A REVIEW ON: PHYTOCHEMISTRY, PHARMACOLOGY AND TRADITIONAL USES OF TAMARINDUS INDICA L.

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ABSTRACT
Currently there has been an increased interest globally to identify plants and explore there therapeutic potential. As because drugs which obtained from nature pharmacologically potent and have low or no side effects for use in preventive medicine and the food industry. They represent a potential source of new compounds with different pharmacological activity. Traditional herbal medicines form an important part of the healthcare system of India. Ayurveda, supposed to be the oldest medical system in the world, provides potential leads to find active and therapeutically useful compounds from plants. Considering the growing interest in the field of plant drugs assessing different pharmacological activity. In this review we have discussed about the therapeutic potential and chemical constituents Tamarindus indica. It is available all over the country. Tamarindus indica is having some reported activities like antidiabetic, hypolipidemic, hepatoprotective and antimicrobial properties. This plant is consumed by rural people as vegetable.

Key words: Tamarindus indica, antidiabetic, hypolipidemic, hepatoprotective and antimicrobial.

INTRODUCTION
Plants have always played a key role in the treatment of different ailment human and animals all over the world. In developing country more researchers are working on plant and plant product so recognition of natural product is growing. Herbal medicine is an important part of both traditional and modern system of medicine[1].
Tamarindus indicia L., belongs to the Dicotyledonous family: Caesalpiniaceae, which is the third largest family of flowering plants with a total of 727 genera and 19,327 species \[^2\]. The tamarind (Tamarindus indica L.) is a tree-type of plant. It is indigenous to tropical Africa but has become naturalized in North and South America from Florida to Brazil, and is also cultivated in subtropical China, India, Pakistan, Philippines, Java and Spain \[^3\].

It is a dicotyledonous plant \[^4\]. Tamarind fruit pulp has a sweet acidic taste due to a combination of high contents of tartaric acid and reducing sugars. The pulp is used for seasoning, in prepared foods, to flavor confections, curries and sauces, and as a major ingredient in juices and other beverages. Commercial tamarin-based drinks are available from many countries \[^5\]. The young green leaves are used for tasty dishes. The fruits and the isolated pulp of it are components of a drink in Jordan, so called souse, prepared by infusing T. indica dried pulp.

But the hygienic state of it is very poor, containing enterobacteriaceae\[^6\].

In western mali the nutritional importance of green leaves and fruits from T. indica, wild gathered was investigated. Availability and use varied with seasons. Preferentially in rural regions wild gathered foods are used as much as fresh cultivated foods. Green leaves were rich in energy, proteins and minerals. This and other plants are concluded to be valuable and important contributors to the diet of the people living there \[^7\].

**Habitat**

It grows well in both semi-arid and humid monsoon climates and can grow on a wide range of soil types. It is a tree of the tropics; it can tolerate temperatures up to 47\(^\circ\)C but is very sensitive to frost. It is mainly grown in areas with 500-1500 mm rain/ year but tolerates down to 350 mm if irrigated at the time of establishment. In the wet tropics with over 4000 mm rain, flowering and fruit setting is significantly reduced and in India it is not grown in areas receiving more than 1900 mm rain/year. Regardless of total annual rainfall, it produces more fruit when subjected to a fairly long dry period \[^8\].

**Vernacular names\[^9, 10\]**

Assam: Teteli

Bengal: Ambli, Tentul, Tinturi, Nuli

English: amarind tree
Geographical Distribution of Plant

*T. indica* has a wide geographical distribution in the subtropics and semi-arid tropics where it is cultivated\(^\text{[11]}\). Tamarind grows naturally all over Asia up to an altitude of about 500 m that is from Burma to Afghanistan. In the Indian subcontinent, it is distributed continuously in southern and central regions (which have similar wet and semi-arid climatic characteristics of tropical regions\(^\text{[12]}\)).

It also occurs in sparse patches up in northern India. In Africa, *T. indica* is commonly found in woodlands, and is well adapted to the arid and semi-arid zones. Essentially a tree of the tropics, it tolerates temperatures up to 47°C but is very sensitive to frost\(^\text{[13]}\).

Plant of *Tamarindus indica* L.

Botanical Description of Plant

*Tamarindus indica* is of medium to large in size, it is evergreen tree, 12-18 m high in height and 7m in girth. Evergreen tree, up to 30 m tall with dense, spreading crown and short trunk.
Leaves
The leaves are up to 15 cm it is a tree with an exceptionally beautiful spreading crown, Leaflets: Subsessile, 10-20 pairs, tolerably closely set on the rachis, 8-30 by 5-8 mm. oblong, obtuse, glabrous reticulately veined, long, alternate and compound with 8-18 pairs of leaflets, each 1-3.5 cm long. Flowers small, yellow streaked with pink, 5-10 together in 3-5 cm long inflorescences\(^{[14]}\).

