



Kigelia africana (Lam.) Benth: Sausage of Medicinal Properties

Jubilee R¹, Komala M^{*2}

¹Department of Pharmacology, School of Pharmaceutical Sciences, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Pallavaram, Chennai-600117, Tamil Nadu, India

²Department of Pharmaceutical Pharmaceutics, School of Pharmaceutical Sciences, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Pallavaram, Chennai-600117, Tamil Nadu, India



Article History:

Received on: 15 Sep 2020
Revised on: 16 Oct 2020
Accepted on: 22 Oct 2020

Keywords:

K.africana,
cucumber,
kigelinole,
pinnatal,
leshmaniasis

ABSTRACT

Nature had been serving humanity from ages by providing with the food and resources of our well-being. It was serving with medicines and herbs that are used to heal many disorders. There were numerous lead molecules that had been isolated from natural sources, especially plants. *Kigelia africana* (Lam.) Benth is a widely distributed plant in Africa. Savage tree or the cucumber plant is the common name of the plant. It belongs to the family Bignoniaceae. The plant is a native plant of Africa which is confined to the south, central and West African regions. Preliminary phytochemical screening was performed for the plant revealed the presence of alkaloids, tannins, saponins, flavonoids, carbohydrates and sapogenetic glycosides. The plant has been reported to contain flavonoids, aldehyde iridioids, coumarins like dihydroisocoumarin, naphthoquinones like pinnatal, isopnnatal, kigelinole and isokigelinole. It had been investigated and proven to possess various chemicals that treat inflammations, cancers, psoriasis, dysentery and bacterial infections.

*Corresponding Author

Name: Komala M
Phone: 9840697473
Email: komala.pharmacy@gmail.com

ISSN: 0975-7538

DOI: <https://doi.org/10.26452/ijrps.v12i1.4097>

Production and Hosted by

IJRPS | www.ijrps.com

© 2021 | All rights reserved.

INTRODUCTION

Nature had been serving humanity from ages by providing with the food and resources of our well being. It was serving with medicines and herbs that are used to heal many disorders. There were numerous lead molecules that had been isolated from natural sources, especially plants (Cordell, 2000). In this paper, one of such most noted plants of Africa is being reviewed for its traditional claims, chemical

constituents that had been isolated till date and the pharmacological activities that had been performed on the plant till now.

Kigelia africana (Lam.) Benth is a widely distributed plant in Africa. The plant is a native plant of Africa which is confined to the south, central and West African regions. Savage tree or the cucumber plant is the common name of the plant. It belongs to the family Bignoniaceae. Its fruits are huge and grow to about 60cm long and weigh about 4-5 kg. In Hindi, it is called a balm kheera plant and is wide distributed in India and most commonly in West Bengal. The plant grows about 10m high and prefers a moist climate to grow (Sofowora, 1980) (Figure 1).

Traditional claims

Traditionally this plant has claimed that the application of crushed or pounded plant topically cures abscess and wounds. The bark of the plant is used in the treatment of many venereal diseases and dysentery (Agyare et al., 2013b). The plant is claimed to treat diseases due to tapeworm, malaria and post-partum hemorrhage (Zofou et al., 2013).



Figure 1: *Kigelia africana* (Lam.) Benth

The plant is claimed to possess healing properties against eczema, psoriasis, amoebic dysentery, plasmodial malaria, DM, foot ulcers, and also used to cure rheumatism (Carey *et al.*, 2008; Picerno *et al.*, 2005).

Chemical Constituents

The plant has been reported to contain flavonoids, aldehyde iridioids, coumarins like dihydroisocoumarin, naphthoquinones like pinnatal, isopinnatal, kigelinole and isokigelinole.

Especially, roots and bark of the plant are isolated for Lapachol, ferulic acid, sterols like stigmasterols, methoxymellein and other two phenols. Kigelin is the major active principle that is isolated from the plant along with methoxymellein (Agyare *et al.*, 2013a). Preliminary phytochemical screening was performed for the plant revealed the presence of alkaloids, tannins, saponins, flavonoids, carbohydrates and sapogenetic glycosides (Agyare *et al.*, 2013b).

