BRINE SHRIMP TOXICITY EVALUATION OF SOME TANZANIAN PLANTS USED TRADITIONALLY FOR THE TREATMENT OF FUNGAL INFECTIONS


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Abstract

Plants which are used by traditional healers in Tanzania have been evaluated to obtain preliminary data of their toxicity using the brine shrimps test. The results indicate that 9 out of 44 plant species whose extracts were tested exhibited high toxicity with LC\textsubscript{50} values below 20 µg/ml. These include Aloe latertia Engl. (Aloaceae) [19.1 µg/ml], Cassia abbreviata Oliv. (Caesalpiniaeae) [12.7 µg/ml], Croton schefleri Pax (Euphorbiaceae) [13.7 µg/ml], Hymenodactyon parvifolium Brig (Rubiaceae) [13.4 µg/ml], Kigelia Africana L. (Bignoniaceae) [7.2 µg/ml], and Ocimum suave Oliv. (Labiateae) [16.7 µg/ml]. Twelve plants gave LC\textsubscript{50} values between 21 and 50 µg/ml, 11 plants gave LC\textsubscript{50} values between 50 and 100 µg/ml, and 18 plants gave LC\textsubscript{50} values greater than 100 µg/ml.

Key words: Brine shrimp test; Toxicity evaluation; Traditional antifungal plants

Introduction

In sub Saharan Africa, where 70% of the world cases of HIV/AIDS are found, Candida infections are very common and cause significant morbidity among patients (UNAIDS, 2004). Among problems that hamper effective management of Candida infections in these countries include: limited number of effective antifungal agents, toxicity of the available antifungal agents, resistance of Candida to commonly used antifungals, relapse of candida infections and the high cost of antifungal agents (Debruyne, 1997; Sangeorzanz et al., 1994). Reports of resistance to commonly used antifungal agents like fluconazole abound (Ruhnke et al., 1994; Redding et al., 1994), including shifts from Candida albicans to less sensitive species such as Candida glabrata and Candida krusei (Bastert et al., 2001; Powderly, 1992). When relapses occur, the infections tend to be increasingly refractory to treatment.

These problems are of even greater relevance to poor countries, where the choice of antifungal agents is rather limited due to limited resources. In these countries, the most practical option remains to search for cheap alternatives to manage opportunistic infections. The difficulties associated with the management of Candida infections necessitate the discovery of new antifungal agents, in order to widen the spectrum of activity against Candida and combat strains expressing resistance to the available antifungal agents.
Plants are widely used in Tanzanian traditional medicine and constitute a potentially useful resource for new and safe drugs for the treatment of opportunistic infections. According to Medicine du Monde, a French non-governmental organisation, in Kagera region, five out of every six HIV patients receive their medical attention from a traditional healer rather than from a hospital or primary health care facility (AIDS Analysis Africa, 1996). Likewise, a survey conducted in Dar es Salaam showed that 21% of the people who seek care from public facilities had first consulted a traditional healer (Kilima et al., 1993).

The purpose of the present study was to evaluate the toxicities and/or potential for other biological activities of extracts of the plants that are used by traditional healers in Tanzania for management of fungal infections.

Materials and Methods

Plant collection and identification

Plants reported to be used for the treatment of oral candidiasis and skin fungal infections by the interviewed traditional healers (Table 1) were collected in four regions of Tanzania from February-March 2004. The plants were identified by Mr. Selemani, an experienced botany technician, and voucher specimens are kept at the Herbarium of the Department of Botany, University of Dar es Salaam.

Extraction of plant materials

All plant samples were air-dried and ground. Approximately 400 grams of the plant materials were macerated with 80% methanol at room temperature and after 24 h filtered through Whatman number 1 filter paper. The procedure was repeated three times to ensure exhaustive extraction of the plant material. The extracts were pooled together, concentrated, and the solvent removed by evaporation under reduced pressure in a rotavap, at 40°C. The extracts were further dried by freeze-drying and kept in a freezer, at -20°C, until the time of use.

