Abstract

**Medicinal plant**, the definition rightly suggests that all plants, in principle, have a potential medicinal value, although in practice a plant is referred to as medicinal when it is so used by some system of medicine. The value of medicinal plants to the mankind is immense. A large number of the people worldwide rely chiefly on traditional health care system and on herbal medicines.

**Jaundice** is not a disease rather a sign that can show up in several disease conditions. There is no specific treatment for jaundice by prescribing modern allopathic and homeopathic drugs, although different workers have documented medicinal plants from various regions of the world for the purpose. Chemical reactions in the liver may generate several reactive species like free radicals. Overloading of reactive species results in significant depletion of antioxidants, which accelerates the advancement of haemolysis. Experimental and clinical studies have demonstrated the pivotal role of oxidative stress in the promotion of hepatic and intestinal injury. Thus, severe oxidative stress is thought to be one of the main causes of jaundice.

**Antioxidant potential** and antioxidant principles are attributed to the hepatoprotective property. The role of antioxidant is to detoxify reactive oxygen intermediate (ROI) in the body. Naturally occurring inhibitors of oxidation generally originate from plant based materials. They are substances that protect the body from being damaged by reacting with free radicals and other reactive oxygen species, thus hinder the process of oxidation.

In the present scenario, the demand for herbal products is growing exponentially throughout the world and major pharmaceutical companies are currently conducting extensive research on plant materials for their potential medicinal value. A large number of plants have been recognized to have medicinal values and to possess a variety of antioxidant effects. Thus the assessment of their chemical composition and antioxidant capacity can be considered as an essential and useful task. This endeavour records a good number of medicinal plants available in the study area, their distribution and their value for human life and Indian economy.
The thesis is divided into four chapters. Chapter 1 is an introduction to different aspects of jaundice. This chapter begins with a discussion on causes and classification of jaundice. Severe oxidative stress is considered as one of the major causes of jaundice. A discussion on traditional remedies of jaundice and commercial drugs available in the market is also presented. As oxidative stress is considered a major factor to cause jaundice, antioxidants are expected to help in preventive measures against jaundice. The chapter concludes with a statement on the objective of the research project.

In Chapter 2, a field study on herbal drugs used against jaundice is presented. A discussion on data collected from traditional practitioners and jaundice patients treated with herbal drugs is also presented. The geographical map of the study area is another element of this chapter. During the field study nine plants used against jaundice are identified from the study area (Table 2.2).

**Table 2.2 : Medicinal plants used in the treatment of jaundice in the study area.**

<table>
<thead>
<tr>
<th>SI No.</th>
<th>Botanical Name</th>
<th>English Name</th>
<th>Local Name</th>
<th>Family</th>
<th>Parts Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Ananus comosus</em></td>
<td>Pine apple</td>
<td>Anaras</td>
<td>Bromeliaceae</td>
<td>Leaf</td>
</tr>
<tr>
<td>2</td>
<td><em>Averrhoa carambola</em></td>
<td>Carambola</td>
<td>Kardoi</td>
<td>Oxalidaceae</td>
<td>Fruit</td>
</tr>
<tr>
<td>3</td>
<td><em>Cajanus cajan</em></td>
<td>Pigeon pea</td>
<td>Arahar</td>
<td>Papilionaceae</td>
<td>Leaf</td>
</tr>
<tr>
<td>4</td>
<td><em>Centella asiatica</em></td>
<td>Indian penny wort</td>
<td>Manimoni</td>
<td>Apiaceae</td>
<td>Leaf</td>
</tr>
<tr>
<td>5</td>
<td><em>Glycosmis pentaphylla</em></td>
<td>Jamaica mandarin</td>
<td>Chauldhowa</td>
<td>Rutaceae</td>
<td>Leaf</td>
</tr>
<tr>
<td>6</td>
<td><em>Leucus plukentii</em></td>
<td>Dronapushpi</td>
<td>Doron</td>
<td>Lamiaceae</td>
<td>Leaf</td>
</tr>
<tr>
<td>7</td>
<td><em>Moringa oleifera</em></td>
<td>Drum stick</td>
<td>Sajina</td>
<td>Moringaceae</td>
<td>Leaf</td>
</tr>
<tr>
<td>8</td>
<td><em>Oroxyllum indicum</em></td>
<td>Indian trumpet Flower</td>
<td>Bhatghila</td>
<td>Bignoniaceae</td>
<td>Bark</td>
</tr>
<tr>
<td>9</td>
<td><em>Scoparia dulcies</em></td>
<td>Sweet broom Weed</td>
<td>Banjaluk</td>
<td>Scophulariaceae</td>
<td>Leaf</td>
</tr>
</tbody>
</table>
Out of these nine plants two plants namely *Glycosmis pentaphylla* and *Oroxylum indicum* have been short listed as potential sources of herbal remedy for jaundice based on facts and figures (Table 2.4).

