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Antimicrobial Evaluation of *Kigelia africana* (Lam)

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Abstract: The evaluation of the activity of the aqueous, methanol and chloroform extracts of the bark of the *Kigelia africana* (Lam) was tested against *E. coli*, *Enterobacter aerogens*, *Klebsiella pneumoniae*, *Salmonella typhi*, *Proteus vulgaris*, *Pseudomonas aeruginosa* (Gram-negative), *Staphylococcus aureus* and *Bacillus cereus* (Gram-positive) by disc diffusion method. The methanol extracts presented a higher activity than the aqueous and chloroform extracts. It exhibits the greatest activity against *Salmonella typhi* and *Proteus vulgaris* moderate activity against *E. coli*, *Staphylococcus aureus* and *Bacillus cereus*. The remaining strains viz., *Enterobacter aerogens*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* were presented less activity. The inhibition zone was recorded and compared with standard antibiotic drug streptomycin. Results support the traditional use of *Kigelia africana* (Lam) bark as a good source of antimicrobial agent.

Key words: Microbiological screening, *Kigelia africana*, methanol extracts, disc diffusion method

INTRODUCTION

Antimicrobial properties of medicinal plants are being increasingly reported from different parts of the world (Saxena and Sharma, 1999; Ahmad and Beg, 2001). Various medicinal plants have been used for years in daily life to treat diseases all over the world. It has been used as a source of medicine. Higher plants, as source of medicinal compounds, have continued to play a dominant role in the maintenance of human health since ancient time (Farombi, 2003). Over 50% of all modern clinical drugs are natural products origin and natural products play an important role in drug development programmes in the pharmaceutical industry (Baker *et al*., 1995).

The success story of chemotheraphy lies in the continuous search for new drugs to counter the challenge posed by resistant strains of microorganisms (Khan *et al*., 2003). Antibiotics are sometimes associated with adverse effects on hosts which include hypersensitivity, depletion of beneficial gut, mucosal microorganisms, immuno suppression and allergic reactions (Idose *et al*., 1968; Ahmed *et al*., 1998). The investigation of certain indigenous plants for their antimicrobial properties may yield useful (Khan *et al*., 2003) and there is increasing interest in plants as source of agent to fight microbial diseases and treatment of several infections (Chariandy *et al*., 1999; Aburjai *et al*., 2001).

Kigelia africana is one of highly valuable ethnomedicinal plants belonging to the family Bignoniaceae and vernacular name is marachurai. The plant bark is used for rheumatism, dysentery and veneral diseases and also used for ring worm, tape worm, haemorrhaging, malaria, diabetes, pneumonia and tooth ache (Akunyili and Houghton, 1993; Kolodziej, 1997). However to the best of our knowledge, there is no previous study on this particular plant. Therefore, the lack of the information in the literature prompted this investigation in order to evaluate the antimicrobial activity of *Kigelia africana*.

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MATERIALS AND METHODS

The medicinal plant *Kigelia africana* (Lam) bark, used in this study, were collected around Tiruchirappalli district, South India. The collected plant materials were identified at Rapinat Herbarium, St. Joseph's College, Tiruchirappalli, South India (Mathew, 1983). The bark were shade-dried at room temperature for 10 days.

Extraction Procedure

The dried and powdered plant materials (100 g) were extracted successively with 600 mL of aqueous, methanol and chloroform (1:6 w/v) by using soxhlet extractor for 48 h at a temperature not exceeding the boiling point of the solvent (Lin *et al*., 1999). The extracts were filtered using Whatman No.1 filter paper and then concentrated in vacuum at 40°C using a Rotary evaporator. Each extracts transferred to glass vials and kept at 4°C before use.

Bacterial Strains

Eight different laboratory bacterial strains were used namely, *Escherichia coli*, *Enterobacter aerogens*, *Klebsiella pneumoniae*, *Salmonella typhi*, *Proteus vulgaris* and *Pseudomonas aeruginosa* (gram-negative), *Staphylococcus aureus* and *Bacillus cereus* (gram-positive). The bacterial strains were supplied by the Department of Microbiology and institute of Basic Medical Science, Chennai, India.

Preparation of Inoculum

The bacterial strains preserved in the nutrient agar at 4°C were revived in nutrient broth (liquid medium) and incubated at 37±1°C for overnight and the suspensions were checked to provide approximately 10^5 cfu/mL.

Microbiological Tests of Plant Extracts

The disc diffusion assay methods of Iennette (1985) as described by Rosoanaivo and Ratsimanaga-Urverg (1993), Rabe and Van Staden (1997) were used with modification to determine the growth inhibition of bacteria by plant extracts. The diluted bacterial culture (200 µL) was spread over nutrient agar plates using sterile glass L-rod. One hundred microliter of the each extracts was applied per filter paper disc (Whatman No. 1, 6 mm dia) and was allowed to dry before being placed on the layer of the agar plate. Each extracts was tested in triplicate (3 discs/plate) and the plates were inoculated at 37±1°C for 24 h. After incubation, the diameter of inhibition zones and the sensitivity were measured with a caliper. Standard antibiotic of streptomycin (10 mg/disc) was used as reference of positive control.