The Brine shrimp lethality test

The brine shrimp lethality test (BST) was used to predict the presence, in the extracts, of cytotoxic activity (Meyer et al., 1982). Solutions of the extracts were made in DMSO, at varying concentrations, and 30 µl of each incubated in duplicate vials with the brine shrimp larvae in a total volume of 5 ml. Ten brine shrimp larvae were placed in each of the duplicate vials. Brine shrimp larvae were placed in a mixture of DMSO (30 µl) and seawater to serve as a negative control. Cyclophosphamide, an anticancer drug, was used as a positive control. After 24 h the nauplii were examined against a lighted background, with a magnifying glass and the average number of survived larvae was determined. The mean percentage mortality was plotted against the logarithm of concentrations and the concentration killing fifty percent of the larvae (LC$_{50}$) was determined from the graph.

Data analysis

The mean results of brine shrimp mortality against the logarithms of concentrations were plotted using the Fig P computer program (Biosoft Inc, USA), which also gives the regression equations. The regression equations were used to calculate LC$_{16}$, LC$_{50}$ and LC$_{94}$ values. Confidence intervals (95% CI) were calculated according to a previously reported method (Litchfield and Wilcoxon, 1949).

Results

Brine shrimp lethality

Among the 65 plant parts collected and belonging to 56 plant species, 50 (76.9%) plant parts of 44 plant species were tested for brine shrimp lethality. Nine plants showed high toxicity to the shrimps with LC$_{50}$ values below 20µg/ml (Table 2). These include Aloe lateritia (19.1µg/ml), Cassia abbreviata (12.7µg/ml), Croton scheffleri (13.7µg/ml), Hymenodactyon parvifolium (13.4µg/ml), Kigelia Africana (7.2µg/ml), and Ocimum suave (16.7µg/ml). Twelve plants gave LC$_{50}$ values between 21 and 50µg/ml, 11 plants gave LC$_{50}$ values between 50 and 100 µg/ml, and 18 plants gave LC$_{50}$ values greater than 100 µg/ml.
<table>
<thead>
<tr>
<th>Species (Voucher Specimen No.)</th>
<th>Family</th>
<th>Local name</th>
<th>Part used</th>
<th>Life form</th>
<th>Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acacia nilotica</em> (L.) Willd ex Del (OH 58)</td>
<td>Mimosaceae</td>
<td>Kloriti</td>
<td>S</td>
<td>Shrub</td>
<td>Topical</td>
</tr>
<tr>
<td><em>Acacia robusta</em> subsp Usambarensis (Taub) Brenan (OH 38)</td>
<td>Mimosaceae</td>
<td>Mkame</td>
<td>L</td>
<td>Tree</td>
<td>Topical</td>
</tr>
<tr>
<td><em>Acalypha fruticosa</em> Forsk. (OH 56)</td>
<td>Euphorbiaceae</td>
<td>Siaiti</td>
<td>L, R</td>
<td>Shrub</td>
<td>Topical (L),</td>
</tr>
<tr>
<td><em>Agauria salicifolia</em> Oliv. (OH 45)</td>
<td>Ericaceae</td>
<td>Mwomboa</td>
<td>L</td>
<td>Tree</td>
<td>Topical</td>
</tr>
<tr>
<td><em>Albizia anthelmintica</em> (A. Rich) Brogn (OH 3)</td>
<td>Mimosaceae</td>
<td>Mfuletia</td>
<td>R</td>
<td>Tree</td>
<td>Oral</td>
</tr>
<tr>
<td><em>Aloe lateritia</em> Engl. (OH 10)</td>
<td>Aloeaceae</td>
<td>Mapunisinyamviri</td>
<td>WP</td>
<td>Shrub</td>
<td>Topical</td>
</tr>
<tr>
<td><em>Annona senegalensis</em> Purs. (OH 11)</td>
<td>Annonaceae</td>
<td>Mnene kanda</td>
<td>L, R</td>
<td>Shrub</td>
<td>Topical (L),</td>
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<tr>
<td><em>Balanites aegyptiaca</em> (L.) Del (OH 17)</td>
