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## Comprehension of Phytochemical and pharmacological study of *Kigelia Africana* (*Bignoniaceae*)

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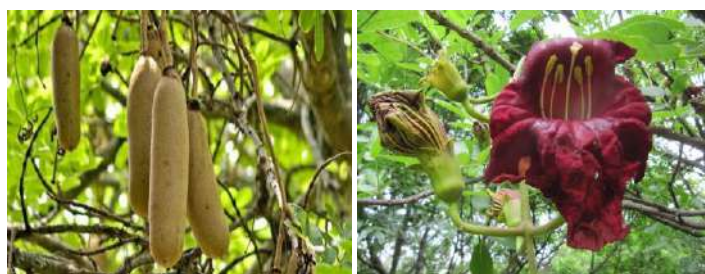
### Abstract

People through out the world use medicinal plants to treat different ailments. *Kigelia Africana* (*Bignoniaceae*), commonly known as African sausage tree, is a medicinal plant traditionally used for the treatment of numerous diseases. *Kigelia Africana* is a deciduous tree, 20-30 m tall and 65 cm in diameter. The plant is described to have a widespread range of therapeutic activities, such as antidiabetic, anticancer, antimalarial, antibacterial, analgesic antileprotic, and anti-diarrhoeal, anti-inflammatory, anti-urolithiasis, antioxidant, etc. The whole plants can be broadly studied for further future potential. The review will provide the information of *Kigelia Africana* on the account of Pharmacognostic, phytochemical and pharmacological study in a similar way.

**Keywords:** Bignoniaceae, *Kigelia Africana*, Pharmacognostic, Phytochemical, medicinal plants.

### Introduction

Medicinal plants have been extensively used in traditional medicine and worldwide ethnomedicine. In current years, many researchers have focused on medicinal plants resulting from natural products because of their wide range of therapeutic significance [1]. Though there are excessive advances of modern scientific medicine, traditional medicine is still the main form of treating ailments of people in developing countries like India, even between those to whom western medicine is available, the number of people using one form or another of balancing of alternative medicine is rapidly increasing global. The greater knowledge of the metabolic process and the effect of plants on human physiology has widened the field of application of medicinal plants [2]. The current review is the attempt to explore one of the important traditional medicinal plants for its Pharmacognostic, Phytochemical and pharmacological aspects.



**Fig 1:** Fruits and Flower of *Kigelia Africana* plant

### Taxonomy

#### Botanical classification [3]:

Kingdom : Plantae, Subkingdom : Tracheobionta, Super-division : Spermatophyta, Division : Magnoliophyta, Class : Dicotyledons, Subclass : Asteridae Order : Scrophulariales Family : Bignoniaceae, Genus : *Kigelia*, Species : *pinnata* (Lam.) Benth.

#### Vernacular names [4]:

English: Sausage Tree, Cucumber Tree, Hindi: Balamkheera, jhar fanus Kannada:

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Aanethoradu Kaayi, Mara Sowthae, Malayalam: Shiva Kundalam, Telugu: Kijili, Ngamalle.

#### Habitat <sup>[5, 6]</sup>:

It is grown in the rainforest, usually at wet sites and along rivers in wet forests. It is a tree that grows up to 20 m (66 feet) in height and generally has extended branches. The bark is initially gray and smooth, peeling older trees. It can have a thickness up to 6 mm (1 pollice4 of an inch) on a branch of 15 cm of diameter the wood is light brown or yellowish, not differentiated and not subject to cracks.

#### Morphology <sup>[7]</sup>:

Leaves: opposite or spirals 30 to 50 cm long, pinnate, with 6-10 oval leaflets, each up to 20 cm long and 6 cm wide.

Flowers: bisexual, very large; long stem up to 11 cm curved at the tip; caliche shaped tubular bell short 2 to 4.5 cm long, which widens and curves upward, limping with 2 lips, with superb or lip with 2 lobes, the lower with 3 lobes and curved.

