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## Therapeutic, phytochemistry and pharmacology of *Tamarindus indica*: A review

**Ashfaque Ahmad, Wasim Ahmad, Fahmeeda Zeenat and Mohd Sajid**

### Abstract

*Tamarindus indica* is a long lived, large sized, famous and common tree of India. It is cultivated throughout India and Burma. It is commonly used in Indian dietary. It is very beneficial for people of hot area and near to equator. Its fruit is salted and stored in almost every house. Deccan people largely eat it and said that 'life is very ticklish in absence of Imli'. It is also used largely as a flavour, stabilizer and binder in food preparations. People used Imli to make curries, jam, pickles, sauce, syrup or sherbet and to prepare majoon and jawarish. Jam of red Imli is very delicious. Virtually every part of the tree is utilized either as food flavouring agent or as medicine. One year old Imli is best for the use of medicinal purposes. The seeds are fried and eaten by poorer classes. Its leaves are used as fodder for domestic animals. Keeping in view the medicinal importance of the tree in Unani medicine (*Tibb-e-Unani*) and other traditional systems of medicine, an attempt has been made to review the available literature on therapeutic uses, phytochemical and ethno-pharmacological properties of different parts of *Tamarindus indica*.

**Keywords:** *Tamarindus indica*, Imli, Tamar Hindi, Unani Medicine

### Introduction

*Tamarindus indica* is a long lived, large sized (Anonymous, 1976)<sup>[3]</sup>, famous and common tree of India (Khan, 2012)<sup>[13]</sup>. It is one of the many purpose forest trees (Masatte *et al.* 2015)<sup>[20]</sup> and it is commonly used in Indian dietary (Nadkarni, 1954)<sup>[21]</sup>. The tree of *Tamar Hindi* is as large as Akhrot and leaves are same as Baid Sada and hard as Lubiya, fruits are as smaller as Gandana (Ibn Baitar, YNM). Leaves are compound and arranged like feather of hen (Ansari, 2009)<sup>[4]</sup>. Geelani explained that, its taste is slightly astringent having excessive sourness (Khan, 2013)<sup>[14]</sup>. Deccan people largely eat it and said that 'life is very ticklish in absence of Imli' (Khan, 2012)<sup>[13]</sup>. It is also used largely as a flavour, stabilizer and binder in food preparations (Masatte *et al.* 2015)<sup>[20]</sup>. People used Imli to make curries, jam, pickles, sauce, syrup or sherbet and to prepare majoon and jawarish (Khan, 2012)<sup>[13]</sup>. Jam of red Imli is very delicious (Khan, 2012)<sup>[13]</sup>. Virtually every part of the tree is utilized either as food flavouring agent or as medicine (Masatte *et al.* 2015)<sup>[20]</sup>. One year old Imli is best for the use of medicinal purposes (Tarique, 2010)<sup>[25]</sup>. Chinese people used Imli as a food (Ansari, 2009)<sup>[4]</sup>.

In famine seasons the seeds (*Tukhm-e-Tamar Hindi*) are ground to flour and made into bread. The seeds are fried and eaten by poorer classes (Nadkarni, 1954)<sup>[21]</sup>. There are very beneficial for people of hot area and near to equator (Khan, 2012)<sup>[13]</sup>. Acid exhalation from foliage of the tree is injurious to health; on this account peasants rarely sleep under it (Nadkarni, 1954)<sup>[21]</sup>. Kernels are extensively employed as a source of a sizing powder in cotton and jute industries (Anonymous, 1976)<sup>[3]</sup>. Its leaves are used as fodder for domestic animals (Masatte *et al.* 2015)<sup>[20]</sup>. Its fruit is salted and stored in almost every house (Nadkarni, 1954)<sup>[21]</sup>. Imli has two types; one is dark red in ripe and unripe condition. This is very gently used to make jam but not easily available. Another one is easily available and white in unripe condition and became reddish after ripen condition (Khan, 2013)<sup>[14]</sup>.

This plant is recommended for planting along fire-line, and in shelter belts and wind breaks to prevent soil erosion. It is also grown for afforestation of the degraded lands in dried areas (Anonymous, 1976)<sup>[3]</sup>. It has diverse uses with a good economic potential (Masatte *et al.* 2015)<sup>[20]</sup>. In March-April, there is abundant leaf-fall and new leaves appear. Seeds are found to be valuable raw material for the preparation of sizing powder for textiles in exigencies of World War II; otherwise seeds were not utilized in former days (Anonymous, 1976)<sup>[3]</sup>.

## Description

The tree is easily propagated from the seeds. It can also be reproduced from cutting and by budding. But rate of growth after seedling stage is slow. It is 24 m heighted and 7 m in girth evergreen tree. It has short, thick and seldom straight trunk. Bark is brownish or dark grey longitudinally and horizontally fissured (Anonymous, 1976<sup>[3]</sup>; Chatterjee and Pakrashi, 1992)<sup>[6]</sup>.