Flowers
Flowers attractive pale yellow or pinkish. Few flowered racemes at the end of the branchlets, pedicel 6-10 mm long slender articulate below the calyx, glabrous, bracts concave, 6-8 mm. long, enclosing the buds cadcous; bracteoles small. Calyx 1.3 cm long; tubes narrowly turbinate, 4 mm long; segments 8 mm. long, sub equal oblong, some what oblique, obtuse or sub acute. Petals 3 (1 upper and 2 lateral), 1 cm long, sub equal obovate, oblong yellowish with pink strip. Stamens 3 fertile, connate nearly half their length; filament pubescent at the base; anther oblong. Ovary stalked; 8-12 or more style pubescent, equalling stamens. Puds 7.5 -20 cm long by 2.5 cm broad and about 1 cm thick, slightly curved, sub compressed, scurfy\(^{[14]}\).

Flowering and Fruiting Habit
Flowering normally occurs synchronous with new leaves growth, which in most areas happens during spring and summer but some trees may flowers much later. The flowers are probably pollinated by insects. The fruits develop during the rainy season and are ripe about 6 months later. The trees begin to produce fruits when they are 8-12 years old and may continue for 200 years\(^{[8]}\).

Fruit: indehiscent pod, brittle, 5-15 cm long, more or less curved and constricted between the seeds. There are 1-10 seeds per pod, embedded in the sticky pulp\(^{[15]}\).

Seed: up to 18 mm long, irregular, reddish, dark brown or shiny black, with hard and smooth testa. There are 1800-2600 seeds/kg\(^{[12]}\).

Traditional uses of *Tamarindus indica*
Leaves: Reduce inflammatory swelling, tumours, ring worm, diseases of blood, small pox, ophthalmia and other eye disease, ear ache, snake bite\(^{[15]}\).

Flower: appetizing, urinary discharges, bad odour in perspiration\(^{[15]}\).
Unripe fruit pulp: Astringent, to the bowel and cure “vata”\[15\].

Ripe fruit pulp: Appetizing, laxative heating, tonic to the heart, anthelmintics and cure ‘vata’ and ‘kapha’; heals wound and fracture\[15\], biliousness and bile disorder\[15\].

Bark: Astringent, properties, heals ulcer, liver complaints\[15\].

Root: root is used to treat ankylostomiasis (hookworm) in some parts of Tanzania\[16\].

*Tamarindus indica* L. was used as a traditional medicine for the management of diabetes mellitus\[17\].

**Chemical constituents of Tamarindus indica**

Phytochemical study on *T.indica* indicate the presence constituents, like; phenolic compounds, cardiac glycosides\[20\], tartaric acid, the mucilage, pectin, fatty acids and essential elements; As, Ca, Cu, Fe, Mn, Mg\[18\].

✓ **Leaf**: contains 13 components among which linonene and benzyl benzoate predominant. [19]

✓ **Root bark**: Root bark of *T. indica* indicate presence of *n*-hexacosane, eicosanoic acid, β-sitosterol, (+)-pinitol, octacosanyl ferulate, 21-oxobehenic acid\[20, 21\].

✓ **Seeds**: Fatty acid like palmitic acid, oleic acid, linoleic acid, and eicosanoic acid. The unsaponifiable matter from the seed oil like: β-amyrin, compesterol, β-sitosterol [22-25]. Polyphenolics was dominated by proanthocyanidins in different forms like apigenin, catechin, procyanidin B2, along with taxifolin, eriodictyol and naringenin [26]. Tamarind seeds comprised only procyanidins, represented mainly by oligomeric procyanidin [27].

✓ **Pulp**: *T.indica* pulp contains different organic acids like: tartaric acid, acetic acid, citric acid, formic acid, malic acid, and succinic acid [28].
6. (a) Procyanidin dimer (b) Procyanidin trimer

1. Naringenin
2. Leupeol
3. Eriodectin
4. Catechin
5. Epicatechin
6. a. Procyanidin dimer  b. Procyanidin trimer

Reported Pharmacological Activity of *Tamarindus indica*

1. **Antidiabetic, Hypolipidemic and antioxidant**
   - Hydroalcoholic and aqueous extract of seed of *T. indica* poses significant antidiabetic activities \(^{[29, 30]}\).
   - The results of antioxidant activity clearly exhibit the antioxidant property of ethanolic extract of *T. indica* on Streptozotocin induced diabetic rats \(^{[31]}\).
   - Pulp and fruit extract of *T.indica* shows hypolipidemic and antioxidant activities on rats fed with cholesterol rich diet \(^{[32]}\).
Different extract of methanol and aqueous acetone extract aqueous acetone extract shows highest antioxidant activity \[33\].

