A review of phytochemical and biological studies of *Diospyros* species used in folklore medicine of Jharkhand

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Abstract

*Diospyros* is one of the most important genus of Ebenacea family. Out of its more than 475 species, about 100 are well explored phytochemically. The medicinal uses and chemical constituents of various *Diospyros* species have been reviewed earlier by Mallavadhani *et al* in 1998 [1]. The present review has been focused only on 9 species of *Diospyros* which are potent and are being used in folklore medicines of Jharkhand to cure diarrhea, fever and ulcer. This review is an extension of the work of Mallavadhani *et al* with regards to these 9 species. These days *Diospyros* species are being explored as a cytotoxic agent to cure cancer and AIDS also. Considering these facts an attempt has been made to present a review on phytochemical and biological studies of *Dispyros* species along with their traditional uses.

Keywords: *Diospyros* species, phytochemical studies, biological studies, traditional uses.

1. Introduction

*Diospyros* is a large genus of trees or shrubs, belonging to family Ebenaceae, which are widely distributed in both the hemispheres. About 41 species are indigenous to India, mostly in evergreen forest of Deccan, Assam and Bengal; a few have been reported in North India [2]. Its bark is bitter, astringent and febrifuge. The unripe fruit is a more powerful astringent [3].

In Indian system of traditional medicines like Ayurveda and Unani, various *Diospyros* species are used medicinally to cure fever, diabetes, snake bite, diarrhoea, biliousness, ulcer etc[4]. Considering the voluminous work on this genus, present review has been focused only on 9 potent species, which are used in folklore medicine of Jharkhand, with regard to their phytochemical, biological evaluations and traditional uses.

Phytochemical studies

Phytochemically about 100 (out of 475) species of *Diospyros* are well explored among which the potent ones like *D. ebenum*, *D. kaki,*

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D. maritima, D. melanoxylon, D. montana, D. peregrina have been studied extensively.

Research on this genus began with the work of Iwata (1922), who isolated d-manitol in a crystalline form from D. kaki fruit [5].

Phytoconstituents of Diospyros ranges from hydrocarbons, long chain fatty acids to steroids, terpenoids, naphthoquinones, and naphthalene based aromatics and aurones.

Following Chemical constituents have been reported from different parts of Diospyros species [6]:

**Fruit:** carotenoids, tannins, sugars, lipids, hydrocarbon, aromatics, flavonoids, terpenoids.

**Seed:** sugars, hydrocarbons, lipids, terpenoids.

**Leaf:** tannins, flavonoids, terpenoids, steroids.

**Bark:** lipids, aromatics, terpenoids, steroids, naphthoquinones.

**Root:** sugars, aromatics, flavonoids, naphthoquinones.

**Heartwood:** terpenoids, steroids, naphthoquinones.

Table 1 presents the Chemical compounds; isolated so far from selected Diospyros species and the structures of pharmacologically active entities are also being presented in Figure 1.

**Biological activities**

Diospyros species are known for their medicinal uses since olden time. Almost all the parts of these plants have been used as medicine e.g., the leaves are good for lumbago, fruits are carminative, astringent, cure biliousness and vata in ayurveda, seeds are sedative where as bark is bitter, astringent and febrifuge [6].

In modern medicine, various metabolites of Diospyros species like ursolic acid showed potent inhibitory activity against HIV-I protease and β-amyrin, betulin and diospyrin exhibit moderate to potent cytotoxic activity on different carcinoma models [6, 7].

Traditional and folklore medicinal uses of potent Diospyros species and in vivo/vitro biological screening have been tabulated in table 2.

**2. Discussion**

While preparing this review article, authors came across all the phytochemical and biological works, done so far on different species of Diospyros. Guided by the fact that only about 100 species have been thoroughly explored, it was found worthwhile to select a potent and virgin plant for further exploration. This is how D. paniculata was selected to work upon. Its evaluation would be forwarded to the journal in near future.

