A Comprehensive Ethno-pharmacological and Phytochemical Update Review on Medicinal Plant of Terminalia arjuna Roxb. of Bangladesh

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Abstract: This review paper focused on ethno-pharmacological uses and phytochemical constituents of Terminalia arjuna Roxb., an important medicinal plant of Bangladesh, used in various indigenous system of medicine. This review has been conducted to pile up information that is available in different scientific literatures. It is observed that a large number of phytochemical components have been obtained from the plant e.g. arjunin, arjunetin, gallic acid, terminic acid, pyrocatechols, luteolin, β-sitosterol, calcium, magnesium, zinc, copper and these components exhibit various medicinal and pharmacological activities such as anti-mutagenic, anti-bacterial, anti-viral, anti-oxidant, anti-inflammatory, anti-atherosclerotic, anti-diabetic etc. The present comprehensive update review is therefore, an effort to give detailed information on phytochemical and pharmacological studies of T. arjuna Roxb. and this information will help the researchers to carry out research on this pharmaceutically important medicinal plant.

Keywords: Ethno-pharmacological activity, T. arjuna Roxb., scientific literatures, systematic study.

INTRODUCTION

After decades of serious obsession with the modern medicinal system, people have started looking at the ancient healing systems like Ayurveda, Siddha and Unnani because of their less adverse effects combined with lower cost that are associated with synthetic drugs [58]. These drugs play an important role in health care programs especially in developing countries. For the treatment of different diseases, about 80% people in the world still rely on conventional medicine [43]. Therefore, the valuation of rich heritage of conventional medicine is essential [64, 46, 55, 57]. The use of therapeutic plant either as a single drug or in combination is increasing in the health care of human beings. Phyto medicines or botanical medicines refer to the use of bark, seeds, root, berries, leaves, or flowers of any plant for therapeutic purposes by large number of people. It has now been recognized that the plants which naturally accumulate and synthesis some secondary metabolites like glycosides, alkaloids, tannins, volatile oils and contain vitamins and minerals, possess medicinal properties [26].

The scientific name of arjun is Terminalia arjuna Roxb. It is about 60-80 feet height perennial tree found everywhere in Bangladesh. It is composed of enormous active constituents include glycosides, tannins, flavonoids, triterpenoids, β-sitosterol and minerals [47] which possesses high therapeutic value and traditionally used for the treatment of different ailments for human beings. The bark extract of T. arjuna Roxb. is considerably prevented the isoprenaline-induced increase through oxidative stress, decrease in endogenous antioxidant level and also avoid fibrosis without increasing the heart weight and body weight ratio, as well as it can prevent myocardial changes induced by the action of chronic beta-adrenoceptor stimulation [35]. The bark is anti-dysenteric, cardiotonic, lithotriptic, antipyretic, astrangent, and tonic while the powder of the bark acts as a diuretic in cirrhosis of liver and gives relief in symptomatic hypertension [11]. In studies in mice, the leaves of T. arjuna Roxb. have been shown to have anti-inflammatory and analgesic properties [47]. It may also be useful in treating hypercholesterolemia by reducing LDL levels [41]. The bark powder has been found to possess cardioprotective properties, anti-ischaemic, antioxidant action [54], hypcholesterolaemic effect, fungicidal [36], anti-microbial [65], anti-bacterial, anti-fertility, treatment of ulcers, skin disorders and as antidote to poisons. It is also useful to cure obesity, hypertension and hyperglycemia [44]. The bark constituents are promising in anti-mutagenic and anti-carcinogenic potential [53, 63, 32, 61, 56].

The aim of this present study was to deliver valuable information on phytochemical and pharmacological characteristics of T. arjuna Roxb. This compendium review also includes its taxonomy, monograph,
morphology, and distribution of this highly significant medicinal plant.

**Taxonomy of T. arjuna** Roxb.

Medicinal plants are characterized according to the habit, habitat, part used, therapeutic value etc., besides the usual botanical classification. But botanical classification is the most scientific classification and comprehensive. The botanical classification of *T. arjuna* Roxb. is as following:

- **Kingdom**: Plantae
- **Division**: Magnoliophyta
- **Class**: Magnoliopsida
- **Order**: Myrtales
- **Family**: Combretaceae
- **Genus**: *Terminalia*
- **Species**: *T. arjuna* Roxb. [54]

**Chromosome number of T. arjuna** Roxb.

The chromosome number of *T. arjuna* Roxb. is n=2 [44].