Statistical Analysis

Random sampling was used for the entire test in triplicates. Calculations were carried out in triplicate with their mean values and standard deviation by using the formula given by Gupta (1977). Positivity index was calculated by comparing the zone of inhibition of bark extracts with standard antibiotics.

$$\text{Activity index} = \frac{\text{Inhibition area of test sample}}{\text{Inhibition area of standard antibiotic}}$$

RESULTS AND DISCUSSION

The antibacterial activity of *Kigelia africana* bark extract (aqueous, methanol and chloroform) against *Escherichia coli*, *Enterobacter aerogens*, *Klebsiella pneumoniae*, *Salmonella typhi*,

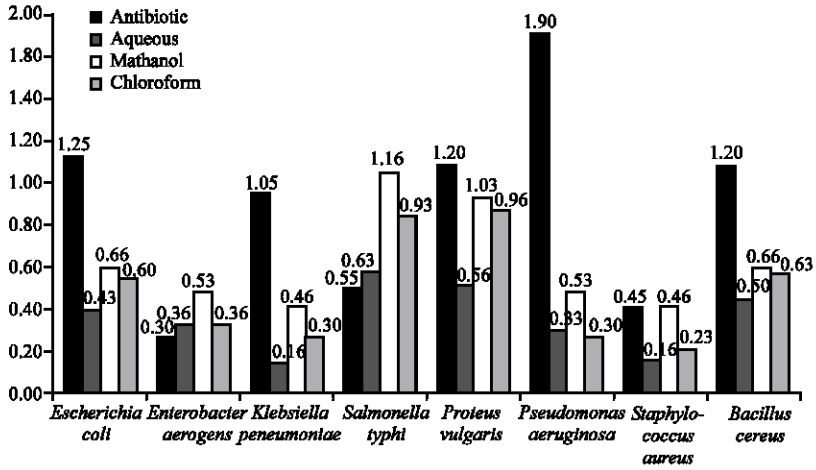

Fig. 1: Representing the diameter of inhibition zones against various pathogens along with plant extracts

Proteus vulgaris, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Bacillus cereus* by disc diffusion method showed that the methanolic bark extracts highly affected the activity of *Salmonella typhi* and *Proteus vulgaris* (Fig. 1). The inhibition against *Escherichia coli*, *Staphylococcus aureus* and *Bacillus cereus* was moderate and less inhibition was associated with *Enterobacter aerogens*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. Chloroform extracts inhibited moderate activity against *Proteus vulgaris* and *Staphylococcus aureus* and the other strains exhibited less activity. The aqueous extracts were exhibited less activity of *Staphylococcus aureus* and all the remaining strains showed very poor activity. These results were compared with standard antibiotic, streptomycin as a standard (Fig. 1).

The aqueous and organic extracts exhibited different activities. Organic extracts showed greater activity than aqueous extract. Because most of the antibacterial principles were either polar or non-polar and were extracted only through the organic solvent medium (John Britto, 2001). It was reported that methanol was a better solvent for the consistent extraction of antimicrobial substances from medicinal plants when compared to other solvents such as aqueous, ethanol, chloroform and hexane (Lin *et al*., 1999; Ahmad *et al*., 1998; Eloff, 1998). Present observation suggested that the organic solvent extraction method was suitable to verify antibacterial activity. Similar conclusions were drawn by Krishna *et al*. (1997) and Singh and Singh (2000) in their studies.

The antibacterial activity of plant extracts can be attributed to not only a single bioactive principle but also due to the combined action of other compounds (Sunayana *et al*., 2003). A number of phytochemicals have been studied for their antibacterial activity which are potentially useful against infectious diseases. It is clear that the chemical structure of the antimicrobial agents found in higher plants belong to most commonly encountered classes of higher plant secondary metabolites such as flavonoids (Watchter *et al*., 1999), terpenes (Conveney *et al*., 1985), terpenoids (Osawa *et al*., 1990; Habibi *et al*., 2000) and phenolic acids (Fernandez *et al*., 1996).

From the results, it can be concluded that plant extracts have great potential as antimicrobial principles against microorganisms and that they can be used in the treatment of infectious disease caused by resistant microorganisms. *Kigelia africana* showed maximum antibacterial activity and hence this plant can be used to discover bioactive natural products that may serve as leads for the development of new pharmaceuticals. This will also offer a great help in facing the emergence for spread of antimicrobial resistance.

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