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Phytochemical composition and antimicrobial evaluation of *Kigelia africana* LAM

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ABSTRACT

Kigelia africana is a plant widely distributed in Africa and different parts of the plant are used traditionally in the treatment of various ailments. Phytochemical screening of petroleum ether, chloroform, methanol and aqueous extracts of Kigelia africana as well as antibacterial study of the various extracts against Candida albicans, Escherichia coli, Klebsiella pneumonia, Pseudomonas aeruginosa, Streptococcus feacalis and Staphylococcus aureus were carried out. Phytochemical screening result showed the presence of glycosides, phenolic compounds (hydrolysable tannins), alkaloids, flavonoid and reducing sugar in all extracts while cardiac glycoside was noted only in chloroform extract. Petroleum ether extract showed a concentration dependent antibacterial activity against Candida albicans and Pseudomonas aeruginosa; chloroform extract showed similar activity against Streptococcus feacalis and Staphylococcus aureus; methanol and aqueous extracts were only active against Staphylococcus aureus. The antimicrobial effect was statistically significant at all the concentrations tested in comparison to ciprofloxacin control group ($P < 0.05$). The dry leaf powder is a good source of phytochemicals/secondary metabolites and also possesses average antimicrobial potential. Thus, this study provides scientific evidence on the traditional use of Kigelia africana leaf extract in treating microbial diseases.

Keywords: Antimicrobials, *Kigelia africana*, Phytochemical, Secondary metabolite.

INTRODUCTION

Almost half of all drugs in clinical use in the world find their origin from natural products and their derivatives. According to World Health Organization estimates, about 80 percent of people living in developing countries rely on wild plants for some part of their primary health care [1]. Different regions of the world are blessed with different plants and there are several reports on the antimicrobial activity of some of these plants extract [2, 3]. Recently, due to the side effects, high cost, unavailability and the resistance developed by pathogenic microorganisms against conventional antibiotics, much attention has been paid to plants as well as their compounds that are bioactive against pathogenic organisms [3]. Plant extracts have great potential as antimicrobial compound against microorganisms [4]. The medicinal value of plants lies in the bioactive compounds such as alkaloids, flavonoids, tannins, and phenolic compounds that produce a definite physiological action on the human body. The increasing use of plant extracts in the food, cosmetic, and pharmacological industries suggests that in order to extract active compounds, a systematic study of medicinal plants is very important[5].

Kigelia africana (Lam.) Benth. Syn. *K. pinnata* (Jacq.) belongs to the family Bignoniaceae, widely distributed in West and South Africa. The plant is commonly called Cucumber or Sausage tree, and different parts are used traditionally in the treatment of various ailments [6]. The fruits are used for the treatment of purgative, ulcer and to increase the flow of milk in lactating mothers [7]. The root and unripe fruits are employed as a vermifuge and aid in the treatment of rheumatism and haemorrhoids [8].

Thus, this study is aimed at evaluating the potential antimicrobial activities and phytochemical screening of different extracts of *Kigelia africana* (LAM).

MATERIALS AND METHODS

2.1 Sample collection and preparation.
Kigelia africana used for the research was collected from wild in Ewu community of Esan-Central Local Government Area of Edo state, Nigeria and authenticated by Mr. Immanuel from Professor J.C Okafor herbarium, Ewu, Nigeria. Voucher specimens were deposited in Professor J.C Okafor herbarium, Paxherbal, Ewu, Nigeria. The sample was freed of foreign matters, washed twice with large quantity of de-ionized water, spread on a clean sack and placed under a shade to air dry at room temperature. The dried *Kigelia africana* was ground into coarse powder using a modern laboratory electric milling machine (Chris Norris, England).

2.2 Extraction of Plant.
The plant was extracted with petroleum ether, chloroform, methanol and water (Laboratory graded solvents) in a soxhlet apparatus. The crude extracts were reduced in vacuo, weighed and stored in the refrigerator at 4^{o}C.

2.3 Phytochemical Screening of various Extracts of *Kigelia africana*.
Preliminary phytochemical screening of the extracts was performed using the standard methods described in [9, 10].

2.4 Antimicrobial Screening
2.4.1 Organisms Source
The organisms used were clinical isolates which include; *Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella pneumonia, Streptococcus feacalis, Candida albicans and Escherichia coli.* They were obtained from the Department of Medical Microbiology, Irrua Specialist Teaching Hospital (ISTH), Irrua, Edo State, Nigeria. All the organisms were checked for purity and maintained at 4^{o}C in nutrient agar and sabouraud dextrose agar (SDA) slants for bacteria and fungi respectively.