<td>Balanitaceae</td>
<td>Mudughyu</td>
<td>RB</td>
<td>Tree</td>
<td>Topical</td>
</tr>
<tr>
<td><em>Cassia abbreviata</em> Oliv. (OH 20)</td>
<td>Caesalpinaceae</td>
<td>Mufafati</td>
<td>R, SB</td>
<td>Tree</td>
<td>Oral</td>
</tr>
<tr>
<td><em>Cassia singuena</em> Del (OH 12)</td>
<td>Caesalpinaceae</td>
<td>Muhufia</td>
<td>R</td>
<td>Shrub</td>
<td>Topical / Oral</td>
</tr>
<tr>
<td><em>Chrysophyllum bangweolense</em> RE Fris (OH 15)</td>
<td>Sapotaceae</td>
<td>Mseweye</td>
<td>RB</td>
<td>Tree</td>
<td>Topical</td>
</tr>
<tr>
<td><em>Cissus petiolata</em> Hook. F. (OH 48)</td>
<td>Vitaceae</td>
<td>Mswilaswila</td>
<td>R</td>
<td>Climber</td>
<td>Topical</td>
</tr>
<tr>
<td><em>Clausena anisata</em> Oliv (OH 6)</td>
<td>Rutaceae</td>
<td>Mjavikali</td>
<td>L,SB,R</td>
<td>Shrub</td>
<td>Oral</td>
</tr>
<tr>
<td><em>Commiphora ptelefolia</em> Engl. (OH 34)</td>
<td>Bursaraceae</td>
<td>Twini ndedemu</td>
<td>R</td>
<td>Shrub</td>
<td>Topical</td>
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<tr>
<td><em>Cordia africana</em> Lam (OH 9)</td>
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<td>Mgwengweni</td>
<td>R</td>
<td>Shrub</td>
<td>Topical</td>
</tr>
<tr>
<td><em>Coronopus didymus</em> (L) (OH 47)</td>
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<td>Kissango</td>
<td>WP</td>
<td>Herb</td>
<td>Oral</td>
</tr>
<tr>
<td><em>Croton Scheffleri</em> Pax (OH 24)</td>
<td>Euphorbiaceae</td>
<td>Muhalange</td>
<td>R</td>
<td>Shrub</td>
<td>Oral</td>
</tr>
<tr>
<td><em>Cucumis aculeatus</em> Cogn. (OH 32)</td>
<td>Cucurbitaceae</td>
<td>Ingángáa</td>
<td>F</td>
<td>Climber</td>
<td>Topical</td>
</tr>
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<td><em>Cyphostemma hildebrandtii</em> (Gilg) Desc. (OH 14)</td>
<td>Vitaceae</td>
<td>Damanyamwili</td>
<td>L</td>
<td>Herb</td>
<td>Topical</td>
</tr>
<tr>
<td><em>Diospyros usambarensis</em> F. (OH 26)</td>
<td>Ebenaceae</td>
<td>Muriorio</td>
<td>R</td>
<td>Shrub</td>
<td>Topical</td>
</tr>
<tr>
<td><em>Drymaria cordata</em> (L).A.Schult (OH 46)</td>
<td>Caryophyllaceae</td>
<td>Ugurashishi</td>
<td>WP</td>
<td>Herb</td>
<td>Topical</td>
</tr>
<tr>
<td><em>Elaeodendron buchananii</em> (Loes)(OH 19)</td>
<td>Celastraceae</td>
<td>Muhorachwi</td>
<td>SB</td>
<td>Tree</td>
<td>Oral</td>
</tr>
<tr>
<td><em>Elaeodendron schlechteranum</em> (Loes)(OH 50)</td>
<td>Celastraceae</td>
<td>Mkandekande</td>
<td>SB</td>
<td>Tree</td>
<td>Oral</td>
</tr>
<tr>
<td><em>Erythrina abyssinica</em> Lam (OH 18)</td>
<td>Papilionaceae</td>
<td>Mkalawanhulu</td>
<td>R</td>
<td>Tree</td>
<td>Topical</td>
</tr>
<tr>
<td><em>Euphorbia heterophylla</em> L. (OH 31)</td>
<td>Euphorbiaceae</td>
<td>Loo</td>
<td>WP</td>
<td>Herb</td>
<td>Oral</td>
</tr>
<tr>
<td><em>Euphorbia tirucalli</em> L. (OH 57)</td>
<td>Euphorbiaceae</td>
<td>Injokii</td>
<td>L</td>
<td>Tree</td>
<td>Topical</td>
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<tr>
<td><em>Ficus sur</em> Benth (OH 51)</td>
<td>Moraceae</td>
<td>Mkuyu</td>
<td>SB</td>
<td>Tree</td>
<td>Oral/Topical</td>
</tr>
<tr>
<td><em>Gonatopus boivinii</em> Hook.f. (OH 1)</td>
<td>Araceae</td>
<td>Kunzulu</td>
<td>T</td>
<td>Herb</td>
<td>Topical</td>
</tr>
</tbody>
</table>
Hymenidictyon parvifolium Brig (OH 2)  
Rubiaceae  
Pekawake  
R  
Shrub  
Topical

