Terminalia species: Phytochemical and Pharmaceutical Review

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Abstract

Terminalia plant is widely present in many countries and used for various Ayurvedic and folklore medicines. All the parts of the plants have medicinal values due to their presence of bioactive compounds. More than 500 active compounds are isolated and characterized by various researchers and published in reputed journals were referred in this manuscript. Bioactive compounds contain hypoglycemic, hypolipidimic, anticancerous (cytotoxic), antihelminthic, immunoboosting and rejuvenating, bowel system and digestive system regulation. This paper concluded the various phytochemical and pharmaceutical role of T. catappa, T. bellerica, T. arjuna and T. chebula species.

Keywords: Terminalia chebula, Phytochemical, Pharmaceutical and Combretaceae

Introduction: Role of Ethnomedicine in humans

According to WHO report, nearly 80% of our human population depends on phytochemical compounds to treat the human ailments. In India, most of the primary health products are derived basically from folklore medicines [1, 2] whereas ethnomedicine considered as an alternative drug, cost effective and user friendly [3]. Various researchers reported the analgesic, antimicrobial and anti-inflammatory properties of medicinal plants [4, 5, 6]. Various polyphenols such as phenolic acids, tannins and flavonoids showed antibacterial, anti-biofilm and anti-enzyme activities [7, 8].
Medicinal plants contain active compounds which showed effective against inflammatory and damaging tissues especially in liver and muscles [9]. Ethanopharmological role of the natural plants and their products has gained a lot attention among the researchers and pharmaceutical companies due to their sustainable usage as well as reliability about their bioactive compounds [10].

**Genus: Terminalia**

The plant family Combretaceae is comprises of more than 500 species of varied morphology as shrubs, trees and lianas. *Terminalia* plants is commonly distributed in many continents such as Asia (Himalayas), Africa and Australia. In India, *Terminalia* plants is quite popular species in Ayurvedic treatments [11]. Four plants such as *Terminalia catappa*, *Terminalia bellerica*, *Terminalia arjuna* and *Terminalia chebula* belongs to the family Combretaceae are selected for this review article. Table 1 showed the binomial classification of the selected four *Terminalia* species along with their common and vernacular name.

**Table 1: Scientific classification of selected Terminalia species.**

<table>
<thead>
<tr>
<th>Binomial classification</th>
<th>Common name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indian Almond</strong></td>
<td><strong>Beleric</strong></td>
</tr>
<tr>
<td><strong>Myrobalan</strong></td>
<td><strong>Malabar</strong></td>
</tr>
<tr>
<td><strong>Black Myrobalan</strong></td>
<td></td>
</tr>
<tr>
<td>Kingdom</td>
<td>Plantae</td>
</tr>
<tr>
<td>Clade</td>
<td>Tracheophytes</td>
</tr>
<tr>
<td>Clade</td>
<td>Angiosperms</td>
</tr>
<tr>
<td>Order</td>
<td>Myrtales</td>
</tr>
<tr>
<td>Family</td>
<td>Combretaceae</td>
</tr>
<tr>
<td>Genus</td>
<td>Terminalia</td>
</tr>
<tr>
<td>Species</td>
<td>Catappa</td>
</tr>
<tr>
<td>Vernacular (Tamil) name</td>
<td>Nattuvadumai</td>
</tr>
<tr>
<td></td>
<td>Thandri</td>
</tr>
<tr>
<td></td>
<td>Marudha maram</td>
</tr>
<tr>
<td></td>
<td>Kadukaai</td>
</tr>
</tbody>
</table>
[12] reported the significance of *Terminalia* plants in human ailment treatments due to their nutraceutical value. *Terminalia* phytocompounds used to treat heart diseases, dysentery, fever, microbial infections, cold infections, gastric ulcers, hair rejuvenation, upper digestive tract disorders, diarrhea, helminth infection, leprosy, dermal fungal infections, internal bleeding and edema [11].

**Phytochemical studies**

[13] Explained that importance of phytochemical studies in *Terminalia* species and also concluded that isolation of various active compounds such as tannins, terpenoids, flavonoids, simple phenolics and phenylpropanoids. Table 2 consolidated the few active compounds in the selected four plant species.