A compound named Kojic acid has been isolated from the plant and was confirmed by XRD studies. This was believed to be the metabolite of the shikimic acid pathway (Eyong *et al.*, 2013). Three fatty acid derivatives had been isolated from the ethyl acetate extract of the fruits of *K. africana*. Fractionation was done using bioassay guidance, and palmitic acid was extracted from the fruits of the plant (Grace *et al.*, 2002).

Natural fibres are extracted from the plant using sodium hydroxide. They are bleached and characterized. The produced fibres are rough and soft. The thermal stability and crystallinity were established. They contained a majority of hemicellulose content

in the fibres. The fibres also exhibited antibacterial properties and hydrophobic nature. All the other characters are similar to that of cotton and many conventional fibres (Ilangovan *et al.*, 2020).

The plant was isolated for caffeic acid glycosides, specioside and verbascoside, including minescoside (Costa *et al.*, 2017). Verminoside and methyl esters of caffeic acid were also isolated from *Africana* (Picerno *et al.*, 2005). The plant also contains sterols like norviburtinal and isopinnatal, which is evident from a study (Jackson *et al.*, 2000). Apart from caffeic acid, it also was elucidated for chlorogenic acid and furanone derivatives like ajujol (Gouda *et al.*, 2003). Compounds like iridioids, phenylpropanoid derivative and eucommiol derivatives were isolated from the plant (Khan *et al.*, 2017).

Pharmacological activities

Antimalarial activity

The plant has been investigated for anti-malarial activity against the chloroquine-sensitive strain of the plasmodium and reported that the methylene chloride leaf extract of the plant showed better activity against the organism. The stem bark also was investigated for the anti-malarial activity and showed 3 activity compounds, Atranorin, Specioside and hydroxyl cinnamic acid which are potent against *Plasmodium falciparum* (Zofou *et al.*, 2011, 2013).

The synergistic effect was investigated by combining the compound, Atranorin with Withaquinine and Artemether, which were potent anti-malarial drugs. Contrarily, there was an antagonistic effect of the above compounds when used in combination with P-hydroxy cinnamic acid and Specioside (Zofou

et al., 2013).

Pharmacological activities

Anti-Bacterial activity

Kigelia africana, along with *Strophanthus hispidus*, were investigated for the antimicrobial activity. The stem bark and leaves of *K. Africana* was extracted with methanol and root and leaves of *S. Hispidus* were extracted with Methanol. These extracts were combined and tested for the antibacterial property against two gram-positive and negative bacteria. Disc diffusion method and Micro dilution methods were used to investigate for the activity. The extracts of *K.africana* showed a better activity with MIC higher than that of *S.hispidus* (Agyare *et al.*, 2013b).

The antibacterial activity of the stem bark and fruits was tested by extracting with water, ethanol or ethyl acetate in another study. This resulted in proving the potent antibacterial activity against gram-positive and negative bacteria. The method used was microtitre plate bioassay. The fruit extracts and stem bark showed similar activity in both types of bacteria (Grace *et al.*, 2002)

The antibacterial activity of the stem bark of the plant was investigated in a study conducted by Omonkhehin. They tested the activity using *Staphylococcus aureus* and the aqueous extract showed no activity, but there was significant activity with the ethanol extract. The zone of inhibition was found to be 15.05. The extract was compared with the standard drugs like ciprofloxacin, Ceftriaxime and ampicillin, including gentamicin and it produced a similar activity compared to the standard drug, amoxicillin (Owolabi *et al.*, 2007).

Anti leishmanial activity

The plant was extracted with various solvents and tested for the antimicrobial properties on various organisms. The hexane derivatives were effective against *Cryptococcus neoformans* Pinh. Chloroform derivatives were active against *Leishmania donovani* which was elucidated for Verminoside and showed a slight inhibition of CB1, CB2. Both the extracts were active against *Trypanosoma brucei*. The ethyl acetate fraction of the extracts showed similar activity against all the organisms (Khan *et al.*, 2017).

Antioxidant activity

The antioxidant activity was investigated using the DPPH free radical scavenging method. The stem bark and leaves were tested for the activity. This was compared with the root and leaves of the plant *S. Hispidus*. The IC₅₀ of stem bark and leaves extract

of *K. africana* were determined as 56.9 and 13.7 mcg/mL, respectively and root and leaf extracts of *S. hispidus* were determined 49.8 and 45.1 mcg/mL, respectively (Agyare *et al.*, 2013b).

