The development of *Terminalia chebula* Retz. (Combretaceae) in clinical research

Anwesa Bag, Subir Kumar Bhattacharyya, Rabi Ranjan Chattopadhyay*

Agricultural and Ecological Research Unit, Indian Statistical Institute 203, Barrackpore Trunk Road Kolkata-700 108, India

**PEER REVIEW**

Medicinal plants are part and parcel of human society to combat diseases from the dawn of civilization. *Terminalia chebula* Retz. (Fam. Combretaceae), is called the ‘King of Medicine’ in Tibet and is always listed at the top of the list of ‘Ayurvedic Materia Medica’ because of its extraordinary power of healing. The whole plant possesses high medicinal value and traditionally used for the treatment of various ailments for human beings. Some of the folklore people used this plant in the treatment of asthma, sore throat, vomiting, hiccup, diarrhea, dysentery, bleeding piles, ulcers, gout, heart and bladder diseases. The plant has been demonstrated to possess multiple pharmacological and medicinal activities, such as antioxidant, antimicrobial, antiadipotic, hepatoprotective, anti-inflammatory, antinutagenic, antiproliferative, radioprotective, cardioprotective, antiarthritic, anticaries, gastrointestinal motility and wound healing activity. But no systematic updated information on the therapeutic effectiveness of *Terminalia chebula*, a popular herbal remedy in India and South–East Asia has so far been reported. This review highlights an updated information particularly on the phytochemistry and various pharmacological and medicinal properties of *Terminalia chebula* Retz. and some of its isolated compounds, along with their safety evaluation. This may provide incentive for proper evaluation of the plant as medicinal agent against the human diseases and also to bridge the lacunae in the existing literature and future scope which may offer immense opportunity for researchers engaged in validation of the traditional claims and development of safe and effective botanical medicine.

**ABSTRACT**

1. Introduction

Ayurveda is a 5000 years old healing tradition rooted in ancient Indian culture. This vast body of healing knowledge–sometimes referred to as ‘Mother of all healing’–has recently come to the attention of Western medical researchers on seeking novel therapeutic compounds due to concerns over more invasive, expensive and potentially toxic mainstream practices. According to World Health Organization, about 80% of world population rely chiefly on plant based traditional medicine for their primary healthcare need[1]. Traditional healing system around the world that utilizes herbal remedies are an important resource for the discovery of modern drugs[2]. While screening a number of medicinal plants, scientist discovered one of the most revered medicinal plant i.e. *Terminalia chebula* (*T. chebula*) Retz. (Combretaceae), which exhibited a number of medicinal activities due to the presence of a large number of different types of phytoconstituents. The fruit of the tree possesses diverse health benefits and has been used as traditional medicine for household remedy against various human ailments since antiquity[3–5]. *T. chebula* has been extensively used in Ayurveda, Unani and Homoeopathic medicine and has become a cynosure of modern medicine.
The observed health benefits may be credited to the presence of the various phytochemicals like polyphenols, terpenes, anthocyanins, flavonoids, alkaloids and glycosides. The purpose of this review is to gather together the available published information on pharmacological and phytochemical analysis of the extracts and some of the isolated compounds of this plant as well as their toxic effects in a bid to highlighting the importance of this untapped resource in the fight against the human diseases.

2. T. chebula Retz.

2.1. Botanical description

The tree is tall about 50-80 feet in height. It has round crown and spreading branches. The bark is dark brown with some longitudinal cracks. Leaves are ovate and elliptical, with two large glands at the top of the petiole. The flowers are monoecious, dull white to yellow, with a strong unpleasant odour, borne in terminal spikes or short panicles. The flowers appear May-June, the fruits July-December. The fruit or drupe is about 1-2 inches in size. It has five lines or five ribs on the outer skin. Fruit is green when unripe and yellowish grey when ripe. Fruits were collected from January to April, fruit formation started from November to January[6].

2.2. Special identity

Taxonomic description of T. chebula Retz. include Kingdom: Plantae—Plants; Subkingdom: Tracheobionta—Vascular plants; Superdivision: Spermatophyta—seed plants; Division: Magnoliophyta—flowering plants; Class: Magnoliopsida—dicotyledons; Subclass: Rosidae; Order: Myrtales; Family: Combretaceae—Indian almond family; Genus: Terminalia L—tropical almond; Species: T. chebula (Gaertn) Retz.—myrobalan.