2.4.2 Preparation of the Inoculums
A loopful of the test organism was taken from their respective agar slants and sub cultured into test-tubes containing nutrient broth for bacteria and sabouraud dextrose liquid for fungi. The test-tubes were incubated for 24hrs at 37^{o}C for bacteria and 48hrs at 30^{o}C for fungi. The microorganisms in the broth were standardized using normal saline to obtain a population density of 10^{8}cfu/ml for the bacteria and 10^{5}cfu/ml for fungi.

2.4.3 Antimicrobial assay.
The different solvent extracts were assayed for their antimicrobial activity using agar disc diffusion technique as described by Isu and Onyeagba, (1998). Agar plates were seeded with standardised 0.1 ml broth culture of test organisms of approximately 1.0×10^{8}cfu/ml and spread on surface with cotton swab stick. 6 mm diameter paper discs, cut from a whatman filter paper, were sterilised in a hot air oven at 105^{o}C for 1 hour and impregnated with the different solvent extracts of the plant graded in different concentration; 50, 40, 30 mg/ml respectively. The paper were aseptically placed on the agar plate seeded with test organism. The plates were incubated at 37°C for 24 hrs and observed for clear zones of inhibition against the test organisms. The diameters of the zones of inhibition were measured in millimetres (mm) with a transparent ruler and recorded. The assay was done in triplicates. Ciprofloxacin at 10mg/ml was used as positive control.

RESULTS AND DISCUSSION

Phytochemical screening results of all the extracts of *Kigelia africana* are shown in Table 1. The presence of glycosides, phenolic compounds (hydrolysable tannins), alkaloids, flavonoid and reducing sugar were noted in all the extracts.

The presence of cardiac-glycoside and terpenoids were only observed in chloroform and aqueous extract respectively as shown in Table 1.

Petroleum ether extract showed a dose dependent antibacterial activity against *Candida albicans* and *Pseudomonas aeruginosa*, highest activity was noted at a dose of 50mg/ml while other extracts showed no clear zone of inhibition against these two pathogenic organisms.

Table 1. Phytochemical screening of *Kigelia africana*

Classes of phytochemicals	Pet. Ether extract	Chloroform extract	Methanol extract	Aqueous extract.
Glycoside	++	+	++	+
Cardiac glycoside	-	+	-	-
Saponin	-	++	++	+
Phenolic compound	+	+	+	++
Hydrolysable tannin	+	+	+	++
Condensed tannin	-	-	-	-
Alkaloid	+	++	++	++
Phlobatannin	-	-	-	-
Terpenoids	-	-	-	++
Flavonoid	+	+	+	+
Reducing sugar	++	+	++	+
Polysaccharide/starch	-	-	-	-

Table 2. Antibacterial assay of plant extracts by disc-diffusion method

Test organism	Graded Concentrations (mg/ml)	Zone of inhibition (mm) as produced in different solvent extracts of the plants			
		Petroleum Ether	Chloroform	Methanol	Aqueous
Candida albicans	50	11	0	0	0
	40	10	0	0	0
	30	8	0	0	0
Escherichia coli	50	0	0	0	0
	40	0	0	0	0
	30	0	0	0	0
Klebsiella pneumonia	50	0	0	0	0
	40	0	0	0	0
	30	0	0	0	0
Pseudomonas aeruginosa	50	11	0	0	0
	40	9	0	0	0
	30	8	0	0	0
Streptococcus feacalis	50	0	10	0	0
	40	0	9	0	0
	30	0	8	0	0
Staphylococcus aureus	50	0	15	22	19
	40	0	11	17	16
	30	0	10	14	14

Chloroform extract showed a dose dependent activity against *Streptococcus feacalis* and *Staphylococcus aureus*, but this antibacterial activity was found to be more pronounced against *Staphylococcus aureus*. Methanol extract and aqueous extract were only active against *Staphylococcus aureus*, methanol extract showed higher activity than corresponding aqueous extract, with highest activity at a dose of 50mg/ml. The effect was statistically significant in all the doses tested in comparison to control group ($P < 0.05$) using ciprofloxacin as positive control and DMSO as negative control as shown in Table 2.

CONCLUSION

From the entire work, it was deduced that *Kigelia africana* possess an average antibacterial hormone relative to ciprofloxacin (standard). Also, the presence of cardiac glycoside was confirmed in chloroform extract of *Kigelia africana*. Moreover, the plant was confirmed to be rich in flavonoids and phenolic compounds, which are suspected to be responsible for the antibacterial as well as antioxidant potential of the plant. However, more researches should be done in isolating the antimicrobial compound (this compound can serve as a lead in producing more potent antibiotic via structure-activity relationship mechanism). Thus, this study provides scientific evidence on the traditional use of *Kigelia africana* leaf extract in treating microbial diseases.

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