

A review on medicinal potential of *Terminalia catappa*

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Abstract

Terminalia is a genus of large trees of the fruiting plant family Combretaceae, comprising around 100 species. *Terminalia catappa* is a common tree in India that is native to Southeast Asia. This is large growing tree found in tropical and subtropical area. *T. catappa* is a well-recognized medicinal plant in Ayurveda. It is vastly grown for its edible nuts. In this review, the pharmaceutical potential of *T. catappa* and its phytochemical constituents are discussed. It is a proven source for antidiabetic, antimicrobial, anti-oxidant, anticancer, and wound healing activities based on ethnobotanical usage that is investigated by researchers for pharmaceutical applications. This review concludes that *T. catappa* is a medicinally valuable plant, with huge pharmacological and phytochemical benefits.

Key words: Ayurveda, Ethanomedical application, Pharmaceutical potential, Phytochemical constituents, *Terminalia catappa*

INTRODUCTION

T*erminalia catappa* is considered one of the important medicinal plants in the world. It is used as folk medicine in many states in and outside of India.^[1] It is commonly known as “Indian almond or Tropical almond.” Phytochemical investigations on different parts of the plant genus *Terminalia* have been done intensively. Hence, the aim of this review is to provide a complete compilation of the phytochemical components of *Terminalia* recorded in the literature and their properties. Based on scientific study, all biological activities and pharmacological properties of *Terminalia* are also summarized.

Botanical Description

It grows up to a height of 40 m with upright and horizontal branches. Its branches are characteristically arranged in the symmetrical crown tier. The leaves are large, broad, and ovoid shaped. Commonly leaves are found in dark green color. It is a monoecious plant, i.e., (male and female flowers found on the same plant). The fruit is ovoid-shaped with a single seed. The fruit appears green in color when raw, but when ripens, it turns into reddish-yellow color. The seed is edible when fruit ripens.

Traditional Uses

T. catappa is one of the most common plants used in Ayurveda; hence, it is considered as “King of Medicine.”^[2] According to Ayurveda and Siddha, *T. catappa* is useful in the treatment of inflammation diseases, wound healing, allergies, skin related problems, asthma, ulcer, cardiovascular diseases, diarrhea, etc. It is also said to be helpful to restoring the power of senses.

Chemical Constituents of *T. catappa*

T. catappa leaves are reported to contain some important chemicals such as chebulagic acid, corilagin, gentisic acid, granatin-B, and kaempferol, whereas seeds are rich in arachidic acid, ascorbic acid, fiber, fat, linoleic acid, palmitic acid, etc. It is rich in minerals such as calcium, iron, potassium, phosphorus, and sodium. It shows the presence of carbohydrate, protein, fats as well as water. *T. catappa* fruits are reported to be rich in tannins. All reported phytochemical secondary metabolite constituents of *Terminalia* plant are summarized in Table 1 with their molecular weight and chemical structure for further discussion.

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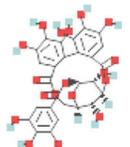
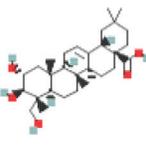
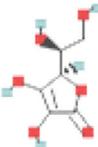
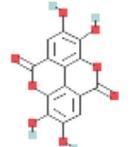
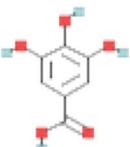
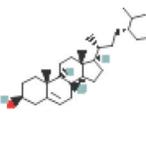
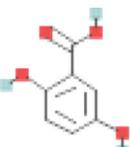
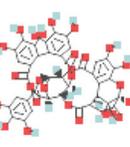
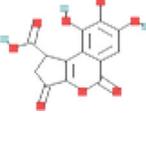
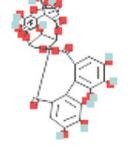
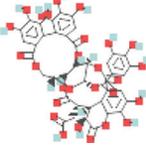
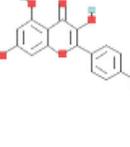
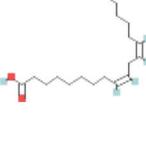
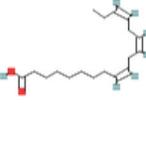
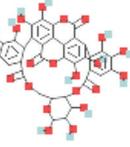
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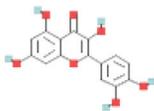
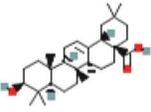
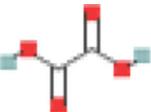
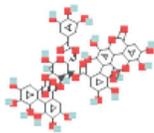
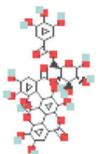
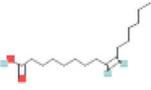
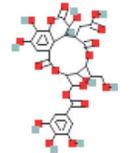
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Table 1: List of known phytochemical secondary metabolites reported from *Terminalia catappa*

Chemical name	Molecular weight (g/mol)	Molecular Structure	Chemical Name	Molecular weight (g/mol)	Molecular structure
Arachidic acid	312.5		Corilagin	634.5	
Arjunolic acid	488.7		Cyanidin-3-glucoside	484.8	
Ascorbic acid	176.12		Ellagic acid	302.19	
Beta-carotene	536.9		Gallic acid	170.12	
Beta-Sitosterol	414.7		Gentisic acid	154.12	
Betulinic acid	456.7		Geraniin	952.6	
Brevifolin carboxylic acid	292.2		Granatin B	784.5	
Chebularic Acid	954.7		Kaempferol	286.24	
Linoleic acid	280.4		Punicalagin	1084.7	
Linolenic acid	278.4		Punicalin	782.5	

(Contd...)