**3. Acknowledgement**

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Plumbagin

7-Methyljuglone

Lupeol \( R_1:\beta-OH; R_2:CH_3 \)
Betulin \( R_1:\beta-OH; R_2:CH_2OH \)
Betulinic acid \( R_1:\beta-OH; R_2:COOH \)

\( \alpha \)-Amyrin \( R_1:\beta-OH; R_2:CH_3 \)
Ursolic acid \( R_1:\beta-OH; R_2:COOH \)
Ursolic acid acetate \( R_1:\beta-OCOCH_3; R_2:COOH \)

Diospyrin

Diospyrol

Disindigo A

Isodiospyrin \( R_1=R_2=R'_1=R'_2=H \)
Table 1: List of compounds isolated from *Diospyros* species

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Species</th>
<th>Chemicals Isolated</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><em>D. chloroxylon</em></td>
<td>2-methyl-3, 6-dihydroxy-4, 5-dimethoxynaphthalene, Betulin, Betulinic acid, β - Sitosterol, 7-methyljuglone, Diospyrin, Isodiospyrin, Xylorpyrin.</td>
<td>8</td>
</tr>
<tr>
<td>2.</td>
<td><em>D. ebenum</em></td>
<td>Lupeol, Betulin, Betulinic acid, Ursolic acid, α-amyrin, Bauerenol, β-sitosterol, Stigmasterol, Ebenone Plumbagin, Hexacosanol, 6-hydroxy-4, 5, -dimethoxy-2-naphthaldehyde, 4, 5, 6-trimethoxy-2-naphthalene, 6-hydroxy-4, 5 -dimethoxy-2-naphthoic acid.</td>
<td>9, 10, 11</td>
</tr>
<tr>
<td>3.</td>
<td><em>D. exculpata</em></td>
<td>Lupeol, Betulin, Betulinic acid.</td>
<td>12</td>
</tr>
<tr>
<td>4.</td>
<td><em>D. kaki</em></td>
<td>Kakispyrol, Diphenolase, β-amyrin, Uvaol, Ursolic acid, Lupeol Betulin, Betulinic acid, Phenolic metabolite (β-glucopyranoside), Xyloglucan, Oleanolic acid, Taraxerol, β-sitosterol, Campesterol, Plumbagin, β-sitosterolglycoside, 7-methyljuglone, Shinanolone, 3-methoxy-7-methyljuglone, Vitexin, Neodiospyrin, Isodiospyrin, 8-hydroxyisodiospyrin, Mamegakinone Maritnine, Hetroglycan DL-3Bb, Pectic polysaccharide DL-2A, 2'-o-rhamnosyl vitexin, Pheophorbide-A-methylester.</td>
<td>1, 13, 14, 15, 16, 17</td>
</tr>
<tr>
<td>5.</td>
<td><em>D. maritima</em></td>
<td>6-(1-ethoxy ethyl) plumbagin, etyledene-3, 3'-biplumbagin, Diospyroidone, Diospylidediethyl malate, Lupeol, Betulin, Betulinic acid, 3-(E)-coumaroylbetulin-28-ylethylsuccinate, Plumbagin, 3-bromoplumbagin Droserone,isoshinanolone, Euptinone, Maritnineone, Scopeletin, Chitraneone, Zeylanone.</td>
<td>18, 19, 20</td>
</tr>
<tr>
<td>6.</td>
<td><em>D. melanoxylon</em></td>
<td>Aurone, Lupeol, Betulin, Betulinic acid, Ursolic acid, α &amp; β-amyрин, Uvaol, Bauerenol, Oleanolic acid, Hentri-acotanol, β-sitosterol, 7-methyljuglone, Dimelquinone, Dihydroxytriterpenic acid, Methoxysterivative of -1, 4-Naphthquinone, Disinidigo A&amp;B, Pentacylicquione Biramentaceone, Dimethoxysterivative of 1-naphthol Hentriacotane, 8-hydroxy-octadec-10(Z) -enoic acid Malvalic acid, Bicyclusquetsperene, Sterucic acid.</td>
<td>21, 22, 23, 24, 25, 26</td>
</tr>
<tr>
<td>7.</td>
<td><em>D. montana</em></td>
<td>Kaempferol diglucoside, Quercetin, Gallic acid Lupeol, Betulin, Betulinic acid, Allobetulin, Oxybetulin Ursolic acid, Ursolic stearate &amp; palmitate, α-amyrenone Epiuvaol, α-amyrin, Oleanolic acid, β-Sitosterol, Stigmasterol, 7-Methyljuglone, Chromenone acid, Yerrinquinone, Diospyrin, β'-Dihydodiospyrin 8-Hydroxydiospyrin, Cyclodiospyrin, 2'&amp;3'-Chloro-diospyrin, Biramentactone, Isodiospyrin, Mamegakinone.</td>
<td>27, 28, 29, 30, 31</td>
</tr>
<tr>
<td>8.</td>
<td><em>D. peregrina</em></td>
<td>Peregrinol, Lupeol, Betulinic acid, Betulin, β-Amyrin Marsfromosanone, β-Sitosterol, Oleanolic acid Oleanolic acid glycoside, β-Sitosterol glucoside Hexitosanetriacontanol, Nonadecan-7-ol-2-one.</td>
<td>32, 33, 34, 35</td>
</tr>
<tr>
<td>9.</td>
<td><em>D. paniculata</em></td>
<td>Naphthoquinones.</td>
<td>36</td>
</tr>
</tbody>
</table>
Table 2. Pharmacological screening and Traditional uses