Flowers appear from April to June (Anonymous, 1976)<sup>[3]</sup>. The flowers are bitter, sweet and delicious in taste (Khan, 2012)<sup>[13]</sup>, having 1 cm long three petals initially whitish, then yellowish with light red stripes (Anonymous, 2000)<sup>[2]</sup>. Few flowered racemes at the end of the branches and small flowers in lax (Chatterjee and Pakrashi, 1992<sup>[6]</sup>; Anonymous, 1976)<sup>[3]</sup>. Narrow, top shaped base with 4 thickly covered segmented single calyx. Segments are fused in a sheath, which is open at the top (Anonymous, 2000)<sup>[2]</sup>.

The fruit is 7.5- 20 cm long, 2.5 cm broad and 1 cm thick (Anonymous, 1976)<sup>[3]</sup>, matt brown coloured, indehiscent (Anonymous, 2000)<sup>[2]</sup>, scurfy, slightly curved, more or less constricted between the seeds like pods are attached to tree (Anonymous, 1976)<sup>[3]</sup>. The fruit has very hard and glossy brown 3-12 seeds with odorless, mushy and sweet-tasting mesocarp (Anonymous, 2000)<sup>[2]</sup>. Fruit ripen in cold season (Anonymous, 1976)<sup>[3]</sup>.

Seeds are exal buminous (Anonymous, 1976)<sup>[3]</sup>. The seeds are 14 mm long (Anonymous, 2000)<sup>[2]</sup>, 1.5x0.8 cm sized, 3-12 in number, smooth, brown, shining, obovate-oblong, compressed, with shallow, oblong pit on each side of the flat faces (Chatterjee and Pakrashi, 1992<sup>[6]</sup>; Anonymous, 1976)<sup>[3]</sup>, irregular and roundish quadrangular in shape (Anonymous, 2000)<sup>[2]</sup>. It consists of an outer hard and brown testa. Seeds are contained in loculi, enveloped by a tough, leathery membrane. The outer most covering of pod is fragile and easily separable. Kernel consist 70% of the weight of seed and separated from testae either by roasting or by soaking the seeds in water (Anonymous, 1976)<sup>[3]</sup>.

Leaves are 15 cm long paripinnate with 10-20 pair, subsessile, oblong, 8-30 mm x 5- 10 mm sized leaflets are present (Chatterjee and Pakrashi, 1992<sup>[6]</sup>; Anonymous, 1976)<sup>[3]</sup>.

## Habitat

According to some phytologist Tamar is located in Egypt, Amlan, near to Bahar-e-Faras, Yaman, Sudan and Western areas (Khan, 2013)<sup>[14]</sup>. It is cultivated throughout India and Burma (Nadkarni, 1954)<sup>[21]</sup>. Chief collection centers for the seeds are Calcutta and Ghatal in west Bengal, Cuttack, Jeypore, Parlakimidi, Berhampore and Rayagada in Orissa; Bobbili, Warangal, Hyderabad, Secunderabad and Hindupur in Andhra Pradesh; Madurai and Pollachi in Tamil Nadu; Thoduvatti in Kerala and Mumbai, Ahmadnagar, Satara and Nashik in Maharashtra (Anonymous, 1976)<sup>[3]</sup>.

## Vernaculars

The plant is known by different vernacular names in different language, areas and traditions: *Tamarinde* (Africa); *Humer*, *Roka* (Amharic); *Sara*, *Homar*, *Hamar*, *Ardeib*, *Aradeib* (Arabic); *Tetuli* (Assam); *Amlikaa*, *Suktaa*, *Aml*, *Chukraa*, *Chukrikaa*, *Chinchaa*, *Chandikaa* (Ayurveda); *Mushishi* (Bemba); *Anbli*, *Aml*, *Nuli*, *Tintul*, *Tintiri*, *Tentul* (Bengali); *Tentul*, *Tuntil*, *Anbli* (Bengali); *Magyee*, *Majee-pen* (Burmese); *Tamarenn* (Creole); Tamarind, Tamarind tree, Madeira mahogany, Indian date (English); *Khurma*

*Hindi* (Farsi); *Sampalok*, *Kalamagi*, *Salomagi* (Filipino); *Tamarinde*, *Tamarinier* (French); Tamarindi (German); *Aml*, *Ambli* (Gujarat); *Aml*, *Imli*, *Imbali*, *Anbli*, *Aml*, *Tentul*, *Chinta*, *Anbli*, *Tamrulhind* (Hindi); *Asam*, *Asam jawa*, *Tamaring* (Indonesian); *Tamar-i-hind* (Kashmir); *Khous me*, *'Am'pul*, *Ampli* (Khmer); *Sino-Tibetan*, *Mak kham*, *Khaam* (Lao); *Mukoge* (Luganda); *Asam jawa* (Malay); *Puli*, *Amlam* (Malayalam); *Tomi*, *Timbingo*, *Timbimb*, *Tombi* (Mandika); *Chinch*, *Chintz* (Marathi); *Mwemba* (Nyanja); *Imli* (Nepali); *Konya*, *Tentuli* (Oriya); *Imbli* (Panjabi); *Ambala* (Persian); *Qasarfurniqan* (Rome); *Amlavraksha*, *Amlika*, *Ambia*, *Aml*, *Tintiri* (Sanskrit); *Puli*, *Amilan* (Sindh); *Siyambala* (Sinhala); *Rakhai*, *Hamar* (Somali); *Tamarin*, *Tamarindo* (Spanish); *Msi*, *Mkwaju* (Swahili); *Puliyam*, *Puliyam-palam* or *pazham*, *Amilam*, *Puli*, *Puliamavam* (Tamil); *Chintachettu*, *Sintachettu*, *Chinta-pandu Asek* (Telugu); *Bakham*, *Mkham*, *Somkham* (Thai); *Humer* (Tigrigna); *Musika* (Tongan); *Tamar Hindi* (Unani); *Imli* (Orwa); *Trai me* (Vietnamese); *Daharg*, *Dakah*, *Dakhar*, *Ndakhar* (Wolof) (Anonymous, 1976<sup>[3]</sup>; Khan, 2013<sup>[14]</sup>; Nadkarni, 1954<sup>[21]</sup>; Orwa *et al.* 2009)<sup>[22]</sup>.