Hypericum roeperanum Schimp. ex A. Rich (OH 44)  
Guttaeferae  
Mwambaziwa  
L  
Shrub  
Topical

Indigofera rhynchocarpa Bak. Var (OH 16)  
Papilionaceae  
Igangula  
R  
Shrub  
Topical

Jatropha multifida L. (OH 53)  
Euphorbiaceae  
Maugwamwipoli  
L,S,R  
Shrub  
Topical

Khaya anthotheca (Welw.) C.Dc (OH 52)  
Meliaceae  
Mgolaminzi  
SB  
Tree  
Topical

Kigelia africana L. (OH 49)  
Bignoniaceae  
Mungungu  
RB, F  
Tree  
Oral

Lannea stuhlmanii Engl. (OH 7)  
Anacardiaceae  
Muhungilo  
L  
Tree  
Topical

Lobelia giberroa Neumeleg (OH 35)  
Campanulaceae  
Gongoa  
L  
Herb  
Topical

Ocimum basilicum L. (OH 29)  
Labiateae  
Irumbasi  
WP  
Herb  
Oral

Ocimum suave Oliv. (OH 13)  
Labiateae  
Suameno  
L  
Herb  
Topical

Plumbago zeylanica L. (OH 36)  
Plumbaginaceae  
Chambula  
R  
Herb  
Oral

Pteridium aquilinum (L.) Kuhn (OH 41)  
Densitraediaceae  
Shilu  
L  
Herb  
Topical

Rapanea melanophloeos (L.) Mez (OH 5)  
Myrsinaceae  
Mpaja  
L, SB  
Tree  
Oral

Rhicissus tridentata (Lf) Wild & Drumm (OH 27)  
Plumbaginaceae  
Chambula  
R  
Herb  
Oral

Salvadora persica L (OH 30)  
Salvadoraceae  
Mukunkuni  
R  
Tree  
Topical

Sclerocarya birrea. (A.Rich.) Hochst. subsp. caffra (Sond.) (OH 8)  
Anacardiaceae  
Muongozi  
L, R  
Tree  
Topical

Securidaca longipedunculata Fres (OH 28)  
Polygonaceae  
Musatu  
R  
Shrub  
Oral