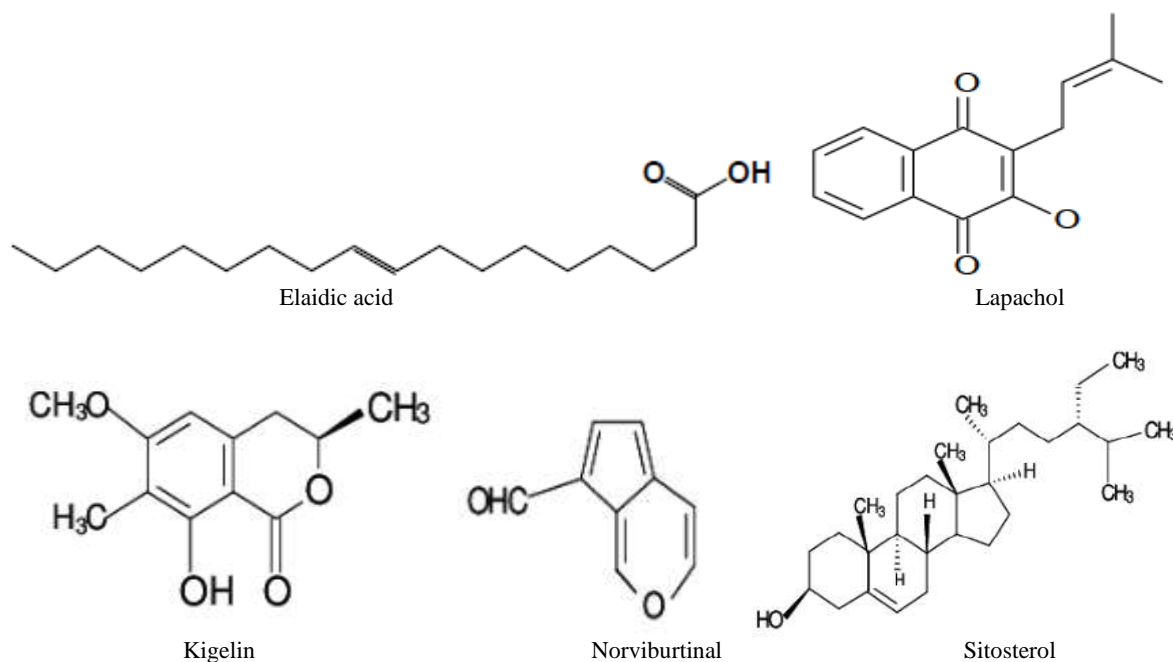
Fruits: a large gray-brown fruit is a woody berry 30 to 100 cm long and up to 18 cm wide. It weighs between 4 and 10 kg and hangs on a long and fibrous stem. The fruit is fibrous and fleshy, and contains numerous hard seeds that are not edible for humans.