**Table 2.4 : Effectiveness of different plants used in the treatment of jaundice.**

<table>
<thead>
<tr>
<th>Entry</th>
<th>Name of the plant used in the treatment of Jaundice</th>
<th>No. of patients used the plant ($N_T$)</th>
<th>No. of patients fully cured ($N_C$)</th>
<th>No. of patients partially cured</th>
<th>No. of patients recording no effect</th>
<th>Effectiveness (%) ($N_C/N_T$) x 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Ananus comosus</em></td>
<td>04</td>
<td>01</td>
<td>02</td>
<td>01</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td><em>Averrhoa carambola</em></td>
<td>06</td>
<td>03</td>
<td>01</td>
<td>02</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td><em>Cajanus cajan</em></td>
<td>14</td>
<td>09</td>
<td>03</td>
<td>02</td>
<td>64</td>
</tr>
<tr>
<td>4</td>
<td><em>Centella asiatica</em></td>
<td>05</td>
<td>03</td>
<td>01</td>
<td>01</td>
<td>60</td>
</tr>
<tr>
<td>5</td>
<td><em>Glycosmis pentaphylla</em></td>
<td>24</td>
<td>20</td>
<td>04</td>
<td>0</td>
<td>83</td>
</tr>
<tr>
<td>6</td>
<td><em>Leucas plukentii</em></td>
<td>05</td>
<td>04</td>
<td>01</td>
<td>0</td>
<td>80</td>
</tr>
<tr>
<td>7</td>
<td><em>Moringa oleifera</em></td>
<td>06</td>
<td>04</td>
<td>01</td>
<td>01</td>
<td>67</td>
</tr>
<tr>
<td>8</td>
<td><em>Oroxylum indicum</em></td>
<td>18</td>
<td>15</td>
<td>03</td>
<td>0</td>
<td>83</td>
</tr>
<tr>
<td>9</td>
<td><em>Scoparia dulcies</em></td>
<td>02</td>
<td>0</td>
<td>01</td>
<td>01</td>
<td>0</td>
</tr>
</tbody>
</table>

In Chapter 3, experimental results on antioxidant activity of all the nine plant species listed in Table 2.2 are reported and discussed. Results from phytochemical screening Table 3.64 on the plant extracts are also presented. From the study reported in this chapter *Glycosmis pentaphylla* appears the most effective plant against jaundice among the nine plants studied (Table 3.65).
### Table 3.64: Phytochemical screening of the tested plant materials.

<table>
<thead>
<tr>
<th>SI No.</th>
<th>Name of Plants</th>
<th>Phytochemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Phe</td>
</tr>
<tr>
<td>1</td>
<td><em>Glycosmis pentaphylla</em></td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td><em>Oroxylum indicum</em></td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td><em>Leucus plukentii</em></td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td><em>Cajanus cajan</em></td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td><em>Moringa oleifera</em></td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td><em>Centella asiatica</em></td>
<td>+</td>
</tr>
<tr>
<td>7</td>
<td><em>Averrhoa carambola</em></td>
<td>+</td>
</tr>
<tr>
<td>8</td>
<td><em>Ananus comosus</em></td>
<td>+</td>
</tr>
<tr>
<td>9</td>
<td><em>Scoparia dulcis</em></td>
<td>+</td>
</tr>
</tbody>
</table>

Abbreviation:

- Phe = Phenol
- Alk = Alkaloid
- Ter = Terpenoid
- Fla = Flavonoid
- Sap = Saponin
- Phy = Phytosterol
- Phl = Phlobatannin
- Cgl = Cardiac glycosides
- Ste = Steroids
- Tan = Tannins
- Car = Carbohydrates

+ = Presence of phytochemicals
- = Absence of phytochemicals
Table 3.65: Results of antioxidant activity, IC-50 values of the tested plants.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the plants</th>
<th>Antioxidant activity (%)</th>
<th>Antioxidant activity (%)</th>
<th>IC-50 values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>05 mg/L</td>
<td>25 mg/L</td>
<td>50 mg/L</td>
</tr>
<tr>
<td>1</td>
<td><em>Glycosmis pentaphylla</em></td>
<td>06</td>
<td>24</td>
<td>45</td>
</tr>
<tr>
<td>2</td>
<td><em>Oroxylum indicum</em></td>
<td>04</td>
<td>22</td>
<td>43</td>
</tr>
<tr>
<td>3</td>
<td><em>Leucus plukentii</em></td>
<td>4</td>
<td>21</td>
<td>42</td>
</tr>
<tr>
<td>4</td>
<td><em>Cajanus cajan</em></td>
<td>03</td>
<td>20</td>
<td>39</td>
</tr>
<tr>
<td>5</td>
<td><em>Moringa oleifera</em></td>
<td>03</td>
<td>18</td>
<td>36</td>
</tr>
<tr>
<td>6</td>
<td><em>Centella asiatica</em></td>
<td>3</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>7</td>
<td><em>Averrhoa carambola</em></td>
<td>04</td>
<td>15</td>
<td>28</td>
</tr>
<tr>
<td>8</td>
<td><em>Ananus comosus</em></td>
<td>03</td>
<td>13</td>
<td>26</td>
</tr>
<tr>
<td>9</td>
<td><em>Scoparia dulcies</em></td>
<td>01</td>
<td>07</td>
<td>13</td>
</tr>
</tbody>
</table>

In Chapter 4, analysis of extracts from the leaves of *Glycosmis pentaphylla* is presented. Elaborate discussion on the experimental procedures involved in fractionation of the extracts, (Scheme 4.1 to Scheme 4.7).
Powdered material (100 g)

Step I
Petroleum ether (700 ml), filtered

Filtrate
Residue

Step II
Diethyl ether (700 ml), filtered

Extract A
Filtrate
Residue

Step III
Ethyl acetate (700 ml), filtered

Extract B
Filtrate
Residue

Step IV
Methanol (700 ml), filtered

Extract C
Filtrate
Residue

Step V
Water (700 ml), filtered

Extract D
Filtrate
Residue

Extract E
Disposed

Scheme 4.1
CC = Column Chromatography

Scheme 4.2
Extract B

CC

B₁ B₂ B₃ B₄

CC = Column Chromatography

Scheme 4.3

Extract C

CC

C₁ C₂ C₃ C₄ C₅

CC

C₁₁ C₁₂ C₂₁ C₂₂ C₃₁ C₃₂ C₃₃ C₄₁ C₄₂ C₄₃ C₄₄

CC

C₅₁ C₅₂ C₅₃ C₅₄

CC

C₅₄₁ C₅₄₂ C₅₄₃

CC

C₅₄₁₁ C₅₄₁₂ C₅₄₁₃

CC

CC = Column Chromatography

Scheme 4.4
Extract D

\[ \text{CC} \]

\[ \rightarrow \]

\[ D_1 \quad D_2 \quad D_3 \quad D_4 \]

\text{CC} = \text{Column Chromatography}

\text{Scheme 4.5}

Extract E

\[ \text{CC} \]

\[ \rightarrow \]

\[ E_1 \quad E_2 \quad E_3 \]

\text{CC} = \text{Column Chromatography}

\text{Scheme 4.6}
Dry & powdered material (100g)

Step I | Soxhlet

Ext. A
(3.414g)

Ext. B
(1.447g)

Step II | CC

Bi
(303mg)

Step III | AA

2%

Step IV | IC-50

3321

Ext. D
(6.603g)

Step II | CC

D1
(17mg)