Senecio deltoidea Less (OH 33)  
Cucurbitaceae  
Ulenge  
WP  
Climber  
Oral

Solamum incanum L (OH 23)  
Solanaceae  
Mtula ndulele  
WP  
Herb  
Oral

Spirostachys africana Sonder (OH 54)  
Euphorbiaceae  
Ormotanga  
S  
Tree  
Topical

Sterculia africana (Lour) Fiori (OH 39)  
Sterculiaceae  
Muhoza  
L  
Tree  
Oral

Strophanthus eminii Asch & Pax (OH 25)  
Apocynaceae  
Muhunguti  
RB  
Shrub  
Oral

Strychnos potatorum Gilg. (OH 21)  
Loganiaceae  
Mumpande  
L  
Tree  
Oral

Tagetes minuta L. (OH 43)  
Compositae  
Mbangi  
L  
Climber  
Topical

Turraea holstii Gurk (OH 37)  
Meliaceae  
Muhenga  
L  
Shrub  
Oral

Zanthoxylum chalybeum L. (OH 22)  
Rutaceae  
Mulungu  
RB  
Tree  
Topical/Oral

Ziziphus pubercens Oliv. (OH 42)  
Cucurbitaceae  
Foiza  
WP  
Climber  
Topical

Ziziphus pubescens Oliv. (OH 55)  
Rhamnaceae  
Indigishi  
L  
Shrub  
Topical

Key: F, Fruit; L, Leaves; R, Roots; RB, Root bark; S, Stem; SB, Stem bark; T, Tubor; WP, whole plant. * No other uses report.
Table 2: The brine shrimp lethality results represented as LC<sub>50</sub> in µg/ml and 95% confidence intervals (CI).