## Mizaj (Temperament)

Some Unani physicians described the Mizaj of Tamar Hindi as Barid (Cold) 1 degree and Yabis (Dry) 2 degree (Khan, 2012)<sup>[13]</sup>. Ibn Sina described it as Barid (Cold) and Yabis (Dry) in 2 degree (Khan, 2013)<sup>[14]</sup>. Ibn Baitar stated it as Barid (Cold) and Yabis (Dry) in 3 degree (Ibn Baitar, YNM; Khan, 2013)<sup>[14]</sup>. While few others considered the Mizaj of sweet type as Muatadil ba Mayal ba Hararat (Khan, 2013)<sup>[14]</sup>.

Mizaj of Tukhm-e-Tamar Hindi is Barid (Cold) and Yabis (Dry) in 3 degree (Tarique, 2010)<sup>[25]</sup>.

## Afa'al (Action)

In classical Unani literature, various actions of Tamar Hindi (*Tamarindus indica*) have been described in details such as mussakine safra wa hiddate khoon, mushtahi, hazime ta'am, mulaiyan, jali, dafe peyas (Lubhaya, 1977)<sup>[17]</sup>, dafe riyah specially excessive safra, muwallid-e-khoon, mulattif, muqawwi-e-qalb, musakkin-e-hararat (Khan, 2012)<sup>[13]</sup>, qate safra, musakkin haijan-e-khoon, kharish, khujli, safravi haiza (Khan, 2013)<sup>[14]</sup>. According to Ibn Sina, Imli is laxative for akhlat-e-muhatarauqa (Ibn Baitar, YNM). Dry Imli is mufarreh, dafe safra, dafe zayabitash (Lubhaya, 1977)<sup>[17]</sup>.

Tukham Tamar Hindi is muzaiq-e-farj (Abdul Hakim, 1999)<sup>[1]</sup>, qabiz, yabis, barid (Khan, 2012)<sup>[13]</sup>, mumsik, mujaffif (Tarique, 2010)<sup>[25]</sup>. Maghz Tukham-e-Tamar Hindi is used as qabiz, mujaffif and mumsik (Usmani, 2008)<sup>[27]</sup>.

Kernel or pulp is used as mushil-e-safra, musakkin-e-safra wa dam, mufarrah wa muqawwi-e-qalab (Usmani, 2008)<sup>[27]</sup>. Tamar Hindi is more often used in different countries for different actions; Tamar Hindi is used as daf-e-humma in Brazil and as folk medicine to cure amenorrhoea and dysmenorrhoea in Madagascar and Malaysia. The seed used as abortifacient agent in Colombia and Indonesia (Ansari, 2009)<sup>[4]</sup>.

Ethyl acetate extract and petroleum ether extract of leaves of Tamar Hindi has antiviral activity and used against *P. falciparum* (Ansari, 2009)<sup>[4]</sup>.