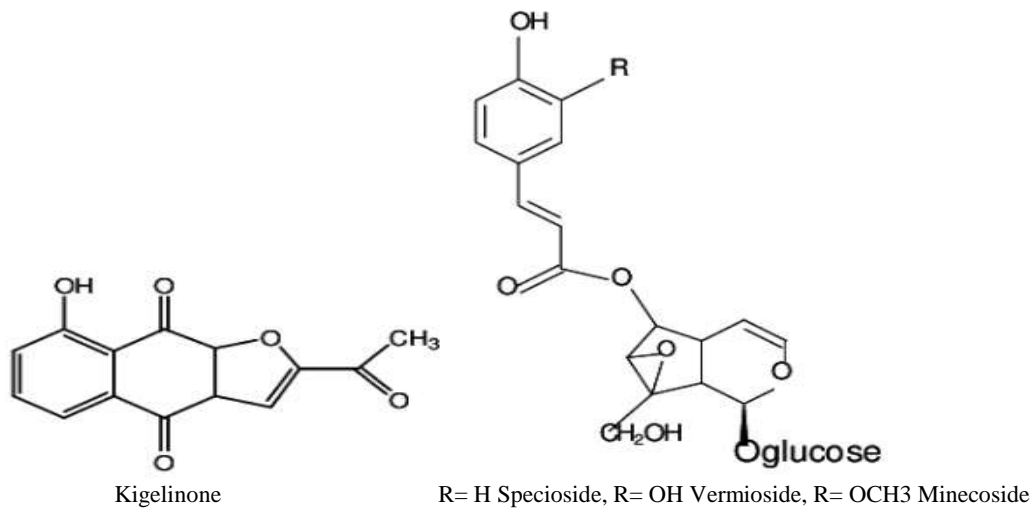
#### Phytochemistry

The consideration of the phytochemical components of medicinal plants such as *K. Africana* is vital not only for the understanding of the scientific basis for their use, but also for the discovery of new compounds of therapeutic value <sup>[8]</sup>. Several phytochemical studies have revealed that the extracts of Many Bignoniaceae species contained secondary metabolites such as saponins, tannins, flavonoids, quinone alkaloids, derivatives of anthralenes, reducing sugars, glycosides, carbohydrates, quercetin, kaempferol,  $\beta$ -sitosterol, terpene, steroids, secondary metabolites and their derivatives <sup>[9, 10, 11]</sup>

**Table 1:** Phytoconstituents in different parts of *Kigelia africana* plant

Sr. no.	Part	constituents	Reference
1	Leaves	Hentriacontane, $\beta$ tocopherol, 3-hydro-4,8-phytene, 1,3,3,5,6,6-hexamethylcyclohexa-1,4-diene	12
		Lupeol, $\beta$ - Sitosterol, sitosteryl $\beta$ -D-glucoside, canophyllol, pomolic acid, hydroxy-pomolic acid,	13
		Caffeic acid, 7-hydroxy viteoid II, Polybotrin, Benzyl- $\beta$ -D-glucopyranoside, Verminoside, Scutellarin 7-O- $\beta$ -D-glucopyranoside,	14
3	Fruits	$\beta$ -friedelinol, fibrarecisin, sesamin, paulownin,	13
		iridoid glycosides, phenylpropanoid derivatives, and a eucommiol derivative.	08,15
		verminoside (iridoid), verbascoside(polyphenol)	16
4	root	iridoids, naphthoquinones and coumarins, Elaidic acid, Lapachol	17
5	stem bark	iridoids specioside, verminoside and minecoside	18





**Fig 2:** Some phytoconstituents of Kigelia Africana plant

## Pharmacology

### Anti-atherosclerotic effects

Kim HJ *et al.*, 2018 studied the effects of the extract of *Kigelia africana* (Lam.), Focusing in particular on the anti-atherosclerotic effects on endothelial cells (EC). *Kigelia africana* methanol extract showed no cytotoxicity in the EC at doses of 10 ~ 200 µg / ml. At a concentration of 50 µg / ml it showed a significant inhibition. The work concludes that it could be used for the treatment of atherosclerosis without cytotoxicity [19].

### Anticonvulsant activity

Singh A *et al.*, 2010 [20] studied the anticonvulsant activity of methanolic (KPM) and aqueous (KPA) bark extracts of *Kigelia pinnata* using pentylene tetrazole and convulsions induced by maximum electroqueque in glycine rats. 250 mg / kg and 500 mg / kg of KPM and KPA showed a significant anticonvulsant effect by increasing the onset of clonic convulsions and decreasing the onset of tonic convulsions. [20]

### Antidiabetic and antioxidant activities

Babu BH *et al.*, 2019 [21] studied the antioxidant and antidiabetic activity of the *Kigelia pinnata* stem using 1,1-diphenyl-2-picrylhydrazyl (DPPH) and the *in vitro* α-amylase inhibition method, respectively. The inhibition of DPPH was tested for ethyl acetate, methanol, aqueous extracts. In *Kigelia africana* (stem), the aqueous extract found an IC<sub>50</sub> at 20 µg / ml in the DPPH method and standard ascorbic acid shows DPPH IC<sub>50</sub> at 20 µg / ml. The aqueous extract shows an inhibition of α-amylase IC<sub>50</sub> at 15 µg / ml, while the standard acarbose drug shows an inhibition of α-amylase IC<sub>50</sub> at 20 µg / ml. [21]