Varnacular names of T. chebula Retz. include Assamese: shilikiha; Bengali: haritaki; English: Chebulic myrobalan; Gujarati: hardi, harde; Hindi: hara; Kannada: alale; Konkani: ordo, hardi; Malayalam: katukka; Manipuri: Manali; Marathi: hirda; Oriya: karadha; Persian: halela; Sanskrit: haritaki; Sindhi: har; Tamil: Kata-K-Kay, Kadukkai; Telegu: Karaka; Urdu: Haejarad.

T. chebula is found in the Sub Himalayan tracks from Ravi eastwards to West Bengal and Assam, ascending upto the altitude of 1500 m in the Himalayas. This tree is wild in forests of Northern India, central provinces and Bengal, common in Madras, Mysore and in the southern part of the Bombay presidency[7].

Classification according to size of the T. chebula fruit: Survari harade—which is large, dense, and heavy about 2 inches long, yellowish brown; Rangari harade—these is smaller, less wrinkled and less furrowed than the Survari harade, in length about an inch; the epidermis is yellow; Bala harade—is smaller than the above two varieties, whose colour is deep brown to black; highly wrinkled, dark or brown epidermis; Java harade—these is the smallest of all, other characters are similar to those of Bala harade.

Classification according to the shape of the fruit: Vijaya—having alabu shape, used in all diseases, habitat in Vindahya mountain; Rohini—round in shape, used in vrana, habitat in Zansi and other parts of Madhya Pradesh; Pootana—size is small, mesocarp is less, seed is bigger, externally used, habitat Sindha; Amrita—Mesocarp is more used for shodhanakarma, habitat Madhya Pradesh and Champaranaya; Abhya—fruit having 5 ribs, used in eye diseases, habitat Champaranaya, Himalaya; Jeevantee—fruit is golden yellow, used in all diseases, habitate Himalaya; Chetaki—fruit having three ribs, used as purgative.

Classification according to the growth of the fruit: Zira—when the size is that of cumin seed; Javi—when the size is that of barley corn; Zangi—when the size is of a raisin; Chini—when the fruit is greenish yellow and somewhat hard; Asfer—when it is very nearly mature; Kabul—when it is fully matured[8].

3. Ethnobotanical uses

The tree is mild laxative, stomachic, tonic, alterative, antispasmodic. It is useful in ophthalmia, hemorrhoids, dental caries, bleeding gums, ulcered oral cavity. Its paste with water is found to be anti-inflammatory, analgesic and having purifying and healing capacity for wounds. Its decoction is used as gargle in oral ulcers, sore throat. Its powder is a good astringent dentifrice in loose gums, bleeding and ulceration in gums. It is good to increase appetite, digestive aid, liver stimulant, stomachic, gastrointestinal prokinetic agent, and mild laxative. The powder of T. chebula fruits has been used in chronic diarrhea. It is used in nervous weakness, nervous irritability. It promotes the receiving power of five senses. It is adjuvant in hemorrhages due to its astringent nature and good for chronic cough, chorizo, sore throat as well as asthma. Also it is useful in renal calculi, dysurea, retention of urine and skin disorders with discharges like allergies, urticaria and other erythematous disorders[4,9].

4. Diseases that have beneficial effects

Digestive diseases, urinary diseases, diabetes, skin diseases, heart diseases, irregular fevers, constipation, ulcers, vomiting, colic pain, haemorrhoids.

5. Phytoconstituents of T. chebula Retz.

The fruits of T. chebula is rich in tannins (about 32%-34%)
and its content varies with geographical distribution[10,11]. The tannins of *T. chebula* are of pyrogallol (hydrolysable) type. A group of researchers found 14 components of hydrolysable tannins (gallic acid, chebulagic acid, punicalagin, chebulanic acid, corilagin, galloyl glucose, punicalagin, terflavin A, maslinic acid[13]. Besides, fructose, amino acids, succinic acid, betasitosterol, resin and purgative principle of anthraquinone are also present[14,15]. Twelve fatty acids were isolated from *T. chebula* of which palmitic acid, linoleic acid and oleic acid were main constituents[19]. Triterpenoid glycosides such as chebulosides I and II, arjunin, arjunglucoside, 2α-hydroxyursolic acid and 2α-hydroxymicromiric acid also have been reported[20]. The leaves were found to contain polyphenols such as punicalin, punicalagin, terflavins B, C, and D[12,21,22]. The plant is found to contain phloroglucimol and pyrogallol, along with phenolic acids such as ferulic, p-coumaric, caffeic and vanillic acids[23]. Oil extracted from kernels yielded palmitic, stearic, oleic, linoleic, behenic and arabidic acids[23].