**Istemat (Uses)**

Tamar Hindi has been described to be useful in various diseases such as khafqan haar (hot palpitation), (safravi qai) bilious vomiting, paralytic stomach, iltehab-e-meda wa jigar, ghashi, bechaini (Khan, 2013) <sup>[14]</sup>, yarqan, safravi bukhar, qabz, toxicity of alcohol and dhatura (Lubhaya, 1977) <sup>[17]</sup> and gastric paralysis caused by excessive vomiting (Ibn Baitar, YNM). Ripe Imli improves appetite, cures motion and purifies (tanqiya) urinary bladder (Lubhaya, 1977) <sup>[17]</sup>. Humool of powder of Tukhme-e-Tamar Hindi is used for atony of vagina (Khan, 2013) <sup>[14]</sup>. Mazmaza (mouth wash) of Imli is effective in qula-e-haar and gargle is effective in khunaque (diphtheria) (Khan, 2013) <sup>[14]</sup>. According to Ibn Sina seeds are used with other supplements to join bone and joints (Ibn Baitar, YNM). Powder of Tukhm-e-Tamar Hindi with milk is used to cure jiryani, kasrat-e-ehetlam, riqqat-e-mani and sur'at-e-inzal (Usmani, 2008) <sup>[27]</sup>. Internally use of powder of 2.25 gm Tamar Hindi seeds with or without Isapgol is very effective in chronic diarrhea or piles (Khan, 2012) <sup>[13]</sup>. Seed paste is locally applied on inflammatory site to alloy inflammation (Usmani, 2008) <sup>[27]</sup>. Unripe Tamar Hindi reduces sauda and increases safra (bile) and balgham (phlegm) (Lubhaya, 1977) <sup>[17]</sup>. Mixture (powder) of kernel of Imli with sugar, ilaichi khurd, filfil siyah and kafoor is used to cure vomiting. One year old kernel of Imli is very effective in liver, intestinal and stomach problems and chronic constipation (Lubhaya, 1977) <sup>[17]</sup>. In summer season, use of liquid mixture of Tamar Hindi and salt with meal is very beneficial for harmful effect of medicine as it reduces heat of stomach (Khan, 2012) <sup>[13]</sup>. Watery mixture of Tamar Hindi is very beneficial to reduce thrust in dose of 36 gm (Ibn Baitar, YNM). Juice of 9-12 gm Imli leaves with 1 gm salt is used to cure fever and acute or chronic riggers (Khan, 2012) <sup>[13]</sup>. Tamarind charcoal is used to make gunpowder (Lubhaya, 1977) <sup>[17]</sup>.

**Muzir (Adverse Effect)**

Tamar Hindi has adverse effect on *sadar* (thorax), *tihal* (spleen), *a'asabi azaa* (nervous organs), and causes *su'al* and *surfa* (cough), unripe imli causes (embolus) *sudda*, (flatulence) *nafkhe hazm*, and *zofe hazm* (indigestion) (khan, 2013) <sup>[14]</sup>.

**Musleh (Corrective)**

Kateera/ Khashkhash/ Banafsha/ Unnab/ Loa'ab-e-Baheedana/ Sharbat-e-Banafsha/ Khamira Banafshan/ Sharbat-e-Khashkhash/ Sheerni, used as corrective (Khan, 2013) <sup>[14]</sup>. It may also be corrected by mixing with Shahed (Honey) and Qand safed (Sugar) (Khan, 2012) <sup>[13]</sup>.

**Badal (Substitute)**

Tamar Hindi may be replaced Aaloo Siyah by two times (khan, 2013) <sup>[14]</sup>, Aloo Bukhara & Zarishk (Tarique, 2010) <sup>[25]</sup> and Bijband (Usmani, 2008) <sup>[27]</sup> in case of absence of drug or its side effects.

**Pharmacological Actions**

(As described in Ethnobotanical and traditional literature)

The plant *Tamarindus indica* is described in detail in ethnobotanical and scientific literature and various actions have been reported to possess by it. Some pharmacological actions and therapeutic uses are as follows:

Tamarind has antiscorbutic properties in absence of lemon

(Nadkarni, 1954) <sup>[21]</sup>. Its seed acts as antiulcer, anti-asthmatic and antioxidant (Suralkar *et al.* 2012) <sup>[24]</sup>. Pharmacological studies of the plant revealed that tamarind possess antibacterial, anti-diabetic, antifungal, anti-inflammatory, antimalarial, anti lipoperoxidant, hepatoprotective (Jha *et al.* 2005) <sup>[10]</sup>, healing agent, laxative in pediatric fevers and astringent. But red outer covering of seeds is a mild astringent (Nadkarni, 1954) <sup>[21]</sup>.

Fruit acts as aperient. Ripe fruit is laxative, appetizer, digestive, simulant, cleanses urinary bladder and unripe fruit is highly acidic (Nadkarni, 1954) <sup>[21]</sup>. Pulp of fruit is acidic, cooling (refrigerant), carminative, digestive, laxative, antiscorbutic and antibilious (Nadkarni, 1954) <sup>[21]</sup>, antiseptic (Anonymous, 1976) <sup>[3]</sup>. Dried fruit pulp is a cardiac tonic. Pulp of fruit makes cooling drink when preserved with sugar. According to Vaidyas, ripe pulp has laxative property for habitual constipation (Nadkarni, 1954) <sup>[21]</sup>. The pulp of the fruit is tonic to the heart, astringent and aperients; useful for checking bilious vomiting (Kirtikar and Basu, 1991) <sup>[16]</sup>. Leaves are astringent and tender leaves are cooling and antibilious, anti-inflammatory, analgesic in nature. Flowers are cooling and antibilious (Nadkarni, 1954) <sup>[21]</sup>. Bark is astringent, tonic and febrifuge (Anonymous, 1976 <sup>[3]</sup>; Nadkarni, 1954) <sup>[21]</sup>. Bark ash acts as digestive (Nadkarni, 1954) <sup>[21]</sup>.

**Therapeutic Uses**

The drug Imli (*Tamarindus indica*) was used in folk medicine for the treatment of many complains and described in details in ethno-botanical literature and various uses have been reported.