Table 1: (Continued)

Chemical name	Molecular weight (g/mol)	Molecular Structure	Chemical Name	Molecular weight (g/mol)	Molecular structure
Myristic acid	228.37		Quercetin	302.23	
Oleanolic acid	456.7		Stearic acid	284.5	
Oleic acid	282.5		Tercatain	786.6	
Oxalic acid	90.03		Terflavin A	1086.7	
Palmitic acid	256.42		Terflavin B	784.5	
Palmitoleic acid	254.41		Terminali C acid	652.5	

APPLICATIONS OF KNOWN PHYTOCHEMICALS

The pharmaceutical bioactivity of some of the known phytochemicals in *T. catappa* is described as follows;

Chebulagic Acid

It is benzopyran tannin, and it is reported as immunosuppressive, hepatoprotective, and antioxidant in nature. It shows antagonistic activity against *Staphylococcus aureus* as well as *Candida albicans*.^[3] It is found in *Terminalia chebula* and *T. catappa*.

Corilagin

Corilagin is a major active compound found in many medicinal plants. It is widely used as an anti-inflammatory agent.^[4] It shows antitumor activity in *Phyllanthus niruri* L a herbal medicinal plant, but its antitumoral mechanism in human body has not been investigated clearly.^[4]

Gallic Acid

Gallic acid is a well-known antioxidant phenolic compound. It increases anti-oxidant enzymes and inhibits lipid peroxidation, thus producing protective activity against cardiovascular diseases.^[5] Gallic acid is used in bio-based high-density polyethylene as a natural additive.^[6]

Garantin B

Garantin B is a phenolic compound commonly found in Pomegranate.^[7] In viral as well as in bacterial diseases, it plays an important medicinal role. It is also useful in the treatment of diabetes mellitus, acute, and chronic inflammations.

Geraniin

Geraniin possesses antioxidant, antimicrobial, anticancer, cytoprotective, immune-modulatory, and analgesic properties.^[8] It shows the therapeutic effect on cardiovascular disease as well as metabolic dysregulation.^[9]

Kaempferol

Kaempferol is strongly antioxidant in nature. Some recent scientific studies proved that kaempferol acts as chemopreventive agent in human body to prevent formation of cancer cells.^[1] Kaempferol also showed inhibition activity against monocyte chemoattractant protein-1 which plays an important role in the initial step of atherosclerotic plaque formation.^[10]

Quercetin

It is originally a plant pigment which is widely used as medicine for its antioxidant and anti-inflammatory effect. It is useful in the treatment to control blood sugar level, to kill cancer cells, to reduce inflammation, and also to prevent heart diseases.^[11]

Oleanoic Acid

It is a naturally occurring pentacyclic triterpene.^[12] It is anti-inflammatory and anti-asthmatic in nature when it gets binded with zinc metal. It shows antibacterial activity, as well as anticancer activity against prostate cancer.^[13]

PHARMACOLOGICAL ACTIVITIES OF *T. CATAPPA*

Anti-oxidant Activity

Antioxidant is fundamental factor in many foods. In aging-related phenomenon oxidative stress plays important role. *T. catappa* leaf extracts shows strong antioxidative as well as free-radical scavenging activity with 2,2-Diphenyl-1-picrylhydrazyl (DPPH) assay at a concentration of 8.2 µg/mL.^[14] Methanolic extract of *T. catappa* L. has been studied for its antioxidant activity against hydrogen peroxide induced oxidative damage. *T. catappa* extract has antioxidant property and is used to prevent the oxidative stress-induced skin aging in human fibroblasts.^[15] The phytochemical constituents such as punicalin and punicalagin isolated from *T. catappa* have shown significant antioxidant activity.^[14] By nitric oxide assay, DPPH assay, and reducing power assay, it is found that *T. catappa* has been found to possess antioxidant property in dose-dependent manner.^[16]

