INGREDIENTS	A	B	C	D	E
MAIZE	30	30	30	30	30
SOYBEAN MEAL	20	20	20	20	20
WHEAT OFFAL	8	6	6	3	1
MAIZE OFFAL	16	15	14	18	22
RICE HUSK	22	20	16	10	3
FISH MEAL	1	1	1	1	1
KAFM	0	5	10	15	20
SALT	0.5	0.5	0.5	0.5	0.5
DICALCIUM PHOSPHATE	2	2	2	2	2
LYSINE	0.05	0.05	0.05	0.05	0.05
PREMIX	0.45	0.45	0.45	0.45	0.45
TOTAL	100	100	100	100	100
%CRUDE PROTEIN	16.06	16.08	16.36	16.61	16.98
% CRUDE FIBRE	11.11	11.71	11.88	11.80	11.50
ME (KCAL/KG)	2,456.40	2,366.83	2,286.66	2,247.39	2,212.82

*****KAFM= *KIGELIA AFRICANA* FRUIT MEAL, ME-METABOLIZABLE ENERGY

TABLE II: QUANTITATIVE PHYTOCHEMICAL ANALYSIS OF KIGELIA AFRICANA FRUIT AND LEAVE MEALS

Parameters	KAF	KAF (mg/100g)	KAL	KAL (mg/100g)	(P<0.05)
Flavonoids	+++	29.92±0.47^{a}	++	4.63±0.14^{b}	0.016
Steroids	+	0.19±0.00^{b}	+	0.20±0.00^{a}	0.0001
Phytate	++	0.49±0.14	++	0.74±0.29	0.24
Oxalate	+	0.22±0.08^{a}	+	0.14±0.01^{b}	0.01
Saponin	++	0.47±0.29	++	0.29±0.04	0.33
Tannin	++	0.51±0.39^{a}	+	0.03±0.00^{b}	0.001
Phenolic	+	0.04±0.01^{a}	+	0.02±0.00^{b}	0.01
Alkaloids	+	0.04±0.00^{b}	+	0.30±0.26^{a}	0.0001
Terpenoid	-	-	-	-	-
Cardiac glycoside	-	-	-	-	-

SOURCE: ALIYU AND ADEYINA (2022)

3 RESULTS AND DISCUSSION

The results obtained in this study revealed that the haematological parameters of rabbit fed KAF and KAL independently showed significant variations. This experiment focused on comparing the effect of KAF and KAL and their interactions on the parameters. The KA parts as a factor did not significantly ($p>0.05$) influence blood parameters except Lymphocytes, Monocytes and haemoglobin which were all significantly ($p<0.05$) higher in rabbits fed KAF. Lymphocyte and Monocytes are components of WBC which when elevated indicate presence of infection. However, the significant increase observed in this work was within the acceptable range for rabbit since this is highly dependent on Lymphocyte to Neutrophil ratio which is within the range reported by Moore *et al*., (2015). Inclusion levels as another factor also affected the level of WBC and its components. It was highest at 5% inclusion and the increase may indicate presence of infections which was

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combated through production of antibodies by the rabbits under this treatment. This is an indication that their immune response was improved. The WBC is however within the range reported by Leineweber, (2019) (2.71-12.23) for healthy rabbit. Haemoglobin concentration was higher in rabbits fed KAF, even though its lower than values reported by Moore *et al*., (2015) (10.4-17.4 g/dL) who also reported for healthy pet rabbits. Oladapo etal., (2020) reported no significant difference in haematological parameters of diabetics induced rat treated with *Kigelia africana* fruit extract. Rabbit on 15% inclusion had the highest haemoglobin value (8.65 g/dL) which is similar to the result obtained by MSD veterinary, (2025). The PCV at 15% inclusion level was highest (37.68%) and within ranges reported by Moore *et* al., (2015) who assessed the blood of healthy pet rabbits. This can be attributed to the numerous nutrients, minerals (like iron), some vitamins and phytochemicals present (Aliyu & Adeyina, 2022). The presence of some phytochemicals may have enhanced the flavor thereby exciting the olfactory nerves, and palatability of feed by stimulating the taste buds thus improving the feed consumption, (Muanda *et al*., 2011; Velasco and Williams, 2011). They could also act as feed antioxidant, and antimicrobial thereby preventing feed spoilage, improving feed consumption and subsequently good health (Cardoso *et al*., 2012; Kanduri *et al*., 2013; Alipour *et al*., 2015). According to this study, the most available phytochemical in *Kigelia africana* is 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, which will in turn translate to a better blood profile. Generally, the blood indices as observed from this research, have different trend indicating that the KA fruit and leaf meals are dose dependent.