### Antifungal and antibacterial activities

Owolabi OJ *et al.*, 2007 [22, 27] studied antibacterial and antifungal activity of *Kigelia Africana* stem bark. The results revealed that the crude ethanolic extract showed antibacterial and antifungal activity against *Staphylococcus aureus* and *Candida albicans* with zones of inhibition of 15.0 ± 0.95 and 20.75 ± 4.6 mm respectively. The aqueous extract showed no antibacterial or antifungal activity. The activities of the extracts have been compared with various standards; Ampicilina, Amoxicilina, Gentamicina, Ceftriaxona and Ciprofloxacin [22].

### Anti-inflammatory activity

Carey WM *et al.*, 2008 [23] investigated the anti-inflammatory effect of the methanolic extract of the *Kigelia pinnata* fruit using different *in vivo* inflammation models in mice and rats, such as formaldehyde-induced leg edema, acetic acid-induced vascular permeability. using cotton granules, estimation of plasma MDA levels and models of carrageenin-induced peritonitis. The dose of 100, 200 and 400 mg / kg of methanol extract of *Kigelia pinnata* showed an effect comparable to that of standard drugs [23].

Mukesh R *et al.*, 2012 reported anti-inflammatory activity of *Kigelia pinnata* leaf extract on Ratti Wistar. Through methods of leg edema induced by carrageenan and granuloma induced by cotton with indomethacin reference standard. The 200 mg / kg and 400 mg / kg dose of *Kigelia pinnata* leaf extract has a significant reduction in carrageenine-induced leg edema (P <0.001) in a dose-dependent manner [24].

Kamau JK *et al.*, 2016 [25] studied the anti-inflammatory activity of the methanol extracts of *Kigelia Africana* using the carragen-induced posterior leg edema method with the reference drug diclofenac. The extract of the *K. africana* leaf reduced the diameter of the inflamed hind paw of the mice by 0.21% - 4.98%. Diclofenac reduced the diameter of the inflamed hind paw to between 1.11% -4.9%. The extracts were more active at a dose of 150 mg / kg body weight in the fourth hour of treatment [25].

### Antimicrobial, antioxidant and wound healing

Agyare C *et al.*, 2013 [26] studied the antimicrobial and antioxidant properties of methanol leaf extracts and the cortex of the *Kigelia Africana* stem. The antimicrobial activities of the methanol extracts were determined against two Gram positive and two Gram negative bacteria and one fungus using micro and micro dilution diffusion methods. Antioxidant activity was determined using the 1, 1-diphenyl-2-picryl-hydrazyl (DPPH) method. The influence of the extracts on the wound closure rate was studied using the excision injury model. The MIC of the extract of *K. africana* leaves against the examined organisms was 2.5–7.5 mg / ml and the stem bark extract was 2.25–7.5 mg / ml. Extracts of *K. africana* (7.5% w / w) showed a significant wound contraction (P <0.05) on day 7 with a wound closure of 72% while significant wound contractions (P <0, 05) [26].

**Analgesic and anti-inflammatory.**

Owolabi OJ *et al.*, 2007 [22, 27] evaluated *Kigelia Africana* ethanol extract for its analgesic properties using acetic acid induced by acetic acid and the reaction time of hot plaque and anti-inflammatory properties using the edema method of legs induced by carrageenan. The extract of *K. africana* showed a significant dose-dependent reduction in the number of twists ( $P < 0.001$ ) with a dose of 500 mg / kg of body weight which gave the greatest reduction. The extract of *K. africana* showed a significant dose-dependent reduction in the number of twists ( $P < 0.001$ ) with a dose of 500 mg / kg of body weight which gave the greatest reduction. The extract showed an insignificant elongation of the hot plate reaction time ( $P > 0.05$ ). Significant dose-dependent inhibition was observed in carragen-induced leg edema [27].