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Species</th>
<th>Traditional uses 2,3,6,7</th>
<th>Extract for screening</th>
<th>Pharmacological activity</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>D. chloroxylon</strong></td>
<td>Antiviral</td>
<td>50%Ethanol[PER]</td>
<td>Antiviral</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td><strong>D. ebenum</strong></td>
<td>Astringent, attenuant &amp; lithontriptic</td>
<td>50%Ethanol[PER]</td>
<td>Showed activity on cardiovascular system Produced fall in blood pressure and increase in respiration, also showed anorexia, CNA depressant and anti-bacterial activities</td>
<td>37</td>
</tr>
<tr>
<td>3.</td>
<td><strong>D. exculpata</strong></td>
<td>As hemostat for cut &amp; wound, Dysentery [bark], biliousness [wood] Ulcer, disease of blood, urinary losses [fruit], scorpion bite [root]</td>
<td>Unsaponified matter [seed]</td>
<td>Potent cytotoxic activity against human oral squamous cell carcinoma cells (HSC-2) &amp; human submandibular gland tumor (HSG) cells with IC(50) value from 20 to 59microgm/ml</td>
<td>18</td>
</tr>
<tr>
<td>4.</td>
<td><strong>D. kaki</strong></td>
<td>Cough, hiccough, dyspnea, antihypertensive</td>
<td>Methanol extract [PER]</td>
<td>Scavenging activity against DPPH (1,1-diphenyl-2-picrylhydrazyl) radicals with an IC(50) value of 0.11mg/ml (1)-Reduce Hydrogen Peroxide induced NG108 -15 cells</td>
<td>38</td>
</tr>
<tr>
<td>5.</td>
<td><strong>D. maritima</strong></td>
<td>-</td>
<td>Amyrin,ursolic acid [leaves]</td>
<td>Exhibit activity against bacteria, fungi, guppy fish &amp; human tumor cells</td>
<td>41</td>
</tr>
<tr>
<td>6.</td>
<td><strong>D. melanoxylon</strong></td>
<td>Diuretic, carminative, laxative [bark], urinary discharge, inflammation of spleen [flower], antidiabetic</td>
<td>Unsaponefified matter [seed] 90% Ethanol [bark]</td>
<td>Potent antifeedent activity against Spilosoma oblique Spodoptera litura</td>
<td>1</td>
</tr>
<tr>
<td>7.</td>
<td><strong>D. montana</strong></td>
<td>For delirium high fever [bark], crack in sole of feet [fruit], abortifacient [root], tuberculosis [gum]</td>
<td>50% Ethanol [bark] Ethyl acetate Extract</td>
<td>Inhibited the growth of Ehrlich ascites carcinoma in mice Antibacterial and effective against most of the organisms tested extracts were especially active against Bacillus subtilis and Corynebacterium pyogenes</td>
<td>44</td>
</tr>
<tr>
<td>8.</td>
<td><strong>D. peregrina</strong></td>
<td>Good for dysentery &amp; intermittent fever [bark], lumbago &amp; blindness [flower], treatment of snake bite [leaf], dysentery &amp; diarrhea [seed]</td>
<td>-</td>
<td>Showed activity on human epidermoid carcinoma of nasopharynx in tissue culture and diuretic activity Significantly prevented rats from stress, gastric ulcers and hepatotoxicity. To be reported.</td>
<td>-</td>
</tr>
<tr>
<td>9.</td>
<td><strong>D. paniculata</strong></td>
<td>Rheumatism &amp; ulcer [bark]</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

PER: Part excluding root, Ref: Reference
### References