6. Pharmacological activity

6.1. Antioxidant and free radical scavenging activity

The leaves, bark and fruit of *T. chebula* possessed high antioxidant activity and phenolics were found to be responsible for this activity[24]. Aqueous extract of *T. chebula* inhibited xanthine/xanthine oxidase activity and was also an excellent scavenger of DPPH radicals[25]. *T. chebula* in a polyherbal formulation (Aller-7/ NR-A2) inhibited free radical induced hemolysis and also significantly inhibited nitric oxide release from lipopolysaccharide stimulated murine macrophages[26]. Six extracts and four compounds of *T. chebula* fruit exhibited antioxidant activity at different magnitudes of potency[27]. Strong antioxidant activity of aqueous extract of *T. chebula* was observed by studying the inhibition of radiation induced lipid peroxidation in rat liver microsomes at different doses[28], and methanolic extract was also found to inhibit lipid peroxide formation and to scavenge hydroxyl and superoxide radicals in *vitro*[29]. Acetone extract has stronger antioxidant activity than alphatocopherol and HPLC analysis with diode array detection indicated the presence of hydroxybenzoic acid derivatives, hydroxycinnamic acid derivatives, flavonol aglycones and their glycosides, as main phenolic compounds[30].

6.2. Anticarcinogenic activity

A group of researchers have reported the inhibitory action on cancer cell growth by the phenolics of *T. chebula* Retz fruit and found that chebulic acid, tannic acid and ellagic acid were the most growth inhibitory phenolics of *T. chebula*[31]. Ethanol extract of *T. chebula* fruit inhibited cell proliferation and induced cell death in a dose dependent manner in several malignant cell lines including human (MCF-7) and mouse (S115) breast cancer cell line, human osteosarcoma cell line (HOS-1), human prostate cancer cell (PC-3) and a non-tumorigenic immortalized human prostate cell line (PNT1A)[32]. Besides, acetone extract of bark and fruit powder of *T. chebula* harbors constituents with promising anticarcinogenic activity[32]. Some pharmacological activities of *T. chebula* Retz. are shown in Table 1 and some isolated compounds from *T. chebula* Retz. with their bioactivities are shown in Table 2.

Table 1

<table>
<thead>
<tr>
<th>Pharmacological activities</th>
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<tr>
<td>Antioxidant</td>
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<tr>
<td>Antifungal</td>
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<tr>
<td>Antiviral</td>
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<tr>
<td>Antiproteozal</td>
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<td>Anticarcinogenic</td>
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<td>Radioprotective</td>
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<tr>
<td>Antimutagenic</td>
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<tr>
<td>Chemopreventive</td>
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<tr>
<td>Hepatoprotective</td>
<td>36–38</td>
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<tr>
<td>Cardioprotective</td>
<td>39,40</td>
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<tr>
<td>Cytoprotective</td>
<td>41–44</td>
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<tr>
<td>Antidiabetic</td>
<td>45, 46</td>
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<td>Renoprotective</td>
<td>45</td>
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<tr>
<td>Antiinflammatory</td>
<td>74,76</td>
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<td>Antiarthritic</td>
<td>75</td>
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<td>Adaptogenic</td>
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<td>Gastrointestinal motility</td>
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<tr>
<td>Immunomodulatory</td>
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6.3. Antimutagenic, radioprotective and chemopreventive activity

Antimutagenic activity of aqueous extract and hydrolyzable tannins from *T. chebula* in *Salmonella typhimurium* has been documented[33]. Gamma radiation
induced strand breaks formation in plasmid PBR322 DNA was inhibited by aqueous extract of *T. chebula* [25]. The administration of aqueous extract of *T. chebula* prior to whole body irradiation of mice resulted in a reduction of peroxidation of membrane lipids in the mice liver as well as a decrease in radiation induced damage to DNA. It also protected the human lymphocytes from undergoing the gamma radiation-induced damage to DNA exposed in vitro [34]. *T. chebula* showed chemopreventive effect on nickel chloride-induced renal oxidative stress, toxicity and cell proliferation response in male Wistar rats [35].