<table>
<thead>
<tr>
<th>Binomial name</th>
<th>Part tested</th>
<th>LC&lt;sub&gt;50&lt;/sub&gt; µg/ml</th>
<th>(95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acacia robusta</em></td>
<td>Stem</td>
<td>108.5</td>
<td>87.8-134.0</td>
</tr>
<tr>
<td><em>Acalypha fruticosa</em></td>
<td>Roots</td>
<td>23.9</td>
<td>16.5-34.7</td>
</tr>
<tr>
<td><em>Leaves</em></td>
<td>113.9</td>
<td>91.2-142.3</td>
<td></td>
</tr>
<tr>
<td><em>Agauria salicifolia</em></td>
<td>Leaves</td>
<td>&gt;240</td>
<td>-</td>
</tr>
<tr>
<td><em>Albizia anthelmintica</em></td>
<td>Roots</td>
<td>24.9</td>
<td>14.1-44.0</td>
</tr>
<tr>
<td><em>Aloe lateritia</em></td>
<td>Whole plant</td>
<td>19.1</td>
<td>13.2-27.8</td>
</tr>
<tr>
<td><em>Balantites aegyptica</em></td>
<td>Root bark</td>
<td>&gt;240</td>
<td>-</td>
</tr>
<tr>
<td><em>Cassia abbreviata</em></td>
<td>Roots</td>
<td>12.7</td>
<td>8.1-19.8</td>
</tr>
<tr>
<td><em>Commiphora pteleifolia</em></td>
<td>Roots</td>
<td>&gt;240</td>
<td>-</td>
</tr>
<tr>
<td><em>Cordia africana</em></td>
<td>Roots</td>
<td>211.4</td>
<td>117.6-380.1</td>
</tr>
<tr>
<td><em>Croton scheffleri</em></td>
<td>Roots</td>
<td>13.7</td>
<td>21.5-8.7</td>
</tr>
<tr>
<td><em>Chrysophyllum banguelense</em></td>
<td>Root bark</td>
<td>96.3</td>
<td>65.5-141.6</td>
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<tr>
<td><em>Cyphosterma hilderbrandtii</em></td>
<td>Leaves</td>
<td>25.7</td>
<td>16.9-39.0</td>
</tr>
<tr>
<td><em>Drymaria cordata</em></td>
<td>Whole plant</td>
<td>&gt;240</td>
<td>-</td>
</tr>
<tr>
<td><em>Elaedendron schlechteranum</em></td>
<td>Stem bark</td>
<td>37.5</td>
<td>28.1-50.1</td>
</tr>
<tr>
<td><em>Elaedendron stuhlmannii</em></td>
<td>Stem bark</td>
<td>&gt;240</td>
<td>-</td>
</tr>
<tr>
<td><em>Erythrina abbyssinica</em></td>
<td>Root</td>
<td>&gt;240</td>
<td>-</td>
</tr>
<tr>
<td><em>Euphorbia heterophylla</em></td>
<td>Whole plant</td>
<td>80.2</td>
<td>57.3-112.5</td>
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<tr>
<td><em>Euphobia tirucali</em></td>
<td>Leaves</td>
<td>196.2</td>
<td>72.7-529.7</td>
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<tr>
<td><em>Ficus sur</em></td>
<td>Stem bark</td>
<td>146.1</td>
<td>116.1-183.9</td>
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<td><em>Hymenodictyon parvifolium</em></td>
<td>Roots</td>
<td>13.4</td>
<td>8.3-21.5</td>
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<td><em>Hypericum roeperanum</em></td>
<td>Leaves</td>
<td>46.6</td>
<td>34.2-63.6</td>
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<td><em>Indigofera rhynchocarpa</em></td>
<td>Roots</td>
<td>28.3</td>
<td>20.5-39.0</td>
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<td><em>Jatropha multifida</em></td>
<td>Leaves</td>
<td>21.7</td>
<td>16.4-28.7</td>
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<td><em>Khaya anthotheca</em></td>
<td>Stem bark</td>
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<td>28.6-52.2</td>
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<tr>
<td><em>Kigelia africana</em></td>
<td>Fruit</td>
<td>&gt;240</td>
<td>3.9-13.8</td>
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<tr>
<td><em>Leaves</em></td>
<td>7.2</td>
<td>16.6-38.8</td>
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<tr>
<td><em>Lannea stuhlmannii</em></td>
<td>Roots</td>
<td>25.3</td>
<td>16.6-38.8</td>
</tr>
<tr>
<td><em>Leaves</em></td>
<td>7.2</td>
<td>3.9-13.8</td>
<td></td>
</tr>
<tr>
<td><em>Lobelia giberroa</em></td>
<td>Leaves</td>
<td>&gt;240</td>
<td>-</td>
</tr>
<tr>
<td><em>Ocimum basilicum</em></td>
<td>Whole plant</td>
<td>85.3</td>
<td>68.2-106.6</td>
</tr>
<tr>
<td><em>Ocimum suave</em></td>
<td>Leaves</td>
<td>16.7</td>
<td>11.6-24.1</td>
</tr>
<tr>
<td><em>Plumbago zeylanica</em></td>
<td>Roots</td>
<td>&gt;240</td>
<td>-</td>
</tr>
<tr>
<td><em>Rapanea melanophloeus</em></td>
<td>Stem bark</td>
<td>152.4</td>
<td>84.6-274.5</td>
</tr>
<tr>
<td><em>Leaves</em></td>
<td>12.1</td>
<td>8.6-17.2</td>
<td></td>
</tr>
<tr>
<td><em>Rhoicissus tridentate</em></td>
<td>Stem</td>
<td>&gt;240</td>
<td>3.9-13.8</td>
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<tr>
<td><em>Salvadore persica</em></td>
<td>Roots</td>
<td>&gt;240</td>
<td>-</td>
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<td><em>Securidaca longipedunculata</em></td>
<td>Roots</td>
<td>77.1</td>
<td>45.3-131.1</td>
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<tr>
<td><em>Solanum incanum</em></td>
<td>Whole plant</td>
<td>90.2</td>
<td>75.7-107.4</td>
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<td><em>Spirostachys africana</em></td>
<td>Leaves</td>
<td>16.4</td>
<td>9.4-28.8</td>
</tr>
<tr>
<td><em>Stem</em></td>
<td>45.2</td>
<td>24.2-84.5</td>
<td></td>
</tr>
<tr>
<td><em>Sterculia africana</em></td>
<td>Leaves</td>
<td>94.5</td>
<td>57.9-154.9</td>
</tr>
<tr>
<td><em>Strophanthus eminii</em></td>
<td>Root bark</td>
<td>38.9</td>
<td>27.4-55.2</td>
</tr>
<tr>
<td><em>Styrchnos pototorum</em></td>
<td>Leaves</td>
<td>87.6</td>
<td>39.5-194.2</td>
</tr>
<tr>
<td><em>Tecetes minuta</em></td>
<td>Leaves</td>
<td>19.9</td>
<td>14.5-27.3</td>
</tr>
<tr>
<td><em>Turraea holstii</em></td>
<td>Leaves</td>
<td>96.3</td>
<td>42.3-218.5</td>
</tr>
<tr>
<td><em>Zanthoxylum chalybeum</em></td>
<td>Root bark</td>
<td>68.9</td>
<td>36.9-128.6</td>
</tr>
<tr>
<td><em>Zehneria scabra</em></td>
<td>Whole plant</td>
<td>138.1</td>
<td>93.7-203.4</td>
</tr>
<tr>
<td><em>Ziziphus pubescens</em></td>
<td>Leaves</td>
<td>68.2</td>
<td>50.5-92.1</td>
</tr>
<tr>
<td><em>Cyclophosphamide</em></td>
<td>-</td>
<td>16.3</td>
<td>10.6-25.2</td>
</tr>
</tbody>
</table>