The details of interactions between *Kigelia africana* parts and their inclusion levels for the significant parameters are presented in Table 2b and 3b. WBC was significantly higher ($p<0.05$) at 15% and 20% leaf inclusions compared with those on the fruit. The values of blood indices obtained from this study are within the ranges reported by Leineweber *et al.* (2019).

The main effects of the inclusion levels of the *Kigelia africana* meals revealed no significant ($p>0.05$) difference in some of the biochemical parameters (Total cholesterol, Albumin, Creatinine and Urea). This is in contrary to the results obtained by Oyelade *et a.*, (2021) who reported a lowered cholesterol in wister rats treated with methanolic leaf extract of *Kigelia africana*. The slight difference in the result could as a result of possible different constituents in the treatments, specie of animal used and many other factors. In this study, the level of inclusion of *Kigelia africana* meals significantly influenced ($p<0.05$) only the ALP and AST. Their concentrations in the blood serum significantly reduced ($p<0.05$) with increasing level of inclusion, which is corroborated with results of Oyelade *et al*., (2021) who also reported a lowered level of AST and ALP in wister rats treated with methanolic leaf extract of *Kigelia africana*. This is an indication that there were no hepatic cellular damage since low level of AST is not a call for concern (Alessandro, 2007). The significant interactions between KA parts and inclusion levels for ALP are presented in table 3b where it was higher in rabbits fed 15% KA leaf meal. This implies that KA parts (fruit or leaf) can be an influencing factor for ALP even though the result obtained is still within normal range for healthy rabbits (4.1-16.2) (Collin, 1988).

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TABLE III: HAEMATOLOGICAL INDICES OF RABBITS FED *KIGELIA AFRICANA* FRUIT AND LEAF MEALS FOR 8 WEEKS

KA PARTS	WBC ($\times10^9$)/L	HETE (%)	LYMPH (%)	MONO (%)	RBC ($\times10^{12}$)L	HGB (g/dl)	PCV (%)	MCV (fl)	MCH (pg)	MCHC (g/dl)	PLT (10^3 /µL)
Fruit	4.80	34.30	61.07^{a}	2.63^{a}	5.05	7.94^{a}	34.18	54.03	16.42	30.68	240.93
Leaf	4.96	36.25	59.68^{b}	1.80^{b}	4.64	6.99^{b}	35.03	53.63	15.76	29.17	231.68
P Value	0.63	0.11	0.22	0.002	0.08	0.01	0.27	0.75	0.19	0.01	0.36
INCLUSION LEVELS (%)											
0	4.61^{b}	33.50^{b}	62.50	2.75^{a}	4.27^{b}	6.29^{c}	27.81^{c}	50.13^{b}	15.36^{b}	30.11^{bc}	234.75
5	5.83^{a}	38.06^{a}	58.88	1.75^{bc}	4.69^{a}	7.34^{bc}	34.63^{b}	53.44^{ab}	15.87^{b}	27.84^{d}	235.88
10	4.68^{b}	37.56^{ab}	58.06	1.50^{c}	5.23^{a}	7.46^{b}	36.56^{ab}	53.94^{ab}	15.39^{b}	28.74^{cd}	221.75
15	5.01^{ab}	33.50^{b}	61.75	2.38^{ab}	5.25^{a}	8.65^{a}	37.69^{a}	53.94^{ab}	16.13^{ab}	32.07^{a}	238.50
20	4.98^{b}	33.75^{b}	60.69	2.68^{a}	4.79^{ab}	7.58^{ab}	36.31^{ab}	57.69^{a}	17.72^{a}	30.86^{ab}	250.63
P Value	0.04	0.02	0.08	0.01	0.05	0.002	<0.001	0.01	0.02	0.00	0.49
Trt*Type	*	*	*	*	NS	*	*	NS	NS	NS	NS
P Value	0.00	0.02	0.08	0.00	0.27	0.02	<0.001	0.81	0.31	0.06	0.05
SEM	0.63	0.84	0.81	0.18	0.16	0.24	0.54	0.92	0.36	0.41	7.03

KA= *Kigelia africana* a, b, c – means with different superscript are significant along the row, PCV= packed cell volume, WBC= white blood cell, RBC= red blood cell, HGB= haemoglobin, MCHC= measn corpuscular haemoglobin concentration, MCH= mean corpuscular haemoglobin, MCV= mean corpuscular volume, HETE= Heterophyl, LYMPH=Lymphocyte, MONO=Monocyte, *- significant (p<0.05), NS – Not-significant (p>0.05), SEM= Standard Error of Mean

TABLE IV: INTERACTIONS BETWEEN KA PARTS AND KA INCLUSION LEVELS ON SELECTED HAEMATOLOGICAL PARAMETERS OF RABBITS FED *KIGELIA AFRICANA* FRUIT AND LEAF MEALS