Atony of vagina should be treated by a pessary of seed kernel. To treat rectal prolapse, paste of fried seeds was applied on anus after setting the tract in position.

Tamarind is used to cure chronic or acute constipations, liver and gall bladder ailments, bilious vomiting, alcohol intoxications, fever, pharyngitis, stomatitis and hemorrhoids (Anonymous, 2000) <sup>[2]</sup>. It is used in scorpion sting, scurvy, bilious fever, splenomegaly (Nadkarni, 1954 <sup>[21]</sup>; Kirtikar and Basu, 1991) <sup>[16]</sup>. It is also used to cure tuberculosis, asthma, bronchitis, leprosy, wounds, ulcers, inflammation, stomachaches, diarrhea, dysentery, burning sensation, giddiness, vertigo, diabetes (Suralkar *et al.* 2012) <sup>[24]</sup> and amenorrhoea (Anonymous, 1976) <sup>[3]</sup>. Tamarind gargling is very effective to cure aphthous sores and sore throats (Anonymous, 1976 <sup>[3]</sup>; Nadkarni, 1954 <sup>[21]</sup>; Kirtikar and Basu, 1991) <sup>[16]</sup>.

Dried fruit pulp is used to cure exhaustion, giddiness, mental fatigue and morbid thirst. Pulp is used in febrile diseases (Anonymous, 1976) <sup>[3]</sup>. Hakims consider the pulp is useful for checking bilious vomiting, to cure bilious system and to adjust humours (Nadkarni, 1954) <sup>[21]</sup>. Ripe fruits are anthelmintic, carminative, digestive and refrigerant and used as liver tonic (Chatterjee and Pakrashi, 1992) <sup>[6]</sup>.

**Seeds**

In Unani medicine, spermatorrhoea, nocturnal emissions and seminal debility should be cured by the use of roasted seeds and kernel. Homeopathic used seed for stomachaches (Anonymous, 2000) <sup>[2]</sup>. It is also used as an application in cough and for the relaxation of uvula (Anonymous, 1976) <sup>[3]</sup>. Polyuria and urethral discharge should be treated by the prescription of seed kernel pounded with milk used as milk purgative and stimulant (Chatterjee and Pakrashi, 1992) <sup>[6]</sup>.

Red outer covering of seeds is very effective in diarrhea and dysentery (Nadkarni, 1954) <sup>[21]</sup>. Seeds are used to treat colitis and other intestinal disorders (Anonymous, 1976) <sup>[3]</sup>. To feed cattle ground seeds are usually useful (Anonymous, 1976) <sup>[3]</sup>. Seeds are useful in vaginal discharges and ulcers (Kirtikar and Basu, 1991) <sup>[16]</sup>.

### Fruit

Fruit increases intestinal liquid volume and acts as aperient (Kirtikar and Basu, 1991) <sup>[16]</sup>. Ashes of burnt shells of ripe fruit as an alkaline substance along with other alkaline ashes are used to cure long standing splenomegaly (Nadkarni, 1954) <sup>[21]</sup>.

### Leaves

Amlica pana is used to cure loss of appetite and disinclination of food (Nadkarni, 1954) <sup>[21]</sup>. Topical application of juice of leaves was very effective in ringworm. Paste of leaves and Haridraa (*Curcuma longa*) was prescribed as a prophylactic for small pox. Amlikaa leaves, cooked like vegetable and used to treat bleeding piles (Chatterjee and Pakrashi, 1992) <sup>[6]</sup>. To reduce swelling and pain poultice of crushed leaves are applied on inflammation of ankle and joints (Nadkarni, 1954) <sup>[21]</sup>. A poultice of fresh leaves is applied on boils and swelling to allay pain (Anonymous, 1976) <sup>[3]</sup>.

### Fruit and pulp

One or two years old ripe fruit has beneficial effects to cure atony of liver, stomach and intestine.

To relieve pain, pulp of ripe fruit as well as poultice of leaves is recommended to apply on inflammatory swellings. Ripe fruit is useful in constipation. It is also useful in intoxication from *Datura*. Pulp of fruit is used as an adjunct to other laxatives as in the senna confections or to increase the action of sweet purgatives such as *Cassia* and *manna* (Nadkarni, 1954) <sup>[21]</sup>.

### Flower

Local application of poultice of flower helps to cure conjunctivitis and internal use of flower juice helps to cure bleeding piles (Nadkarni, 1954) <sup>[21]</sup>. A poultice of flowers is applied in inflammatory affections of the conjunctiva (Anonymous, 1976) <sup>[3]</sup>.

### Bark

Lotion and poultice of bark is very effective in boils and sore. Bark is also given in diarrhea (Anonymous, 1976) <sup>[3]</sup> stem-bark is used as antipyretic and astringent (Chatterjee and Pakrashi, 1992) <sup>[6]</sup>. Ash of bark with common salt is used to treat intestinal obstructions, colic and indigestion. Fire fomentation of bark is used to allay arthritic inflammations, stiffness of joints and gout. The bark is used topically for loss of sensation in paralysis (Kirtikar and Basu, 1991) <sup>[16]</sup>.