D2
(17mg)

D3
(536mg)

D4
(56mg)

Step III | AA Step II| AA Step III| AA Step III| AA Step III| AA

2% 23% 43% 70% 24% 48% 84% 65% 84% 68%

142 119 109

Step VI | Phyto

Phenol

(3.070g)

Step II | CC

C11 C21 C31 C41 C422 C52 C542 C56412 C6413

(257mg) (10mg) (35mg) (10mg) (20mg) (19mg) (114mg) (65mg) (148mg) (77mg)

Step II | AA Step II| AA Step II| AA Step II| AA Step II| AA Step II| AA Step II| AA Step III| AA

2% 23% 43% 70% 24% 48% 84% 65% 84% 68%

3328 228 117 70 211 104 57 76 60 73

Step VI | Phyto

(3.414g)

Step II | CC

A12 A21 A23 A3142 A3144 A3222 A555 A52 A512

(489mg) (59mg) (157mg) (39mg) (56mg) (52mg) (16mg) (20mg) (182mg) (96mg)

Step II | AA Step II| AA Step III| AA Step II| AA Step II| AA Step II| AA Step II| AA Step III| AA

17% 9% 17% 9% 44% 84% 26% 84% 84% 27% 45%

495 735 355 114 58 195 59 60 199 117

Ext. A

(3.414g)

Alkaloid

Phenol

Scheme 4.7
Measurement of antioxidant activity of each sub-fractions Table 4.13 and screening of the phytochemicals present in three sub-fractions Table 4.14 are also presented.

### Table 4.13 : Fractions with antioxidant activity higher than 80%

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Fraction</th>
<th>Quantity (mg)</th>
<th>Antioxidant activity (%)</th>
<th>IC-50 values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A\textsubscript{3.1.44}</td>
<td>056</td>
<td>84</td>
<td>58.35</td>
</tr>
<tr>
<td>2</td>
<td>A\textsubscript{5.5.4}</td>
<td>016</td>
<td>84</td>
<td>59.50</td>
</tr>
<tr>
<td>3</td>
<td>A\textsubscript{5.5.3a}</td>
<td>020</td>
<td>84</td>
<td>60.08</td>
</tr>
<tr>
<td>4</td>
<td>C\textsubscript{5.2}</td>
<td>114</td>
<td>84</td>
<td>57.55</td>
</tr>
<tr>
<td>5</td>
<td>C\textsubscript{5.4.1.2}</td>
<td>148</td>
<td>84</td>
<td>60.74</td>
</tr>
<tr>
<td>6</td>
<td>D\textsubscript{3}</td>
<td>5367</td>
<td>84</td>
<td>59.50</td>
</tr>
<tr>
<td>7</td>
<td>D\textsubscript{4}</td>
<td>056</td>
<td>81</td>
<td>61.48</td>
</tr>
</tbody>
</table>

### Table 4.14 : Phytochemical classification of constituents in sub-fractions C\textsubscript{5.2}, C\textsubscript{5.4.1.2}, D\textsubscript{3}

<table>
<thead>
<tr>
<th>Sl</th>
<th>Fraction</th>
<th>Phytochemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Phe Alk Ter Fla Sap Phy Phi Cgl Ste Tan Car</td>
</tr>
<tr>
<td>1</td>
<td>C\textsubscript{5.2}</td>
<td>- + - - - - - - -</td>
</tr>
<tr>
<td>2</td>
<td>D\textsubscript{3}</td>
<td>+ - - - - - - - -</td>
</tr>
<tr>
<td>3</td>
<td>C\textsubscript{5.4.12}</td>
<td>+ - - - - - - - -</td>
</tr>
</tbody>
</table>

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- Fla = Flavonoid
- Sap = Saponin
- Phy = Phytosterol
- Phi = Phlobatannin
- Cgl = Cardiac glycosides
- Ste = Steroids
- Tan = Tannins
- Car = Carbohydrates

+ = Presence of phytochemicals
- = Absence of phytochemicals
The study has resulted in isolation of a new alkaloid from the most potent antioxidant fraction of the ethyl acetate extract. From the spectral investigation the following structure has been suggested for the new alkaloid.