Wound healing activity

K. africana stem bark and leaf extracts were elucidated at 7.5% w/w and were investigated for the wound healing activity and the activity was very rapid. The complete closure was seen in 9 days (Agyare *et al.*, 2013b).

Antifungal activity

The antifungal activity of the stem bark of the plant was investigated in a study conducted by Omonkhehin. They tested the activity using *Candida albicans* and the aqueous extract showed no activity but there was significant activity with the ethanol extract. The zone of inhibition was found to be 20.75. The extract was compared with the standard drugs, including gentamicin and it produced a similar activity compared to the standard drug, amoxicillin (Owolabi *et al.*, 2007).

Quorum Sensing (QS) inhibition

The antivirulence properties of the plant were investigated using Quorum Sensing (QS) inhibition. Four extracts, Dichloromethane, Ethyl acetate, Hexane and methanol were tested for the activity against biosensor systems of *Agrobacterium tumefaciens* and *Chromobacterium violaceum*. The inhibition of the Quorum sensing controlled production of violacein was assayed and measured using the agar diffusion assay method. The order of the activity is as follows in ascending order: methanol<ethyl acetate<dichloromethane<hexane. Both the LuxI and Lux R were investigated, which targeted the QS signal and QS receptor (Chenia, 2013).

Antiprotozoal activity

The antiprotozoal activity of the fruits of the plant was investigated using the modified disc diffusion method and MIC method. The activity was tested against *Giardia duodenalis*. Methanol, water and ethyl acetate were used as solvent of extraction. The methanol and water extracts showed potent activity against the organisms. The methanol, water, and ethyl acetate extracts also inhibited between 55 and 70 % of the growth of the gastrointestinal parasite *Giardia duodenalis* (Arkhipov *et al.*, 2014).

Anticancer activity

The anti-cancer activity of the fruits of the plant was tested against the HeLa cell lines and CaCO₂ induced cancers in the colorimetric proliferation of cells. The proliferation of the cell lines was inhibited in the CaCO₂ model by 50% and the HeLa cell lines were

inhibited from the growth in the cervical cell growth using the methanol extract. Other extracts, chloroform and hexane stimulated HeLa cell growth and were found to show proliferative effects (Arkhipov et al., 2014).

Polycystic Ovary Syndrome (PCOS)

The fruit powder of the plant was used for the treatment of PCOS in patients at a dose of one ounce twice daily. The patients were tested for Amenorrhoea and hirsutism. The herbal preparation of the fruits was used to restore the menstrual flow in both the patients leading to the reduction in the acne and there was no significant reduction in the acnes. Overall the fruits of the plant were proven beneficial in treating the PCOS (Oyelami et al., 2012)

CNS stimulant

The stem bark of the plant was extracted with ethanol and was tested for the stimulation activity of the central nervous system. It was tested in the mice induced with sleep with the help of barbiturates in the rotarod method. The extract was able to successfully recover the mice faster from the barbiturate when compared with the standard (Owolabi et al., 2008).

CONCLUSIONS

Plants are the sources of many drugs and the sole nature of the plants of lack of side effects is the advantage of using herbs as medicines. They are the sources of numerous lead molecules that treat many dreadful diseases. *K. africana* is one of those plants that grow in Africa with a potency of generating various leads and competing with synthetic drugs. It had been investigated and proven to possess various chemicals that treat inflammations, cancers, psoriasis, dysentery and bacterial infections. This demands further in-depth research to isolate those leads that are used to treat the above-stated diseases and establish a prominent mechanism of action.

ACKNOWLEDGEMENT

The authors are thankful to the management of Vels Institute of Science, Technology and Advanced Studies (VISTAS), Pallavaram, Chennai-600 117, Tamil Nadu, India for providing research facility.

Conflict of interest

The authors declare that they have no conflict of interest for this study.

Funding support

The authors declare that they have no funding support for this study.