Carey MW *et al.*, 2010 [28] studied the possible anti-inflammatory and analgesic activities of the methanolic extract of the *Kigelia pinnata* flower. Anti-inflammatory activity performed in the model of carrageenan-induced leg edema in rats and analgesic activity in models of leg licking induced by acetic acid, heating plate and induction of formalin in mice. The extract showed anti-inflammatory and analgesic activity with doses of 100, 200 and 400 mg / kg of body weight. in rats and mice respectively [28].

**Antineoplastic activity**

Momekov G *et al.*, 2012 [29] assessed the antineoplastic activity of a total methanolic extract from the stem bark of *Kigelia pinnata* using *in vitro* testing included cytotoxicity (MTT assay) and pro-apoptotic activity investigation. The extract displayed prominent cytotoxicity against a panel of human tumor cell lines and exerted strong antineoplastic activity against Lewis lung carcinoma with prominent increase of the life span of treated animals and tumor growth inhibition [29].

**Antioxidant and antimicrobial activity**

Olubunmi A *et al.*, 2009 [30] antimicrobials in a Gram positive (*Staphylococcus aureus*), two Gram negative bacteria strains (*Klebsiella pneumonia*, *Salmonella typhi*) and two fungi (*Candida albicans* and *Trichophyton mentagrophyte*) using tetracycline as standard antibiotics [30].

Abere TA *et al.*, 2015 [31] studied the antioxidant activity of using different fractions of *Kigelia pinnata* leaf extracts with the DPPH radical scavenging method. The polyphenolic contents were also evaluated. The inhibitory activity of the crude methanol extract and the fractions against the clinical strains of *Escherichia coli*, *Bacillus subtilis*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsiella aerogenes*, *Candida albicans* and *Candida parasilopsis* were compared respectively with ciprofloxacin and nystatin for bacteria and fungi. The N-butanol fraction showed the maximum antioxidant activity. The extract and the crude methanol fractions inhibited the growth of *E. coli*, *B. subtilis*, *S. aureus*, *P. aeruginosa*, *C. albicans* and *C. parasilopsis* at various levels, with the exception of the aqueous fraction without activity [31].

**Antiamobic activity**

Bharti N *et al.*, 2006 [18] studied the *in vitro* antiamobic evaluation of isolated iridoids, such as speciosid, verminoside and minecoside. Metronidazole used as a

reference standard. Verminoside showed a double antiamobic activity compared to the standard drug, while the spicy one showed an activity comparable to metronidazole [18].

**Antioxidant and anticancer activity**

Olubunmi *et al.*, 2013 [32] studied isolated fractions of leaf extract for antioxidant and cytotoxic activity. Antioxidant activity performed by *in vitro* techniques such as reducing ferric antioxidant power (FRAP), elimination of 2,2-diphenyl-1-picrylhydrazyl radicals (DPPH) and 2,2-azinobis acid (3-ethyl-benzothiazoline acid -6 test 'sulfonic acid (ABTS). The cytotoxic activity was evaluated in human rhabdomyosarcoma tumor cells to determine their cytotoxicity using 3- (4.5-dimethylthiazol-2-yl) -2 bromide cell viability assays. 5-diphenyltetrazolium (MTT) with reference cyclophosphamide the methanol extract was richer in phenol and was more potent as an antioxidant and cytotoxic agent among all the substances analyzed the relatively high cytotoxicity index was found to be extracted from acetate ethyl [32].

**Anticonvulsant activity, anxiolytic activity and effect on motor coordination.**

Dhanasekaran. M *et al* 2014 [33] studied extracts of petroleum ether, chloroform and methanol obtained from *Kigelia Africana* leaves using the animal model of Wistar of albino rat for anticonvulsant activity, anxiolytic activity and effect on motor coordination activity. The discovery revealed that the plant can be used as a nervous tonic [33].