### 6.4. Hepatoprotective activity

A mixture of chebulic acid (CA) and its minor isomer, neochebulic acid with a ratio of 2:1 isolated from ethanolic extract of *T. chebula* fruits showed strong hepatoprotective activity [36]. Ethanol extract *T. chebula* was found to prevent the hepatotoxicity caused by the administration of rifampicin, isoniazid and pyrazinamide (combination in sub-chronic model (12 weeks)) [37]. Protective effects of an aqueous extract of *T. chebula* fruit on the tert-butyl hydroperoxide-induced oxidative injury was observed in cultured rat primary hepatocytes and rat liver have also been documented [28-29]. *T. chebula* in a herbal formulation (HP-1) showed hepatoprotective activity against carbon tetrachloride induced toxicity in rat hepatocytes [38].

### 6.5. Cardioprotective activity

*T. chebula* extract pretreatment was found to ameliorate the effect of isoproterenol on lipid peroxide formation and retained the activities of the diagnostic marker enzymes in isoproterenol induced myocardial damage in rats [39]. Its pericap has also been reported to have cardioprotective activity in isolated frog heart model [40].

### 6.6. Cytoprotective activity

Gallic acid (GA) and CA were isolated from the extract of the herbal medicine Kashi (myrobalan, the fruit of *T. chebula*) as active principal that blocked the cytotoxic T–lymphocyte–mediated cytotoxicity. Granule exocytosis in response to anti–CD3 stimulation was also blocked by GA and CA at the equivalent concentrations [41]. The ethanolic extract of *T. chebula* fruit exhibited a notable cytoprotective effect on the HEK–NF cells. In addition its extract exhibited significant cytoprotective effect against UV-induced oxidative damage. These observations were attributed to the inhibitory effect of the *T. chebula* extract on the age dependent shortening of the telomere length as shown by the Southern Blots of the terminal restriction fragments of DNA extracted from sub–culture passages [42]. It exhibited the development of duodenal ulcers and appeared to exert a cytoprotective effect on the gastric mucosa in vitro [43]. Cytoprotection on oxidative stress and inhibitory effect on cellular aging of its fruits have also been documented [44].

### 6.7. Antidiabetic and renoprotective activity

*T. chebula* fruit and seeds exhibited dose dependent reduction in blood glucose of streptozotocin induced diabetic rats both in short term and long term study and also had renoprotective activity [45,46].

### 6.8. Antibacterial activity

*T. chebula* exhibited antibacterial activity against a number of both Gram–positive and Gram–negative human pathogenic bacterial [47–49]. Ethanedioic acid and ellagic acid isolated from butanol fraction of *T. chebula* fruit extract had strong antibacterial activity against intestinal bacteria, *Clostridium perfringens* and *Escherichia coli* [50]. It is effective in inhibiting the urease activity of *Helicobacter pyroli*.
an ubiquitous bacterium implicated in the development of gastritis, ulcers and stomach cancers[49]. GA and its ethyl ester isolated from Ethanolic extract of T. chebula showed antimicrobial activity against methicillin-resistant Staphylococcus aureus(S. aureus)[51]. Ripe seeds of T. chebula also exhibited strong antibacterial activity against S. aureus[52]. The aqueous extract of T. chebula strongly inhibited the growth of Streptococcus mutans, salivary bacterial[53]. Diffusate of T. chebula showed an inhibitory effect against strain X–100 of the bacterium Xanthomonas campestris pv. citri indicating its usefulness for the management of citrus canker disease[54]. It has also growth inhibitory action against Salmonella typhi[55], Klebsiella[56], Shigella[47] and intestinal bacteria[50]. Ethanol extract of T. chebula fruit showed strong antibacterial activity against multidrug-resistant uropathogenic Escherichia coli and phenolics were found to be responsible for this antibacterial activity[57,58].

6.9. Antifungal activity

An aqueous extract of T. chebula exhibited antifungal activity against a number of dermatophytes and yeasts[59,60]. It is effective against the pathogenic yeast Candida albicans and dermatophytes Epidermophyton, Flaccosum, Microsporum gypseum and Trichophyton rubrum[59]. Its inhibitory effect on three dermatophytes (Trichophyton spp.) and three yeasts (Candida spp.) has also been documented[61]. An aqueous extract of galls of T. chebula showed inhibitory effects on three dermatophytes (Trichophyton spp.) and three yeasts (Candida spp.,)[59]. In vitro anticandidal activity of methanol extract of T. chebula was observed against clotrimazole resistant Candida albicans[62]. Seed extract exhibited antifungal activity against Trichophyton glabratux[59].