Ethanolic extract of \textit{T. indica} fruit pulp shown hypolidemic and weight reducing activity in cafeteria diet and sulpiride-induced obese rats \[34\].

Hydroalcoholic and aqueous extracts of \textit{T.indica} leaves posses antioxidant activity like Fe$^{3+}$ reducing potential, NO-, OH- and DPPH- radical scavenging potential \[35\].

Hydroalcoholic and aqueous extracts of \textit{T. indica} seeds posses hepatoprotective and antioxidant activities. Significantly decreased the hepatic function test markers like SGOT, SGPT, ALP and serum bilirubin and significantly increase the antioxidant enzyme like GSH, CAT, SOD and significantly decreased lipid peroxidation \[36\].

2. Antimicrobial

\textit{T.indica} has broad spectrum antibacterial activity and a potential source of new classes of antibiotics that could be useful for infectious disease chemotherapy and control \[37\].

Ethanolic extract of leaf and stem \textit{T. indica} extracts shows antibacterial activity against some gram negative bacterial \[38\].

Hydroalcoholic and aqueous extracts of \textit{T indica} leaves posses antimicrobial activity against some gram positive and negative bacteria like: \textit{S. aureus, B. subtilis, E coli} and \textit{P. aeruginosa}\[35\].

Hydroalcoholic and aqueous extracts of \textit{T. indica} seeds posses antimicrobial activity against some gram positive and negative bacteria like: \textit{S. aureus, B. subtilis, E coli} and \textit{P. aeruginosa}\[39\].

3. Helminthes infections (parasitic worms)

Macerate of the \textit{T. indica} seeds is used as vermifuge \[40\]. An extract of the leaves and the root is used to treat ankylostomiasis (hookworm) in some parts of Tanzania \[41\].

It posses anti-nematodal activity against \textit{Bursaphelenchus xylphilus}\[42\].

4. Hepatoprotective

Ethanolic extracts of \textit{T. indica} flower was shown hepatoprotective effect in Wister rats hepatotoxicity induced by Isoniazid and Rifampicin\[43\].

5. Analgesic activity

Aqueous fruit extract of \textit{T. indica} posses both central and peripherally acting analgesic activity\[44\].
6. Antipyretic activity
✓ Polysaccharide obtained from T. indica pulp has been shown significant antipyretic activity against bacterial pyrogen and polysaccharide induced pyrexia \[^{45}\].

7. Laxative activity
✓ It improves movement of bowel it is a mild laxative due to the presence of tartaric acid and malic acid in the salt form \[^{46}\].

8. Anticancer activity
✓ T. indica shows cytotoxic activity against cancer cell line with IC\(_{50}\) value <50\(\mu\)g/ml \[^{47}\].

9. Antiemetic activity
✓ Methanolic and butanolic extract of T. indica posses significant anti emetic activity \[^{48}\].

10. Bioavailability enhancer
✓ It is having lack of toxicity and improves the bioavailability of drugs like ibuprofen and aspirin \[^{12}\].

### Drug interactions of Tamarindus indica

<table>
<thead>
<tr>
<th>Drug</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspirin, Anticoagulant (Warfarin or Heparin) antiplatelet (Clopidogrel), NSAIDS (ibuprofen or naproxen) and herbs like Ginkgo biloba</td>
<td>Increased risk of bleeding</td>
</tr>
<tr>
<td>Hypoglycemic drug in diabetic patients</td>
<td>Hypoglycemia</td>
</tr>
<tr>
<td>Topical ophthalmic antibiotic</td>
<td>May result in synergistic effect</td>
</tr>
</tbody>
</table>

### Some Useful Truth of Tamarindus indica
1. Fruits are useful appetizer.
2. Its water helps to remove dandruff.
3. It is a common ingredient Sambhar, Chutneys and curreys.
4. It enhances the bioavailability of drugs like Aspirin and Ibuprofen.
5. It is rich in tartaric acid which is which enhance the taste of Tablet.
6. It is a powerful antioxidant.
7. Seeds oil is useful for paints.

### CONCLUSION
This review gives a broad information about the bioactive constituents and ethnopharmacology along with the scientifically claimed medicinal uses of T indica.
posses large range of medicinal application in human health care it also posses large amount of vitamin B and C which is responsible for enhancement of immune system. Several, carbohydrates, fat, proteins and tannins, acids, minerals have been reported to be present in different parts of *T indica*. The plant shows various types of activities such as antidiabetic, hypolipidemic, antioxidant, hepatoprotective, antimicrobial, anti snake venom analgesic and anti-inflammatory properties which may be due to the presence of the investigated active chemical constituents. It also use as flavoring agent to impart flavor to various dishes and beverage a impart flavor to the pharmacological studies so far have been performed in both vitro and in vivo. Therefore, there is need for investigation and quantification of different phytocostituents present and its pharmacological profile.

REFERENCES