**Plant parts of T. arjuna** Roxb. used as medicinal purposes or medicines

Its fruit, root bark, seeds root, leave and mostly barks are useful in the medicinal purposes [57].

**Monograph of T. arjuna** Roxb.

- Bengali name: Arjun, Arjhan [43].
- English name: Arjun terminalia, White murda, Tropical almond, Malabar almond [43].
- Botanical name: *T. arjuna* Roxb.
- Family: Combretaceae [35, 36, 62].
- Duration: Perennial.
- Growth habit: Tree.
- Native: Bangladesh, India, Sri Lanka [43].

**Morphology of T. arjuna** Roxb.

- Tree is about 60-80 feet in high, large, drooping branches and evergreen with a spreading crown [44].
- Leaves are simple, borne sub-opposite coriaceous, often crenulating, oblong or elliptic.
- Petioles are 6-10 mm long with one or usually two prominent glands at the top, immediately below the leaf. This is a unique pharmacognostic feature of *T. arjuna* Roxb. [32].
- Panicles are small, apical and when young, it is light green and when it is mature, then turns into their color.
- Stems are buttressed and often fluted.
- Bark is thick, soft and smooth gray, red color from inside, irregular sheets, curved and rather flat pieces [60].
- Flowers are white or yellowish and found in groups.
- Calyx is glabrous.
- Fruit is a drupe, 2.5-5 cm long, ovoid or oblong, fibrous-woody, smooth-skinned with five hard angles or wings [32].
- Seeds are hard germination 50-76 days [50-60%].
- Odour is characteristic.
- Taste is bitter.
- Root is superficial, shallow and spreads radially along stream banks.

**Distribution of T. arjuna** Roxb.

*T. arjuna* Roxb. is a deciduous tree found in dry hill areas by the side of water bodies- ravines, streams and rivers. It is abundance throughout Bangladesh, Madhya Pradesh, Indo-sub-Himalayan tracts of Uttar Pradesh, Delhi, and South Bihar. It is also found in forests of Sri Lanka, Burma and Mauritius [65].

**Phytochemical studies of T. arjuna** Roxb.

The chemical constituents of *T. arjuna* Roxb. are shown in Table 1. The whole plant of *T. arjuna* Roxb contains tannins, triterpenoid, flavonoids, saponins, gallic acid, ellagic acid, OPCs, phytosterols, zinc, copper, calcium, magnesium etc. It also contains oleanolic, arjunic acids, arjunoside I, II, arjunolic acid, 8-hydroxy hexadecanoic, and β-sitosterol.

**Table 1: Major chemical constituents of various parts of T. arjuna** Roxb.

<table>
<thead>
<tr>
<th>Plant part</th>
<th>Chemical constituents</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stem bark</td>
<td>Triterpenoids: arjunolic acid, arjunic acid, arjunin, *arjungenin, **terminic acid</td>
<td>[53]; *[60]; **[5]</td>
</tr>
<tr>
<td></td>
<td>Glycosides: arjunetin, *arjunoside II, *arjunoside I, **arjunaphthanoloside, ***terminaloside A</td>
<td>[61, 54]; *[31]; **[1]; ***[2]; [62]</td>
</tr>
<tr>
<td></td>
<td>β-Sitosterol</td>
<td>[5]</td>
</tr>
<tr>
<td></td>
<td>Flavonoids: arjuneone, bicalerin, arjunolone, *luteolin, ethyl gallate, gallic acid, kempferol, pelargonidin, quercetin, oligomeric proanthocyanidins</td>
<td>[62]; *[2]; [6]</td>
</tr>
<tr>
<td></td>
<td>Tanins: tertelvin C, castalagin, punicallin, casuarinin, punicalagin, terchebulin, casuarin, pyrocatechols</td>
<td>[36, 65, 44]</td>
</tr>
</tbody>
</table>
Trace elements/Minerals: zinc, copper, calcium, aluminium, silica, magnesium

