Exploration of Antimicrobial Potential of Methanol and Water Extract of Seeds of Swietenia macrophylla (Family: Meliaceae), to Substantiate Folklore Claim

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ABSTRACT
The antimicrobial efficacy of methanol and water extracts of seeds of the plant Swietenia macrophylla (Family: Meliaceae) was evaluated against selected pathogenic bacterial strains (Bacillus cereus MTCC 430, Klebsiella pneumoniae MTCC 109, Pseudomonas aeruginosa MTCC 424, Escherichia coli MTCC 443, Staphylococcus aureus MTCC 96, Salmonella typhimurium MTCC 98, Micrococcus luteus MTCC 106) and fungal stains (Candida albicans MTCC 183, Cryptococcus albidus MTCC 2661, Aspergillus niger MTCC 16404, Aspergillus flavus MTCC 1973). The antimicrobial activity was evaluated by disc diffusion and micro dilution assay methods. Streptomycin and gentamicin were used as standard antibacterial drugs whilst fluconazole was used as standard antifungal drug. Results of both assays ensured that the seeds possess significant antimicrobial activity in terms of antibacterial and antifungal activity. Results are comparable to that of standard drugs selected. It is also evident from results that methanol extract showed better activity than that of water extract.

Keywords: Swietenia macrophylla, Antimicrobial activity, Disc diffusion assay, Minimum inhibitory concentration (MIC)

Herbal medicines have been used since the dawn of civilization to maintain health and to treat disease. There is a tremendous historical legacy in folklore uses of plant preparations in medicines. Scientific studies on plants used in ethnomedicine led to the discovery of many valuable drugs [1]. Antimicrobial properties of medicinal plants are being increasingly reported from different parts of the world [2,3]. The World Health Organization estimated that about 80 % of the world’s population still believes in herbal drugs for their primary health care [4]. There are indiscriminate use of synthetic antimicrobial drugs for the treatment of infectious diseases and as a result drug resistance developed in human beings as well as in plant also [5,6,7]. Some times antibiotics cause adverse reaction like hypersensitivity, immunosuppression and allergic reactions [8]. Therefore, there is a need to develop alternative antimicrobial drugs for the treatment of infectious diseases from various sources, including medicinal plants [9, 10].

The plant Swietenia macrophylla (Family: Meliaceae) is a beautiful, lofty, evergreen large tree native to tropical America, Mexico and South America usually 30-40m in height and 3-4m in girth [11]. The seeds of S. macrophylla have been reported to have anti-inflammatory, antimutagenecity and antitumor activity [12]. Various phytochemicals have been isolated from the plant are swietenine, swietenolide [13], swietemahonin, khayasin, andirobin, augustineolide, 7-deacetoxy-7-oxogedunin, proceranolide and 6-O-acetyl swietenolide [14]. Paste of seeds of Swietenia macrophylla are traditionally used by the local healers of East Midnapore, West-Bengal, India for curing skin diseases and infections being caused by wounds. The present study was undertaken to explore the antimicrobial potential of methanol and water extract of seeds of S. macrophylla against some pathogenic bacteria like Bacillus cereus MTCC 430, Klebsiella pneumoniae MTCC 109, Pseudomonas aeruginosa MTCC 424, Escherichia coli MTCC 443, Staphylococcus aureus MTCC 96, Salmonella typhimurium MTCC 98, Micrococcus luteus MTCC 106 and fungi species namely Candida albicans MTCC 183, Cryptococcus albidus MTCC 2661, Asper-
gilus niger MTCC 16404 and Aspergillus flavus MTCC 1973. These microorganism strains were clinical isolates collected from the Institute of Microbial Technology, Chandigarh, India and preserved as slant agar culture at 4°C.

**MATERIALS AND METHODS**

**Collection of plant material and extraction**

Seeds of *Swietenia macrophylla* (Family: Meliaceae) were collected in the month of December and January, from the villages of Midnapore (E), west-Bengal, India. The plant was authenticated by the Botanical Survey of India. A voucher specimen was deposited at our institute for future reference. The Seeds of *Swietenia macrophylla* were shade-dried, powdered and passed through 40-mesh sieve and stored in an airtight container for future use. Powdered seeds were extracted with 95% methanol with the help of soxhlet apparatus. Water extract was prepared by maceration for a period of 24 hours. The resulting extracts were evaporated under vacuum. The percentage yield of methanol and water extract was found 15% and 12.7% w/w respectively.

**Disc Diffusion Assay**

The agar diffusion method [15] was used to evaluate the antimicrobial activity of the subjected extracts. Inoculum of 100 μl suspension containing 10^8 CFU/ml of bacteria and 10^4 spores/ml of fungi were spread on Mueller Hinton Agar and potato dextrose agar medium respectively. The discs (9 mm in diameter) impregnated with 20 μl of 50 mg/ml (i.e. 0.5mg/disc) extracts were placed on seeded agar medium. Streptomycin (10μg/disc) and gentamycin (10μg/disc) were used as positive control for bacteria and fluconazole (10μg/disc) for fungi. Methanol was used as negative control. The experiments were conducted in triplicate and the test plates were incubated 24 hours at 37°C for bacteria and 28°C for fungi. The diameters of zone of inhibition measured in mm [16]