		Inclusion Levels (%)					
Parameters	**KA Parts**	**0%**	**5%**	**10%**	**15%**	**20%**	**SEM**
WBC ($\times10^9$)/L	**Fruit**	4.61^{abc}	6.81^{ab}	5.26^{abc}	3.70^{c}	3.61^{c}	0.24
	Leaf	4.61^{abc}	4.85^{abc}	4.10^{bc}	6.33^{ab}	5.98^{a}	0.24
Hterophils (%)	**Fruit**	33.50^{ab}	38.13^{a}	37.88^{a}	33.38^{ab}	28.63^{b}	1.89
	Leaf	33.50^{ab}	38.00^{a}	137.25^{ab}	33.63^{ab}	38.88^{a}	1.89
Monocytes (%)	**Fruit**	2.75^{ab}	1.50^{b}	1.63^{b}	3.00^{ab}	4.25^{a}	0.41
	Leaf	2.75^{ab}	2.00^{b}	1.38^{b}	1.75^{b}	1.13^{b}	0.41
Haemoglobin (g/dl)	**Fruit**	6.29^{c}	8.28^{abc}	7.33^{abc}	8.79^{ab}	9.01^{a}	0.54
	Leaf	6.29^{c}	6.40^{bc}	7.59^{abc}	8.51^{abc}	6.14^{c}	0.54
PCV (%)	**Fruit**	31.44^{bc}	34.79^{abc}	35.85^{abc}	34.48^{abc}	37.10^{ab}	1.51
	Leaf	31.44^{bc}	36.11^{abc}	36.56^{abc}	34.38^{abc}	40.25^{a}	1.51

*KA= *Kigelia africana*, WBC= white blood cell, a, b, c – means with different superscripts are significant along the row, SEM= Standard Error of Mean

TABLE V: EFFECT OF *KIGELIA AFRICANA* FRUIT AND LEAF MEALS ON SELECTED SERUM BIOCHEMICAL PARAMETERS OF RABBITS FED FOR 8 WEEKS

KA Parts	Total Cholesterol (mg/dl)	ALT (U/L)	AST (U/L)	ALP (U/L)	Albumin (mg/dl)	Total protein (mg/dl)	Creatinine (mg/ml)	Urea (mmol/l)
Fruit	37.20	20.56	41.59^{b}	6.60	1.78	10.35^{a}	1.43	2.56
Leaf	36.35	20.07	44.05^{a}	6.32	1.74	8.45^{b}	1.49	2.41
P value	0.68	0.29	0.01	0.53	0.19	0.01	0.87	0.17
Inclusion Levels (%)								
0	38.81	21.08	44.83^{a}	8.71^{a}	1.78	14.89^{a}	1.29	2.54
5	38.54	20.40	42.93^{a}	4.76^{c}	1.79	9.63^{b}	2.08	2.63
10	38.35	20.72	42.93^{a}	6.71^{b}	1.79	7.71^{bc}	1.56	2.53
15	35.34	19.74	42.06^{ab}	5.93^{bc}	1.74	7.70^{bc}	1.38	2.44
20	32.83	19.63	41.34^{b}	5.93^{bc}	1.72	7.07^{c}	1.01	2.30
P value	0.28	0.22	0.21	<.0001	0.52	<.0001	0.57	0.36
Parts*Levels	NS	NS	NS	*	NS	NS	NS	NS
P value	0.71	0.96	0.58	0.002	0.68	0.68	0.21	0.08
SEM	1.02	0.23	0.47	0.22	0.02	0.37	0.21	0.05

KA= *Kigelia africana*, ALT= Alanine aminotransferase, AST= Aspartate aminotransferase, ALP= Alkaline phosphatase, a, b, c – means with different superscripts are significant along the row, *- significant, NS – Not-significant, SEM= Standard Error of Mean

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TABLE VI: INTERACTIONS BETWEEN KA PARTS AND INCLUSION LEVELS ON ALP OF RABBITS FED KIGELIA AFRICANA MEALS FOR 8 WEEKS

		Inclusion Levels (%)					
Parameter	**KA Parts**	0%	5%	10%	15%	20%	SEM
ALP (U/L)	**Fruit**	8.71^{a}	4.85^{bc}	7.62^{abc}	4.52^{c}	7.30^{abc}	0.69
	Leaf	8.71^{a}	4.67^{bc}	5.81^{abc}	7.89^{ab}	4.55^{bc}	0.69

KA= *Kigelia africana*, a, b, c – means with different superscripts are significant along the row, ALP= Alkaline phosphatase, SEM= Standard Error of Mean

4 CONCLUSION

In conclusion, *Kigelia africana* fruit and leaf meal supplementation in rabbit diet demonstrated a positive response in some parameters with those on the fruit meal exhibiting best performance, and also showcasing a hepatho-protective ability of both plant parts, indicating their safe use up to 15% inclusion in rabbit diets without posing danger to their health.

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