6.10. Antiviral activity

T. chebula fruits afforded four immunodeficiency virus type 1 (HIV–1) integrase inhibitors, GA (I) and three galloyl glucoses (II–IV). Their galloyl moiety plays a major role for inhibition against the 3’–processing of HIV–1 integrase of the compounds[63]. T. chebula has also retroviral reverse transcriptase inhibitory activity[64]. It protects epithelial cells against influenza A virus, supporting its traditional use for aiding in recovery from acute respiratory infections[65]. The methanol and aqueous extracts of T. chebula showed a significant inhibitory activity with IC₅₀≤5 μg/mL on human immunodeficiency virus–1 reverse transcriptase[66]. It also demonstrated the therapeutic activity against herpes simplex virus both in vitro and in vivo tests[67]. These finding prompted a team of Japanese researchers to investigate T. chebulas's effect on human cytomegalovirus (CMV). They found that T. chebula was effective in inhibiting the replication of human cytomegalovirus in vitro and in an AIDS model with immunosuppressed mice and concluded that it may be beneficial for the prevention of CMV diseases and immunocompromised patients[68]. It is also helpful in sexually transmitted diseases and AIDS[69]. Tannins from T. chebula are effective against potato virus x[70].

6.11. Antiprotozoal activity

A combination of T. chebula and four other botanicals (Boerhavia diffusa, Berberis aristata, Tinospora cordifolia, and Zingiber officinale) had a maximum cure rate of 73% in experimental amoebic liver abscess in hamsters[71] and 89% in experimental caecal amoebiasis in rats showing its antiamoebic activity against Entamoeba histolytica[72]. The acetone extract of T. chebula seeds showed anti plasmodial activity against Plasmodium falciparum[73].


Aqueous extract of dried fruit of T. chebula showed anti–inflammatory by inhibiting inducible nitric oxide synthesis[74]. Chebulagic acid from immature seeds of T. chebula significantly suppressed the onset and progression of collagen induced arthritis in mice[75]. T. chebula in a polyherbal formulation (Aller–7) exhibited a dose dependent anti–inflammatory effect against Freund’s adjuvant induced arthritis in rats[76].

6.13. Adaptogetic and antianaphylactic activities

T. chebula fruit was one of the six Ayurvedic herbs administered to animals to test their adaptogenic potential. All six traditional rasayana plants were able to aid the animals against a variety of different stressors working in different ways[77]. Besides, animal studies show that when extract of T. chebula was administered following induction of anaphylactic shock, the serum histamine levels were reduced, indicating its strong antianaphylactic action[78]. Water soluble fraction of T. chebula had a significant increasing effect on anti–dinitrophenyl IgE–induced tumor necrosis factor–alpha production from rat peritoneal mast cells indicating its strong antianaphylactic action[78].


Hypolipidemic activity of T. chebula extract against experimentally induced atherosclerosis have been documented[79]. It also possessed hypocholesterolemic activity against cholesterol–induced hypercholesterolemia and atherosclerosis in rabbits[80].

6.15. Gastrointestinal motility improving and anti–ulcerogenic activity

Although its traditional use as laxative is well established,
T. chebula fruit has been shown to increase gastric emptying time\cite{81}. This action appeared to be balanced with a protective effect on the gastrointestinal mucosa, with the improvement in the secretory status of Brunner’s gland involved in the protection against duodenal ulcer\cite{82}.

### 6.16. Antispasmodic activity

One of the numerous studies of T. chebula demonstrated its ‘anti–vata’ or ‘anti–spasmodic’ properties by the reduction of abnormal blood pressure as well as intestinal spasms. This confirm its traditional usefulness for spastic colon and other intestinal disorders\cite{83}.

### 6.17. Anticaries activity

The aqueous extract of T. chebula strongly inhibited the growth, sucrose induced adherence and glucan induced aggregation of Streptococcus mutans. Mouth rinsing with a 10% solution of the extract inhibited the salivary bacterial count and glycolysis of salivary bacteria for up to 90 min post rinsing\cite{53, 84}.

### 6.18. Wound healing activity

Topical administration of an alcoholic extract of T. chebula leaves on the healing of rat dermal wounds showed that T. chebula treated wounds healed faster as indicated by improved rates of contraction and decreased period of epithelialization\cite{85}.

### 6.19. Purgative property

Purgative action of an oil fraction from T. chebula has been documented\cite{86}.

### 6.20. Immunomodulatory activity

Aqueous extract of T. chebula produced an increase in humoral antibody titer and delayed type hypersensitivity in mice\cite{87}. Crude extract of T. chebula stimulated cell–mediated immune response in experimental amoebic liver abscess in golden hamsters\cite{71}.