### Root

A decoction of root was prescribed for alleviating sprue syndrome, piles and alcoholism. Root bark past topically applied on freckles to clean it.

### Phyto-chemistry

Fruit has 3-10% tartaric acid, malic acid, citric acid and lactic acid. 25-30% invert sugar, aromatic substances like

pyrazines and thiazols (Anonymous, 2000) <sup>[2]</sup>.

Pulp of Tamarind is a rich source of micro-nutrients like calcium, phosphorus, vitamin A, C and tartaric acid (Masatte *et al.* 2015) <sup>[20]</sup>. Moisture, 20.9; protein 3:1, fat, 0.1; fibre, 5.6; other carbohydrates, 67.4; and minerals, 2.9%: calcium, 170; phosphorus, 110 and iron, 10.9 mg/100g; riboflavin, 0.07; niacin, 0.7; and vitamin C, 3.0 mg/100g; carotene, 60 µg/100g, tartaric acid (8-18%) and invert sugars (30-40%), pectins and pentosans are also found in pulp. Proline and pipercoline are the chief amino acids present in the pulp (Anonymous, 1976) <sup>[3]</sup>. Tamarindial has been isolated from fruit pulp. Pulp consist of citric acid, carbohydrates, tartaric acid, glucocides (Ansari, 2009) <sup>[4]</sup>

Seeds are rich in phenolic compounds, polymeric tannins, fatty acids, flavonoids, saponins, alkaloids, glycosides (Suralkar *et al.* 2012) <sup>[24]</sup>, essential amino acids, fatty acids (Masatte *et al.* 2015) <sup>[20]</sup>. Auxins also present in seeds (Anonymous, 1976) <sup>[3]</sup>. Seeds have 2-hydroxy-3', 4'-dihydroxyacetophenone (TAO), methy 1-3, 4-dihydroxybenzoate (TA<sub>1</sub>), 3, 4-dihydroxyphenylacetate (TA<sub>2</sub>) and (-)-epicatechin. Seed also consist of arabinose, acetic acid, dihydroxyphenyl acetate (Ansari, 2009) <sup>[4]</sup>. Seed oil consisted of lauric, palmitic, myristic, stearic, arachidic, behenic, loeic, linoleic and lignoceric acids. Dry form of kernel gave protein, 17.1-20.1; fat, 6.0-7.4; carbohydrates, 65.1-72.2; crude fibre, 0.7-4.3 and ash 2.5-3.2. While roasted kernel contains calcium 121 mg/100 gm, phosphorous 237 mg/100 gm and prolamines, albumins like proteins (Anonymous, 1976) <sup>[3]</sup>.

Leaves contain 4.0-5.8% protein (Masatte *et al.* 2015) <sup>[20]</sup>, glycosides, vitexin, isovitexin, orientin and isoorientin (Anonymous, 1976) <sup>[3]</sup>, vitexin, iso-vetexin. Two distinct enzymes i.e polyosedepolymerase and polyose-glycosidase are present in the leaves (Anonymous, 1976) <sup>[3]</sup>. Aqueous extract of the leaves contain ascorbic acid, β-carotene (Pimple *et al.* 2007) <sup>[23]</sup>.

Bark: Alkaloids, hordenine and proanthocyanidin are to be found in bark of Tamarind (Anonymous, 1976) <sup>[3]</sup>.

Flowers: Moisture, nitrogen, ether extract, crude fibre, ash, calcium, phosphorus, iron, carotene, thiamine, riboflavin, niacin and ascorbic acid are found to be present in flower in different extent (Anonymous, 1976) <sup>[3]</sup>.

### Pharmacological Studies

A number of studies have been carried out on *Tamarindus indica* in recent years showing that it possesses diverse pharmacological effects. Some of the important pharmacological actions are as follows:

#### Analgesic

Methanolic extract of *Tamarindus indica* seeds showed significant analgesic and anti-inflammatory effects in reducing carrageenan induced paw edema in rats (Suralkar *et al.* 2012) <sup>[24]</sup>.

#### Anthelmintic

A study was carried out to evaluate the anthelmintic activity of ethanolic and aqueous extract of leaves and bark of *Tamarindus indica* Linn using *Pheretima posthuma* and *Tubifex tubifex* as test worms. The time of paralysis and death was observed and the activity was compared with piperazine citrate as standard standard. The alcohol and aqueous extract of bark of *Tamarindus indica* exhibited

significant anthelmintic activity as evidenced by decreased paralyzing time and death time. The results thus support the use of *Tamarindus indica* as an anthelmintic agent (Das *et al.* 2011) [7].

#### **Antiasthmatic**

A study was carried out to evaluate the action of the methanolic extract of leaves of *Tamarindus indica* on various aspects of asthma like H<sub>1</sub> receptor antagonist, eosinophilia, leucocytosis and mast stabilizing activity using various animal models. The result showed significant anti-asthmatic activity (Tayade *et al.* 2009) [26].