**Table 2. Isolated active compounds using various *Terminalia* part extracts**

<table>
<thead>
<tr>
<th>Extract (solvent)</th>
<th>Isolated compounds</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Terminalia catappa</strong></td>
<td></td>
<td>[14, 15, 16, 17, 18]</td>
</tr>
<tr>
<td>Leaves (H(_2)O and Acetone), Bark (H(_2)O)</td>
<td>Gallic acid, Coumaric acid, (p)-hydroxybenzoic acid, 3,4-dihydroxybenzoic acid, Terflavin (A), (B) and (C), Punicalagin, Isovitexin, 2”-O-galloylvitexin, 2”-O-galloylisovitexin, Gallocatechin, Orientin, Isoorientin, Vitexin, Isovitexin, Arjunglucoside (I)</td>
<td></td>
</tr>
<tr>
<td><strong>Terminalia bellerica</strong></td>
<td></td>
<td>[19, 20, 21, 22]</td>
</tr>
<tr>
<td>Leaves (H(_2)O and Acetone), Bark (H(_2)O)</td>
<td>Gallic acid, Coumaric acid, (p)-hydroxybenzoic acid, 3,4-dihydroxybenzoic acid, Terflavin (A), (B) and (C), Punicalagin, Isovitexin, 2”-O-galloylvitexin, 2”-O-galloylisovitexin, Gallocatechin, Orientin, Isoorientin, Vitexin, Isovitexin, Arjunglucoside (I)</td>
<td></td>
</tr>
</tbody>
</table>
(2α,3β,19α,23-tetrahydroxyolean-12-en-28-oic acid-28-O-β-D-glucopyranoside), 7-hydroxy-3’,4’-methylenedioxyflavan

**Terminalia arjuna**

| Leaves (H₂O), Fruits (MeOH), Leaves (MeOH) | Arjunglucoside (I) (2α,3β,19α,23-tetrahydroxyolean-12-en-28-oic acid-28-O-β-D-glucopyranoside), Catachin, Quercetin, Kaempferol, Luteolin, Arjunolone (6,4’-dihydroxy-7-O-methylflavones), Baicalein (5,6,7-trihydroxy-flavones) | [23, 24, 25, 15, 16] |

**Terminalia chebula**

| Leaves (H₂O), Fruits (MeOH), Leaves (MeOH) | Gallic acid, Methyl gallate, Ethyl gallate, 1,6-di-O-galloyl-β-D-Glc, 3,4,6-tri-O-galloyl-β-D-Glc, Chebulic acid, Chebulinic acid, Tellimagrandin(I), Corilagin, Terflavin (B) and (C), Ellagic acid, 3-O-methyl ellagic acid, Gallagic acid, 3’-O-methyl-4-O-(3”′,4”′-di-O-galloyl-α-L-rhamnopyranosyl) ellagic acid, 4-O-(4’′-O-galloyl-α-L-rhamnopyranosyl) ellagic acid, Ethyl gallate, Chebulanin | [21, 22, 26, 27, 28, 29] |

**Pharmaceutical role of Terminalia plant species**

*T. catappa* plant leaf extracts are used as hemostatic, antipyretic and hepatitis [30]. *T. catappa* methanolic leaf extracts showed anti-ageing and anti-cancerous activities [31]. In Ayurveda, *T. bellerica* phytocompounds were the predominant compounds used as rejuvenating, laxative and detoxifying agents in polyherbal formulations [32]. *T. bellerica* used widely for water diarrhea treatments [33]. A methanolic fruit extracts showed high
inhibitory activities of $\alpha$-amylase and $\alpha$-glucosidase [34]. [35] also reported the PPAR$\alpha$ and $\gamma$ signaling activities of $T$. bellerica fruit extracts.

[36] reported that *Terminalia arjuna* phytocompounds are traditionally used for to treat liver and cardiac ailments in India and Sri Lanka. In Indian traditional medicine, *T. chebula* were widely used to treat diabetes, constipation, and dementia [37]. [38] reported antibacterial, antioxidant, anti-inflammatory and cardiotonic properties of *T. chebula* fruit extracts. [35] also reported the PPAR$\alpha$ and PPAR$\gamma$ signaling activities of *T. chebula* fruit extracts. Methanolic fruit extracts of *T. chebula* showed anticancerous activities against many various cancer cell lines [39]. *T. arjuna* ethanolic extract of bark showed antilipidimic activities [40] whereas ethanolic leaf extracts of *T. catappa* has molluscicidal activity which was used as a biocontrol agent in agriculture as well as Schistosomiasis host mortality agent [41, 42].

**Conclusion**

This review compiles the short literature about the four *Terminalia* sp. phytochemical constituents and their biological role in human ailments. The phytocompounds were actively utilized in folklore, ayurvedic and allopathic medicines for hypoglycemic, microbial, helminth, cardiotonic, digestive, rejuvenation, hypolipidemic, cancer cell growth control and many others. Phytocompounds act as an effective and alternative medicinal product for various chemical based products.

**Acknowledgement**

We would like to express our thanks to Head of the Department, Plant Biology and Plant Biotechnology, Presidency College (Autonomous), Chennai, and Head of the Department, PG & Research Department of Botany, Govt. Arts College, Dharmapuri-5, Tamilnadu, India for the facilities provided to carry out my research work.
Conflict of Interest
The authors have no conflicts of interest.

References