**Discussion**

Previous investigations of our group on the *in vitro* antifungal activity of the plants support the therapeutic claims of the traditional healers (Hamza et al., in Press). Identification of herbal medicines for the treatment of fungal infections in HIV/AIDS patients could be pivotal in supporting the needs of these patients in terms of easy availability, affordability, and possibly to cope with the problem of recurrent *Candida* infections and emergence of resistance.

Apart from efficacy, safety of herbal medicines is of paramount importance as there is not much that is known about many plants that are used in traditional medicine. We have used the brine shrimp lethality test as a preliminary tool to evaluate the toxicity of the identified plants. Unfortunately not all the plants collected were tested. However, among those tested 9 were quite toxic to the shrimps. Since the test is also used to identify potential anticancer substances, the results may mean that these plants are either outright toxic or may have potential anticancer activity. Two of the plants *Euphorbia heterophylla* L. (Rocha e Silva, 1943) and *Jatropha multifida* are reported to be toxic (Levin et al., 2000), thus supporting what was reported by the healers. The extracts of the roots and leaves of *Jatropha multifida* also exhibited relatively high toxicity on the shrimps, while for *Euphorbia heterophylla* the toxicity was low (LC50 80.2 µg/ml). Toxicity results from animals will be crucial as a way to definitively judge the safety of these plants, as and when they are found to have enough potential for development. The present results only suggest possibility of other hitherto unreported biological activities, of toxic nature or even anticancer activity. Among the plants tested were seven plants that in earlier investigations of our group showed to have potent antifungal activity (Hamza et al., in Press). The toxic effect of these plants are shown in Table 2. All these plants need to be further investigated for their potential as a source of antifungal compounds.

The results of this toxicity study showed the relative toxicities of the plants. More work is needed in order to determine their usefulness as potential antifungal and anticancer agents.

**Acknowledgements**

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**References**


11. Rocha e Silva M (1943). Studies on poisonous plants in the state of Sao Paulo: toxicological expts. on 27 plants which have been suspected of toxicity. Arq Instit Biol (Sao Paulo) **14**:15.