#### **Antiatherosclerosis**

In hypercholesterolemic hamsters, the effect of the crude extract from the pulp was investigated on lipid serum levels and atherosclerotic lesions. The result showed that Tamarind extract has a high potential in diminishing the risk of atherosclerosis in humans (Martinello *et al.* 2006) [19].

#### **Antidiabetic**

In a study, aqueous extract of seed of *Tamarindus indica* was found to have potent anti-diabetogenic activity that reduces blood sugar level in streptozotocin induced diabetic male rat. Supplementation of this aqueous extract by gavage at the dose of 80 mg/0.5 ml distilled water/100 g body weight per day in STZ-induced diabetic rat result a significant diminution of fasting blood sugar level after 7 days (Maiti *et al.* 2004) [18].

#### **Anti-emetic**

A study was carried out to evaluate the anti-emetic activity of methanolic and butanolic extracts of *Tamarindus indica* leaves. The result showed significant antiemetic activity when compared with standard drug chlorpromazine (Khan *et al.* 2005) [15].

#### **Anti-inflammatory**

Methanolic extract of *Tamarindus indica* showed anti-inflammatory activity in carrageenan induced hind paw edema in rats as it inhibits histamine, serotonin, prostaglandin, bradykinin and leukotriene, membrane stabilizing activity, antioxidant activity. Anti-inflammatory activity is also supported by presence of flavonoids, saponins and tannins in Tamarindus seeds (Suralkar *et al.* 2012) [24].

The anti-inflammatory activity of a hydro-ethanolic extract of *Tamarindus indica* leaves along with its possible mode of action was carried out. The anti-inflammatory activity was estimated by carrageenan induced hind paw oedema in male wistar albino rats. Oral administration of extract at the dose of 500, 750 and 1000 mg/kg body weight produced significant anti-inflammatory actions in a dose dependent manner (Bhadoriya *et al.* 2012) [5].

#### **Antimicrobial**

Extract of Stem bark and leaves of *Tamarindus indica* Linn has broad spectrum activity as it showed effective results against some common gram positive, gram negative bacteria and fungi (Doughari, 2006) [8].

Tamarindial; isolated from *Tamarindus indica* showed strong bacterial activity against *Bacillus subtilis*, *Staphylococcus aureus*, *E-coli* and *Pseudomonas aeruginosa*.

#### **Anti-nociceptive**

An investigation of anti-nociceptive activity of hydro-ethanolic extract of *Tamarindus indica* leaves along with its possible mode of action was carried out. The antinociceptive action was determined by acetic acid-induced writhing, tail-flick and hot plate model. Oral administration of extract at the dose of 500, 750 and 1000 mg/kg body weight produced significant anti-nociceptive actions in a dose dependent manner (Bhadoriya *et al.* 2012) [5].

#### **Antioxidant**

Ethanolic extract of seed coat exhibited the potent antioxidant activity.

#### **Antiulcer**

A study was carried out to evaluate the antiulcer effect of methanolic extract of seed coats of *Tamarindus indica*. The result showed significant reduction in the total volume of gastric juice, free and total acidity of gastric secretion in pylorus ligation induced ulcer model as is comparable with the standard drug ranitidine. There was also a significant reduction in ulcer index (Kalra *et al.* 2011) [12].

#### **Fungicidal**

Tamarindial showed fungicidal activity against *Aspergillus Niger* and *Candida albicans*.

#### **Hepatoprotective**

A study was carried out to evaluate the hepatoprotective activity of *Tamarindus indica*. Aqueous extract of different parts of *Tamarindus indica* such as fruits, leaves and unroasted seeds showed significant hepatoprotective effects in Paracetamol induced hepatotoxicity in rats (Pimple *et al.* 2007) [23].

#### **Hypolipidemic**

It has observed in a study that pulp and fruit extract of *Tamarindus indica* showed hypolipidemic and antioxidant activities on rats fed with cholesterol rich diet (Martinello *et al.* 2006) [19]. In another study a significant hypolipidemic and weight reducing activity of ethanolic extract of *Tamarindus indica* fruit pulp was observed in cafeteria diet and sulphuride-induced obese rats (Jindal *et al.* 2011) [11].

#### **Immunomodulatory**

A polysaccharide isolated from fruit pulp showed phagocytic enhancement, leukocyte migration inhibition and lymphocyte proliferation inhibition like immunomodulatory activities.

#### **Conclusion**

*Tamarindus indica* (Imli) has been in use since times immemorial to treat wide range of indications. It has been subjected to quite extensive phytochemical, experimental and clinical investigations. Experimental studies have demonstrated its analgesic, anthelmintic, antiasthmatic, antiatherosclerosis, antidiabetic, anti-emetic, anti-inflammatory, antimicrobial, anti-nociceptive, antioxidant, antiulcer, fungicidal, hepatoprotective, hypolipidemic and immunomodulatory effects. The scientific studies have proved most of the claims of traditional medicines. However, further, detailed clinical research appears worthwhile to explore the full therapeutic potential of various parts of *Tamarindus indica* in order to establish it as a standard drug.