Roots
- β-Sitosterol
- Triterpenoids: terminic acid, arjunic acid, oleanolic acid, arjunolic acid

Leaves and fruits
- Glycosides
- Flavonoids: luteolin

Table 2: Various pharmacological activities of *T. arjuna* Roxb.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Plant part used</th>
<th>Animal model</th>
<th>Observations</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-atherosclerotic</td>
<td>Orally administered indigenous drug</td>
<td>Rabbits</td>
<td>Partial inhibition of rabbit atheroma indicating antiatherogenic role</td>
<td>[61]</td>
</tr>
<tr>
<td>Antibacterial</td>
<td>Acetone, hexane and dichloromethane from leaf extract</td>
<td>Human pathogens <em>E. coli</em>, <em>P. aeruginosa</em>, <em>B. subtilis</em>, <em>S. aureus</em> and <em>S. epidermidis</em></td>
<td>Exhibit antibacterial activity</td>
<td>[63]</td>
</tr>
<tr>
<td>Anti-cancer</td>
<td>Arjunic acid isolated from bark</td>
<td>Human oral [KB], ovarian[PA 1] and liver [HepG-2, WRL-68] cancer cell lines</td>
<td>Treated as anti-cancer treatment</td>
<td>[59]</td>
</tr>
<tr>
<td></td>
<td>Aqueous extract of <em>T. arjuna</em></td>
<td>Lymphoma bearing mice</td>
<td>Down regulation of anaerobic metabolism by inhibiting the activity of lactate dehydrogenase and reducing the oxidative stress leading to anti-carcinogenic activity</td>
<td>[65]</td>
</tr>
<tr>
<td>Antidiabetic</td>
<td>Ethanol extract from stem bark</td>
<td>Liver and kidney tissues of diabetic rats</td>
<td>Exhibit the antioxidant activity through correction of oxidative stress and validates the traditional use of this plant in diabetic animals</td>
<td>[59]</td>
</tr>
<tr>
<td>Anti-inflammatory</td>
<td>Bark powder</td>
<td>Carrageenan-induced rat paw edema</td>
<td>Prevention of inflammation</td>
<td>[29]</td>
</tr>
<tr>
<td>Antioxidant</td>
<td>Casuarinin extracted from <em>T. arjuna</em></td>
<td>Madin-Darby canine kidney [MDCK] cells</td>
<td><em>H</em>₂<em>O</em>₂ induced oxidative stress, decreases DNA oxidative damage</td>
<td>[41]</td>
</tr>
</tbody>
</table>
Tissue Culture of *T. arjuna* Roxb.

In vitro clonal propagation of this medicinal plant of *T. arjuna* Roxb. has been reported by using cotyledonary node explants from 21 day old seedlings which were cultured on MS medium supplemented with different concentrations of BAP for shooting and IBA for root generation. About 80% of these plantlets were successfully acclimatized and 70% plantlets were transferred in the field. [58].

CONCLUSION

The present comprehensive etheno- medicinal or etheno- pharmaceutical review reveals that *T. arjuna* Roxb. is a very important medicinal plant with its large number of phytochemical and pharmacological properties as well as medicinally important chemicals like tannins, triterpenoid, saponins, flavonoids, gallic acid, ellagic acid, oleanolic, arjunic acids. From the point of view a number of investigations of pharmacological activity have been observed. *T. arjuna* Roxb. is to be very useful in anti-bacterial, anti-viral, anti-mutagenic, anti-inflammatory and wound healing activities. While some of the other reported uses include anti-dysentric, anti-pyretic, anti-diabetic, anti-oxidant, gastric and reproductive activity. The most exciting aspects of the medicinal plant of *T. arjuna* Roxb. was treatment of diabetics, cancer and heart diseases. This compendium literature are supported various potential medicinal characteristics of *T. arjuna* Roxb. So, this review can be a preliminary authentic source for the researchers to investigate the unknown and unexplored potential of this medicinal plant of *T. arjuna* Roxb. through modern techniques such as NMR, Mass spectrophotometer analysis, HPLC and HPTLC. Moreover, further systematic study and research is essential to extend the next stage of clinical trial to form novel drugs for the treatment of serious ailments.

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