REFERENCES

- Agyare, C., Dwobeng, A. S., et al. 2013a. Antimicrobial, Antioxidant, and Wound Healing Properties of *Kigelia africana*(Lam.) Benth. and *Strophanthus hispidus* DC. *Advances in Pharmacological Sciences*, 2013:1–10.
- Agyare, C., Obiri, D. D., Boakye, Y. D., Osafo, N. 2013b. Anti-Inflammatory and Analgesic Activities of African Medicinal Plants. *Medicinal Plant Research in Africa*, pages 725–752.
- Arkhipov, A., Sirdarta, J., et al. 2014. An examination of the antibacterial, antifungal, anti-Giardial and anticancer properties of *Kigelia africana* fruit extracts.
- Carey, M. W., Babu, M. J. D., et al. 2008. Anti-inflammatory activity of the fruit of *Kigelia pinnata* DC. *Pharmacologyonline*, 2:234–245.
- Chenia, H. 2013. Anti-Quorum Sensing Potential of Crude *Kigelia africana* Fruit Extracts. *Sensors*, 13(3):2802–2817.
- Cordell, G. A. 2000. Biodiversity and drug discovery — a symbiotic relationship. *Phytochemistry*, 55(6):463–480.
- Costa, R., Albergamo, A., et al. 2017. Phytochemical screening by LC-MS and LC-PDA of ethanolic extracts from the fruits of *Kigelia africana* (Lam.) Benth. *Natural Product Research*, 31(12):1397–1402.
- Eyong, K. O., Kuete, V., Efferth, T. 2013. Quinones and Benzophenones from the Medicinal Plants of Africa. *Medicinal Plant Research in Africa*, pages 351–391.
- Gouda, Y. G., Abdel-baky, A. M., et al. 2003. Iridoids from *Kigelia pinnata* DC. fruits. *Phytochemistry*, 63(8):887–892.
- Grace, O. M., Light, M. E., et al. 2002. Antibacterial activity and isolation of active compounds from fruit of the traditional African medicinal tree *Kigelia africana*. *South African Journal of Botany*, 68(2):220–222.
- Ilangovan, M., Guna, V., Prajwal, B., Jiang, Q., Reddy, N. 2020. Extraction and characterisation of natural cellulose fibers from *Kigelia africana*. *Carbohydrate Polymers*, 236:115996–115996.
- Jackson, S. J., Houghton, P. J., Retsas, S., Photiou, A. 2000. In Vitro Cytotoxicity of Norviburtinal and Isopinnatal from *Kigelia pinnata* Against Cancer Cell Lines. *Planta Medica*, 66(8):758–761.
- Khan, I. A., Osman, A. G., et al. 2017. *Kigelia africana* fruit: Constituents, bioactivity, and reflection on composition disparities. *World Journal of Traditional Chinese Medicine*, 3(4):1–1.

- Owolabi, O. J., Fc, A., Eledan, A. B. 2008. Central nervous system stimulant effect of the ethanolic extract of *Kigelia africana*. *J Med Plants Res*, 2(2):20-023.
- Owolabi, O. J., Omogbai, E. K., Obasuyi, O. 2007. Anti-fungal and antibacterial activities of the ethanolic and aqueous extract of *Kigelia africana* (Bignoniaceae) stem bark. *African Journal of Biotechnology*, 6(14):1677-1680.
- Oyelami, O. A., Yusuf, K. O., Oyelami, A. O. 2012. The Use of *Kigelia africana* in the Management of Polycystic Ovary Syndrome (PCOS). *Chinese Medicine*, 03(01):1-3.
- Picerno, P., Autore, G., et al. 2005. Anti-inflammatory Activity of Verminoside from *Kigelia africana* and Evaluation of Cutaneous Irritation in Cell Cultures and Reconstituted Human Epidermis. *Journal of Natural Products*, 68(11):1610-1614.
- Sofowora, A. 1980. The present status of knowledge of the plants used in traditional medicine in western Africa: a medical approach and a chemical evaluation. *Journal of Ethnopharmacology*, 2(2):109-118.
- Zofou, D., Kengne, A. B. O., et al. 2011. In vitro antiplasmodial activity and cytotoxicity of crude extracts and compounds from the stem bark of *Kigelia africana* (Lam.) Benth (Bignoniaceae). *Parasitology Research*, 108(6):1383-1390.
- Zofou, D., Kuete, V., Titanji, V. P. K. 2013. Antimalarial and Other Antiprotozoal Products from African Medicinal Plants. *Medicinal Plant Research in Africa*, pages 661-709.