## References

1. Abdul Hakim M, Bustanul Mufradat. Zafar Book Depo, Delhi, 1999; 72.
2. Anonymous. PDR for Herbal Medicine. 2<sup>nd</sup> Ed, Medical Economics Company, 2000, 753-754.
3. Anonymous. The Wealth of India- A Dictionary of Indian Raw Materials and Industrial Product. (Sp-W). (New Delhi): Publication & Information Directorate, CSIR, 1976; X:114-123.
4. Ansari MY. Manafeul Mufradat. Ejaz Publishing House, New Delhi, 2009; 244-245.
5. Bhadoriya SS, Mishra V, Raut S, Jain S. Anti-inflammatory and antinociceptive activities of hydroethanolic extract of *Tamarindus indica* leaves. *Scientia Pharmaceutica Article inpress*. 2012; 80(3):685-700.
6. Chatterjee A, Pakrashi SC. The Treatise on Indian Medicinal Plants. Vol. II. Publication & Information Directorate, CSIR, New Delhi, 1992, 46-47.
7. Das SS, Dey M, Ghosh AK. Determination of anthelmintic activity of the leaf and bark extract of *Tamarindus Indica* Linn. *Indian J Pharm Sci*. 2011; 73(1):104-107.
8. Doughari JH. Antimicrobial activity of *Tamarindus indica* Linn. *Tropical Journal of Pharmaceutical Research* 2006, 5(2): 597- 603.
9. Ibn Baitar. Al-Jame le-Mufradat al-Advia wal Aghzia. (Urdu translation). CCRUM, New Delhi, YNM, I, 350-351,
10. Jha N, Jha A, Pandey I. *Tamarindus indica*: Tamarind: Imli. *Phytopharm*. 2005:6:1-6.
11. Jindal V, dingra D, Sharma S, Parel M, Harna RK. Hypolipidemic and weight reducing activity of the ethanolic extract of *Tamarindus indica* fruit pulp extract in cafeteria diet and sulphiride-induced obese rats. *Journal of Pharmacology and Pharmacother*. 2011; 2(2):80-84.
12. Kalra P, Sharma S, Suman Kumar S. Antiulcer effect of the methanolic extract of *Tamarindus indica* seeds in different experimental models. *J Pharm Bio allied Sci*. 2011; 3(2):236-241.
13. Khan MA. Muheet-e-Azam. India offset press, CCRUM, New Delhi. 2012; I:419-420.
14. Khan MA. Muheet-e-Azam. Vol. II. India offset press, CCRUM, New Delhi, 2013; 74-76.
15. Khan RA, Siddiqui SA, Azhar I, Ahmed SP. Preliminary screening of methanol and butanol extracts of *Tamarindus indica* for anti-emetic activity. *Journal of basic and applied science*. 2005; 1:51-54.
16. Kirtikar KR, Basu BD. Indian medicinal plants. Connaught Place, Dehradun. 1991; II:887-891.
17. Lubhaya R. Goswami Bayanul Advia. Goswami pharmacy, Delhi. 1977; I:157-159.
18. Maiti R, Jana D, Das UK, Ghosh D. Antidiabetic effect of aqueous extract of seed of *Tamarindus indica* in streptozotocin-induced diabetic rats. *J Ethnopharmacol* 2004; 92(1):85-91.
19. Martinello F, Soares SM, Franco JJ, Santos AC, Sugohara A, Garcia SB *et al*. Hypolipemic and antioxidant activities from *Tamarindus indica* L. pulp fruit extract in hypercholesterolemic hamsters. *Food and chem Toxicol*. 2006; 44(6):810-818.
20. Masatte M, Candia A, Ocheng AG. The commercial viability of tamarind (*Tamarindus indica* Linn) fruit based products for improved incoming among farmers in Northrn and Eastern Uganda. *African Journal of Food Sciences and Technology*. 2015; 6(6):167-176.
21. Nadkarni AK. Indian Materia Medica. Bombay Popular Prakashan, Mumbai. 1954; 1:1191-1193.
22. Orwa C, Mutua A, Kindt R, Jamnadass R, Anthony S. *Tamarindus indica*, Agroforest Database: A tree reference and selection guide version, 4.0, 2009, 1-6.
23. Pimple BP, Kadam PV, Badgujar NS, Bafna AR, Patil MJ. Protective effects of *Tamarindus indica* Linn against paracetamol induced hepatotoxicity in rats. *Indian journal of pharmaceutical sciences*. 2007:827-831.
24. Suralkar AA, Rodge KN, Kamble RD, Maske KS. Evaluation of anti-inflammatory and analgesic activities of *Tamarindus indica* seeds. *International Journal of Pharmaceutical Sciences and Drug Research*. 2012; 4(3):213-217.
25. Tarique NA. Tajul Mufradat (Khawasul advia). Idara Kitab-us-shifa, New Delhi, 2010, 85.
26. Tayade PM, Ghaisas MM, Jagtap SA, Dongre SH. Anti-asthmatic activity of methanolic extract of leaves of *Tamarindus indica*. *J Pharmacy Research*. 2009; 2(5):944-947.
27. Usmani MI. Tanqihul Mufradat. Famous Offset Press, Delhi, 2008, 95-96.