Full Length Research Paper

Phytochemical compounds and antimicrobial activity of three medicinal plants (Alchornea hirtella, Morinda geminata and Craterispermum laurinum) from Sierra Leone

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Petroleum ether, acetone, ethanolic and aqueous crude extracts of various plant organs of Alchornea hirtella, Morinda geminata and Craterispermum laurinum used in Sierra Leone exhibited variable degree of antimicrobial activity against four bacterial species. Compared with the standard drug ciprofloxacin, the extracts exhibited low to moderate antibacterial activity. Generally, the tested microorganisms were resistant to the petroleum ether and acetone extracts. The aqueous extract of the stem bark of M. geminata was sensitive to Streptococcus pyogenes (61% inhibition) and leaf extract of A. hirtella inhibited the growth of Proteus vulgaris (56%). Ethanolic crude extract of the stem bark of C. laurinum and M. geminata were particularly sensitive to S. pyogenes; moderate activity was also demonstrated by the stem bark of C. laurinum against Escherichia coli. MIC values indicated that the ethanolic extract showed significant microbiostatic action against S. pyogenes and Staphylococcus aureus (MIC 0.8 – 2 mg/ml), whereas the other strains were more resistant (MIC >2 mg/ml). Phytochemical evaluation revealed moderate to high contents of flavonoids, alkaloid and saponins in the ethanolic extract.

Key words: Antimicrobial activity, medicinal plants, phytochemical constituents.

INTRODUCTION

Recently, much attention has been directed toward extracts and biologically active compounds isolated from popular plant species. The use of medicinal plants plays a vital role in covering the basic health needs in developing countries, particularly Africa (Munoz-Mingarro et al., 2003; Macfoy and Sama, 1983). In Sierra Leone were about 80% of the populace live with extremely low per capita income, the purchase of manufactured drugs becomes a big problem due to their high cost. This is compounded by their unavailability in hospitals and peripheral health centers when needed; hence the dependency on traditional medicine is high. Numerous publications abound on the traditional uses of medicinal plants as anti-inflammatory agents, antiplasmodial agents, antimalarial agents, anticholinergic agents, antihypertensive agents, etc. (Marshall et al., 2000; Manga et al., 2004; Okwu and Josiah, 2006; Okokon et al., 2006; Kastrup et al., 1999; Atindehou et al., 2002; Le Grand and Wondergem, 1990). Daziel (1937) identified Craterispermum laurinum as one of the medicinal plants in Sierra Leone. He reported that a decoction of the leaf or bark was used in the treatment of mild fever. Macfoy and Samai (1983) reported that the aqueous extract of the dried stem bark of C. laurinum from the Eastern Province of Sierra Leone was used in the treatment of yellow fever. According to Vasieleva (1969), a decoction of the roots of Morinda geminata is used as a vomitive, laxative and an infusion of the leaves as a soothing and refreshing stomachic or externally as a lotion for fever and headache in Guinea. Abrew et al. (1999) reported the antimicrobial, antifungal and antiyeast activity of methanol : water (9:1) extract of the dried leaves of M.

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Materials

The experimental plant organs (leaves, stem bark, root bark) of M. geminata were collected from the Eastern Province of Sierra Leone and identified at the Department of Botany, Fourah Bay College, University of Sierra Leone, and sub-cultured in agar tubes to obtain pure isolates.

Extracts were first done with petroleum ether (60 - 80°C) in a soxhlet apparatus. The residue was dried, re-extracted with acetone and finally with ethanol. The obtained solutions were filtered using a Buchner funnel, and the filtrate evaporated to dryness in a rotary evaporator to give the crude petroleum ether, acetone and ethanolic extracts respectively. Aqueous extract was obtained by heating the sample with 500 ml of de-ionized water for 1 h. The mixture was filtered and the filtrate dried. All reagents were of analytical grade.

Phytochemical screening

Screening of the samples for bioactive components including alkaloids, tannins, sterols/terpenes, flavonoids and saponins was done using standard methods (Harborne, 1998; Trease and Evans, 1978).

Antimicrobial assay

Antimicrobial analysis was done on the extracts of the various plant organs using the disc diffusion method on two gram-positive and two gram-negative microorganisms namely: Staphylococcus aureus (Sa), Streptococcus pyogenes (Sp), Proteus vulgaris (Pv) and Escherichia coli (Ec) respectively as described by the NCCLS (National Committee for Clinical Laboratory Standards, 1993), using the Muller-Hinton agar as culture medium. The minimum inhibitory concentration (MIC) was determined for the standard antibiotics and the most active extract in parallel experiments in order to control the sensitivity of the test microorganisms. All tests were performed in duplicate.