**Micro Dilution Assay**

The minimum inhibitory concentrations (MIC) were also determined for the subjected microorganisms for methanol extract. The MIC values of extract against pathogenic strains were determined by microdilution method [17] with some modifications. The inoculums of microorganisms were prepared from 6 hour broth (MHB/PDB) culture and suspensions were adjusted to 0.5 McFarland standard turbidity [18]. The extract dissolved in DMSO 2.5% was first diluted to the highest concentration (1000 μg/ml) to be tested; there serial two fold dilutions were made in concentration range 0.48 to 1000 μg/ml in 10 ml sterile test tubes containing 2.5% DMSO. The 10 ml test tubes were prepared by dispensing 9 ml of MHB/PDB in each tube and 1 ml of inoculum (0.5 McFarland turbidity). A 1000 μl from plant extracts initially prepared at the concentration of 50 mg/ml has added into test tube. Then 1000 μl from their serial dilutions was transferred into ten consecutive tubes. The broth (MHB/PDB) without extracts, inoculums and DMSO 2.5% were also used as negative control. Antibiotics streptomycin and fluconazole were used as positive control. The tubes were covered with sterile sealer; contents of each tube were mixed on shaker at 300 rpm for 20 seconds and the incubation at appropriate temperature. Microbial growth was determined by using Ultraspec 200 UV/visible spectrophotometer and confirmed by plating 1 ml sample from clear plate on MHA/PDA. The MIC was interpreted as the lowest concentration of extracts that did not permit any visible growth when compared with that of control.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Extract yield (%)</th>
<th><em>Bacillus cereus</em> MTCC 430</th>
<th><em>Staphylococcus aureus</em> MTCC 96</th>
<th><em>Escherichia coli</em> MTCC 443</th>
<th><em>Pseudomonas aeruginosa</em> MTCC 424</th>
<th><em>Klebsiella pneumonia</em> MTCC 109</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extract (50 mg/ml)</td>
<td>Methanol (15.0)</td>
<td>24.10</td>
<td>28.00</td>
<td>29.60</td>
<td>15.00</td>
<td>15.60</td>
</tr>
<tr>
<td>Extract (50 mg/ml)</td>
<td>Water (12.7)</td>
<td>19.00</td>
<td>21.00</td>
<td>20.15</td>
<td>18.10</td>
<td>12.00</td>
</tr>
<tr>
<td>Streptomycin (10μg/disc)</td>
<td>---</td>
<td>32.00</td>
<td>30.00</td>
<td>29.00</td>
<td>28.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Gentamycin (10μg/disc)</td>
<td>---</td>
<td>33.00</td>
<td>32.00</td>
<td>31.00</td>
<td>30.00</td>
<td>28.00</td>
</tr>
</tbody>
</table>

Values are mean of triplicates experiment

<table>
<thead>
<tr>
<th>Test material</th>
<th><em>Cryptococcus albidus</em> MTCC 2661</th>
<th><em>Aspergillus flavus</em> MTCC 1973</th>
<th><em>Aspergillus niger</em> MTCC 16404</th>
<th><em>Candida albicans</em> MTCC 183</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extract- methanol (50 mg/ml)</td>
<td>36.33</td>
<td>23.46</td>
<td>29.68</td>
<td>31.32</td>
</tr>
<tr>
<td>Extract- water (50 mg/ml)</td>
<td>24.66</td>
<td>18.14</td>
<td>20.00</td>
<td>19.46</td>
</tr>
<tr>
<td>Fluconazole (10μg/disc)</td>
<td>28.00</td>
<td>21.00</td>
<td>22.00</td>
<td>25.00</td>
</tr>
</tbody>
</table>

Values are mean of triplicates experiment
 RESULT AND DISCUSSION

The results of disc diffusion assay of both methanol and water extracts of the seeds of *Swietenia macrophylla* have been tabulated in table-1 and table-2. It is evident from table-1 that the both methanol and water extract was found to be active against the bacteria like *Escherichia coli* MTCC 443, *Staphylococcus aureus* MTCC 96, *Bacillus cereus* MTCC 430, *Klebsiella pneumonia* MTCC 109 and *Pseudomonas aeruginosa* MTCC 424. The results of disc diffusion assay of the crude extracts were compared with that of standard antibiotic *Streptomycin* (10 μg/disc) and *Gentamicin* (10 μg/disc) also recorded. Table-2 indicates that the extract is also potent for its antifungal efficacy. The extracts have shown profound antifungal activity with respect to fungal stains namely *Cryptococcus albidus* MTCC 2661, *Aspergillus niger* MTCC 16404, *Candida albicans* MTCC 183 and *Aspergillus flavus* MTCC 1973. Among bacteria *Escherichia coli* MTCC 443 and among fungi *Cryptococcus albidus* MTCC 2661 are most susceptible to the extracts. Results also proved that methanol extract has more effectiveness than that of water extract against subjected bacteria and fungal stains. Table-3 represents MIC and MBC/MMC values of the methanol extract against bacterial and fungal strains and results were compared with that of standard antibiotics *streptomycin* and *fluconazole* for bacteria and fungi respectively. From above results it can be concluded that the seeds of plant *Swietenia macrophylla* possess significant antimicrobial activity in term of antibacterial and antifungal effects. This antimicrobial property against bacteria and fungi surely is due to presence of some antimicrobial substances in seeds. Now our study will be directed to explore the lead compound responsible for aforementioned activity from this plant.

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