Antimicrobial Activity

Microorganisms can be both harmful to animals/humans and also benefit the same. Those that cause harm (disease) are referred as pathogens, and *T. catappa* has been proven as a natural source to prevent and kill these pathogenic microorganisms. Chloroform root extract of *T. catappa* shows the antimicrobial activity against *Escherichia*

coli and *S. aureus* with a strong MIC value of 0.4 mg/ml concentration.^[10] Both methanolic and chloroform extracts of *T. catappa* roots show good antimicrobial activity against many Gram-positive as well as Gram-negative micro-organisms.^[17] The aqueous as well as methanolic extract of leaves of *T. catappa* shows different degree of antagonism against broad spectrum of bacterial pathogens. Experimentally, it is found that the methanolic extract also possess antifungal activity against *Curvularia lunata*.^[18]

Antidiabetic Activity

Nowadays, diabetes is more common problem found in both developed and developing countries. To overcome this problem medicinal plants with their antidiabetic potential have long been established.^[19] Fresh aqueous extract of *T. catappa* leaves is proven to decrease the high blood glucose level in a dose-dependent manner. It also shows inhibitory activity on alpha-amylase as well as alpha-glucosidase enzymes, up to 54.04% and 73.2%, respectively.^[18] Extracts of dry leaves and fruits of *T. catappa* are proven to help maintain cholesterol level. It is studied that chebulic acid presents in methanolic extract of *T. catappa* shows preventive effect diabetes mellitus condition.^[2]

Wound Healing

Cellular as well as functional damage of living tissues is known as wound. It is studied that the bark extract shows effective activity against wound healing as it is antimicrobial as well as antioxidant in nature. It induces the growth of epithelial tissue faster.^[18]

Anticancer Activity

As per the study of global cancer statistics, as worldwide deaths recorded cases 65% of deaths are due to cancer.^[20] The growth and continuous division of abnormal cells cause damage, and it is referred to as tumor formation. It is observed that mutagenic activity can be controlled by using superficial CO₂ leaf extracts of *T. catappa*.^[16] Furthermore, it is studied that 50–200 mg/kg of the oral intake of ethanol extract of *T. catappa* helps in decreasing tumor mass, increases patients lifespan as well as increases peritoneal cells.^[21] Leaf extracts of *T. catappa* and its major phytochemical components such as punicalagin, tannin play an important role in the treatment of cancer as well as controlling gene mutation. *T. catappa* extract show antimetastatic activity, which inhibits the mRNA level of matrix metalloproteinase-9, which is helpful in the treatment of cervical cancer.^[19]

Hepatoprotective Activity

Liver is a very important organ which is helpful in the removal of toxicity and harmful chemicals present in body.

T. catappa is highly hepatoprotective in nature, and the key bioactive molecule was identified as corilagin present in it.^[4] The antioxidant activity present in *T. catappa* extract and corilagin plays protective function against lipopolysaccharide as well as galactomine, which induces the liver injury through apoptosis.^[5] It is experimentally studied that CCl₄ contained toxicity present in rat liver is reduced using aqueous extract of *T. catappa*.^[22] The chloroform extract leaves of *T. catappa* containing carbon tetrachloride and D-galactomine are helpful to induce acute liver damage as well as hepatocyte activity, respectively.^[16]

Anti-inflammatory Activity

From the ancient period, many medicinal plants were used for inflammatory diseases. *T. catappa* is proven to be anti-inflammation and anti-dysfunction in nature. The extract of the stem bark of *T. catappa* (25, 50, and 100 mg/kg/day) is used in the treatment of colitis rats, which causes alteration in gene expression regulated proteins and villin.^[23] Without affecting the estrous cycle, the extract of tender leaves of *T. catappa* shows anti-inflammatory and analgesic activity.^[18] Ursolic acid, oic acid, and many phytochemicals reported from *T. catappa* show strong anti-inflammatory activity.

Antiulcer and Anti-Helicobacter pylori

Caribbean listed *T. catappa* plant as pharmacopeia vegetable to treat gastritis. The aqueous fraction obtained from leaves of *T. catappa* shows curative and protective effect on both chronic and acute induced gastric ulcer whereas for anti-helicobacter pylori microdilution.^[24]

CONCLUSION

Medicinal plants have been serving as the backbone of traditional medicine from ancient times. The value of medicinal plants has been acknowledged by studying and using valuable chemical constituents present in them. *T. catappa* has been widely studied for many curative activities such as antidiabetic, wound healing, anti-inflammatory, anticancer, antimicrobial potential, in addition to its high nutritional values. It is used as raw materials to extract pharmaceutically valuable bioactive phytochemicals. It can be widely used in the field of drug discovery and research as well. It shows an impressive range of medicinal uses, for which it is referred to as “true miracle of nature.” Traditional medicinal practices such as Ayurveda, Unani, Siddha, and homoeopathy have become the cynosure of modern medicine. Modern science started to accept the knowledge and use of such a miracle plant. The review concludes that in addition to the well-known nutritional value of *T. catappa* there are many pharmaceutical benefits that can be exploited from this plant for the benefit of modern medicine. *T. catappa*

valuable source for pharmaceutical industries and is in need of detailed study for usage in modern medicine.

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