### 6.21. Anti–allergic activity

Aller–7, a polyherbal formulation of seven medicinal plants including T. chebula exhibited potent in vitro antiallergic activity in isolated guineapig ileum substrate\cite{76}.

### 7. Clinical studies

Oral rinsing with extract of T. chebula was found to significantly reduce both total bacterial counts and streptococcal counts in saliva samples. The protective effect lasted for about 3 h after rinsing, demonstrating a potential role of T. chebula in the prevention of dental caries\cite{83}.

A short term clinical trials have been carried out on patients with simple constipation. T. chebula increases the stools and has got property of evacuating the bowel completely\cite{88}.

Besides, some Ayurvedic drugs, consisting of T. chebula as one of the constituents have been subjected to clinical trials regarding their effects on constipation, mental and physical disability, allergic rhinitis and mental stress. In all the cases T. chebula containing drugs showed good effects in the treated groups when compared to their normal control patients\cite{89, 90}.

### 8. Safety evaluation

From the literature it has been noted that T. chebula exhibited significant hepatoprotective\cite{36–38}, cardioprotective\cite{39, 40}, antimutagenic/anticarcinogenic\cite{31–33}, cytoprotective\cite{41–44}, antioxidant\cite{24–30} and adaptogenic\cite{77, 78} effects. Aqueous, ethanol, and ethyl acetate extracts of T. chebula fruits also demonstrated no cellular toxicity on sheep erythrocytes as well as acute oral toxic effects on rats at recommended and higher doses\cite{48, 91, 92}. Besides, hydroalcoholic extract of T. chebula fruits demonstrated cytochrome P-450 inhibition potential in rats\cite{93}. T. chebula by itself had no genotoxic effect both in VITOTOX test and Ames assay\cite{94}. Rather, T. chebula fruit could reduce the lead and aluminium induced genotoxicity\cite{95, 96}. The hydrolysable tannins obtained from T. chebula fruits also showed antimutagenic activity against direct acting mutagens like sodium azide and 4-nitro-O-phenylene diamine. These findings indicated that it is a safe substance to be used as drug ordinarily.

### 9. Conclusions and recommendations

T. chebula is one of the most versatile plants having a wide spectrum of pharmacological and medicinal activities. This versatile medicinal plant is the unique source of various types of compounds having diverse chemical structure. Though it has a number of pharmacological activities due to the presence of various types of bioactive compounds, very little work has been done on the plausible medicinal applications of this plant against the diseases particularly on multidrug resistant bacterial pathogens. Hence extensive investigation is needed to exploit their therapeutic ability to combat diseases including drug resistant infections. As the global scenario is now changing towards the use of nontoxic plant products having traditional medicinal use,
a drug development programme should be undertaken to
develop modern drugs with the compounds isolated from
*T. chebula* effective against different types of diseases and
also to overcome the problem of drug resistance after
extensive investigation of its bioactivity, mechanism of
action, pharmacotherapeutics, toxicity and after proper
standardization and clinical trials.

**Conflict of interest statement**

We declare that we have no conflict of interest.

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**Comments**

**Background**

This is a review paper on the benefits of *T. chebula*
as an alternative medicine for many diseases. The
pharmacological effects exhibited by this plant have been
elaborated in depth with citations from studies that have
been conducted using this Ayurvedic plant.

**Research frontiers**

There is no lab experiment being done in this manuscript
since it is a review paper. However, the author cited latest
and recent publications on works done in this particular
field, in which bring the readers to the recent analytical
approach for pharmacological potential of this plant.

**Related reports**

The author cited different papers in his manuscript
to support the therapeutic potential of *T. chebula* in
traditional medicine. Past studies mostly presented the
pharmacological activities of this plant done *in vivo* and *in vitro*.

**Innovations and breakthroughs**

This review paper is one of its own in which it
summarizes any research that have been conducted on *T.
chebula* specifically in medicinal field. It is a good source
of literature survey for researchers who intended to do
studies in this particular field, and using this plant.

**Applications**

This paper could be applied by most Ayurvedic
practitioners in their medication activities to treat patients
with different types of diseases.

**Peer review**

This paper is a good review paper on Ayurvedic and
pharmacological activities of *T. chebula*. Citations used are
also a good resources for reviewing and very informative to
all the Ayurvedic and traditional practitioners.

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