RESULTS AND DISCUSSION

The medicinal value of plants lies in some chemical substances that produce a definite physiological action on the human body. The most important of these bioactive compounds are alkaloids, flavonoids, tannins and phenolic compounds (Musyimi et al., 2008; Weimann and Heinrich, 1997; Atindehou et al., 2002; Edeoga et al., 2005).

Contents of phytochemical compounds in the plant extracts varied with the plant organ and solvent system used (Tables 1 and 2). Moderate to high levels of alkaloids, flavonoids and saponins were present in the ethanolic extract of Alchornea hirtella, Morinda geminata and C. laurinum. Tannins was only found in A. hirtella crude ethanolic extract, while sterols/terpenes was absent except in the ethanolic extract of the root bark of C. laurinum. The acetone extract had moderate content of tannins and saponins. Alkaloids were only found in the root bark and stem bark of C. laurinum. Flavonoids and sterols were found in the leaves of A. hirtella and stem bark of M. geminata. The petroleum ether extract had low to no contents of saponins. Flavonoids were present in...
the leaves of A. hirtella and M. geminata. Sterols/terpenes was present in M. geminata leaves, while alkaloids was absent except in the leaves of M. geminata. Like the alcoholic extract, the aqueous extract had moderate to high levels of phytochemical compounds; tannins and sterols/terpenes was absent in the stem bark and leaves of M. geminata and A. hirtella respectively.

The extracts showed variable degree of antimicrobial activities against one or more of the tested microorganisms. This was affected by the solvent system and plant organ under study. Generally, the tested organisms were resistant to the petroleum ether and the acetone extracts, except the acetone stem bark extract of C. laurinum which had an inhibition of 40% against S. pyogenes (Tables 3 and 4). This low antimicrobial activity may be attributed to the reduced ability of these solvents to extract phytochemical compounds or the presence of pigments or phenols, which are known to interfere with antimicrobial activity (Doughari, 2006).

The aqueous extract demonstrated low to moderate
antimicrobial activity. The stem bark extract of *M. geminata* was sensitive to *S. pyogenes* (61% inhibition) and the leaf extract of *A. hirtella* inhibited the growth of *P. vulgaris* (56% inhibition). The roots bark extract of *C. laurinum* and the stem bark of *M. geminata* exhibited moderate activity against *E. coli* and *Staph. aureus* respectively. The ethanolic crude extract exhibited the highest degree of antimicrobial activity. The stem bark of *C. laurinum* and *M. geminata* were particularly sensitive to *S. pyogenes*, a gram positive haemolytic bacterium known to cause diseases such as pharyngitis, impetigo, scarlet fever, etc. Moderate activity was demonstrated by the stem bark of *C. laurinum* against *E. coli*, a microorganism noted for causing gastrointestinal infections, urinary tract infections, etc. Results from MIC values (Table 5) indicate that the ethanolic extracts of the tested plants showed significant microbistatic action against *S. pyogenes* and *Staph. aureus* (MIC 0.8 - 2.0 mg/ml) whereas the other strains proved more resistant (MIC > 2 mg/ml). However, our MIC values were less than values obtained for the standard drug, ciprofloxacin.

From the present study, it can be seen that these plants possess compounds with antimicrobial activity. However, isolation and purification of the active components will be essential to give more insight into their modes of action.

**REFERENCES**


**Table 5. MIC of ethanolic extract and reference drug**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Plant organ</th>
<th>MIC values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><em>Sp</em></td>
</tr>
<tr>
<td><em>Alchornea hirtella</em></td>
<td>L</td>
<td>1.9</td>
</tr>
<tr>
<td><em>Craterispermum laurinum</em></td>
<td>RB</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>SB</td>
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</tr>
<tr>
<td><em>Morinda geminata</em></td>
<td>L</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>SB</td>
<td>1.0</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>Ref</td>
<td>0.5</td>
</tr>
</tbody>
</table>

*MIC, Minimum inhibitory concentration; values given as mg/ml for ethanolic extract and as µg/ml for ciprofloxacin; - = not determined.*