**Antimicrobial activity**

Abdulkadir MN *et al.*, 2015 [34] studied the antimicrobial activity of petroleum ether, chloroform, methanol and aqueous extracts of *Kigelia africana* against *Candida albicans*, *Escherichia coli*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, *Streptococcus feacalis* and *Staphylococcus a.* Petroleum ether extract showed dose-dependent antibacterial activity against *Candida albicans* and *Pseudomonas aeruginosa*. Chloroform extract showed a dose-dependent activity against *Streptococcus feacalis* and *Staphylococcus aureus*. The methanol extract and the aqueous extract were active only against *Staphylococcus aureus* [34].

**Anti-urolithic activity**

Kumar S *et al.*, 2012 [35] evaluated the ethanol extract of the *Kigelia pinnata* fruit against ethylenic glycol-induced urolithiasis in rats using cistone as a standard anti-urolithic drug. The antiurolithic activity of the *Kigelia pinnata* fruit extract was studied by measuring the serum marker (creatinine and uric acid), the homogenized tissue marker (calcium, oxalate and phosphate), the urinary parameter (calcium, oxalate, phosphate, uric acid and magnesium) and urine production is therefore significantly reduced and prevented the growth of urinary calculi [35].

**Cardioprotective activity**

Yalu H *et al.*, 2015 [36] studied the cardioprotective activity of *Kigelia Africana* leaves in myocardial infarction induced by isoprenaline with propranolol as a reference standard. 100 mg / kg, 200 mg / kg of methanol extract from the leaves of *Kigelia Africana* showed a significant reduction in the serum marker enzymes aspartate transaminase (AST),

lactate dehydrogenase (LDH), alanine transaminase (ALT), alkaline phosphatase (ALP), changes in markers of oxidative stress such as lipid peroxidase (LPO), glutathione (GSH), catalase (CAT) and superoxide dismutase (SOD) caused by ISO (5.25 and 8.5 mg / kg) <sup>[36]</sup>.

#### Diuretic activity

Agarwal V *et al.*, 2010 <sup>[37]</sup> studied the diuretic activity of aqueous *Kigelia pinnata* bark extract in experimental rats. The diuretic properties were evaluated by determining the volume of urine, the concentration of electrolytes and the diuretic power in male albino rats. Different concentrations (250 mg / kg, 500 mg / kg) were administered orally to hydrated rats and their urine production was measured immediately after 5 hours of treatment with Frusemide as a reference drug. 500 mg / kg showed that the highest activity with a power value of 0.80 caused an increase in the Na<sup>+</sup>, K<sup>+</sup> and Cl<sup>-</sup> signs <sup>[37]</sup>.

#### Hypoglycemic activity

Njogu SM *et al.*, 2018 <sup>[38]</sup> studied the *in vivo* hypoglycaemic activity of aqueous extracts and ethyl acetate of African *Kigelia* leaves using the Alloxan-induced diabetes model. The study showed that the aqueous extracts and ethyl acetate leaf of African K had antidiabetic activity when therapeutic doses were administered both intraperitoneally and orally in both fractions <sup>[38]</sup>.

#### Spasmolytic and antidiarrheal effects

Otimenyin SO and Uzochukwu DC 2010 have studied the spasmolytic and antidiarrheal effects of K. *Africana* cortex using *in vivo* castor oil that induces the diarrhea model in rats and in rabbit isolated fast *in vitro*. K. *africana* (500 and 1000 mg / kg) significantly reduced (P < 0.05) the frequency of diarrhea in the faeces and the spontaneous propulsive movement of the isolated rabbit fasting (anti-motility) <sup>[39]</sup>.

#### Conclusion

The review reveals that *Kigelia Africana* (Bignoniaceae) was found to be a powerful analgesic, anti-inflammatory, CNS depressant, anthelmintic, antibacterial, antifungal and cytotoxic. The chemical components present in the plant are mainly tannins, terpenoids, saponins and flavonoids which are responsible for the actions. Further research is needed to isolate the components responsible for the required therapeutic activities. This review concludes that the plant has a high medicinal value.

Therefore, by using reverse pharmacological approaches in the discovery of natural drugs, it is possible to study a powerful and safe plant drug for various chronic diseases such as diabetes, liver disease, arthritis, cancer and inflammatory diseases.

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