

ISSN : 2320 4850



BI
MONTHLY

Asian Journal of Pharmaceutical Research And Development

(An International Peer Reviewed
Journal of Pharmaceutical
Research and Development)

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Volume - 01

Issue - 02

MAR-APR 2013

website: www.ajprd.com
editor@ajprd.com



Review Article

A COMPREHENSIVE REVIEW ON PHARMACOLOGICAL ACTIVITY OF *TERMINALIA CATAPPA* (COMBRETACEAE)- AN UPDATE

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Received: 18 March 2013,

Revised and Accepted: 28 March 2013

ABSTRACT

The main aim of this review is to make a proper profile of about the pharmacological activity of *Terminalia catappa* (Combretaceae). *Terminalia catappa* is a very useful medicinal plants that are growing at the different districts of Bangladesh. The local or bangla name of *Terminalia catappa* is Bangla Badam. English name are Country Almond, Indian Almond. *Terminalia catappa* is native to the Indian Ocean island of Madagascar. The distinct part this plant may possess different pharmacological activity to the human being. The plant contains Gallic acid, allagic acid, corilagin and unidentified flavonoids have been isolated from leaves, fruits and bark. Oil from fruits resembled almond oil. The present article attempts to provide comprehensive information on pharmacological properties of *Terminalia catappa* for further potential research.

Keywords: *Terminalia catappa* , Bangla Badam, Indian Almond, Pharmacological activity,

INTRODUCTION

T*erminalia catappa* is native to Southeast Asia, where it is common throughout the area, but apparently rare in Sumatra and Borneo. It is commonly planted in northern Australia and Polynesia, as well as Pakistan, India, eastern and western Africa, Madagascar and the lowlands of South and Central America. *Terminalia catappa* is a tall deciduous and erect tree reaching 15-25 m, trunk 1-1.5 m in diameter, often buttressed at the base. Whorls of nearly horizontal, slightly ascending branches spaced 1-2 m apart in tiers, or storeys, up the trunk. The pagoda-like habit becomes less noticeable as the branches elongate and droop at the tips. Bark grey-brown, rough with age. Leaves alternate obovate with short petioles, spirally clustered at the branch tips, 15-36 cm long, 8-24 cm wide, dark green above, paler beneath, leathery and glossy.

They turn bright scarlet, dark red, dark purplish-red, or yellow. Flowers slightly fetid, greenish-white, very small, with no petals but 10-12 conspicuous stamens, arranged in several slender spikes 15-25 cm long in the leaf axils. The majority of the flowers are male and borne towards the apex, while a few hermaphroditic ones appear below. Some spikes have only male flowers. Fruit hard, to 7 cm, green-red, rounded and flattened, egg-shaped, with 2 ridges but no wings, 2.5 x 3-6 cm long, yellow or reddish when ripe. The cylindrical, oil-containing seeds are encased in a tough, fibrous husk within a fleshy pericarp. There are about 24 fresh fruits and 160 nuts per kg. The generic name comes from the Latin 'terminalis' (ending) and refers to the habit of the leaves being crowded at the ends of the shoots.

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ECOLOGY AND DISTRIBUTION

Natural Habitat

A conspicuous semi-deciduous tree of coastal areas throughout the warm tropics. Grows best in moist tropical climates. The tree is well adapted to sandy and rocky coasts and flourishes on oolitic limestone. The species loses its leaves twice a year in most areas, with a brilliant red-and-yellow display of leaf colour before doing so. Leaf loss helps it tolerate 1 or 2 annual dry seasons when it occurs. Although Indian almond does grow when planted on uplands, the natural habitat of the species is in areas just inland from ocean beaches, near river mouths, and on coastal plains. These areas are typically flat, but they may have dunes or rocky bluffs.

Biophysical limits

Altitude: 0-800 m, Mean annual temperature: 15-35 deg. C, Mean annual rainfall: 750-3 000 mm
Soil type: Oolitic limestone. The species grows in greatest concentration on sands and loamy sands.

Plant Pictures



Figure 1: Whole Plant (T.catappa)



Figure 2: Fruits



Figure 3: Flowering tops & Fruits

PHARMACOLOGICAL ACTIVITIES:

Also found on silts, loam, and clays. Soil pH is usually neutral to moderately alkaline and rich in bases. However it will also grow in strongly acid soils. Good drainage is required on clay soils.

Reproductive Biology

During winter in Florida, especially after a sudden rain, flowers are shed all at once and are quickly replaced with lustrous, silky, purplish new foliage. In Asia, there is a foliage change twice a year. T. catappa flowers up to 3 times a year. The ratio of male to hermaphroditic (female) florets is 16:1. Terminalia has an effective system of self-incompatibility. Various insects (Coleoptera, Diptera, Hemiptera, Hymenoptera and Lepidoptera) pollinate the flowers. The fruit are eaten and the seeds distributed by fruit bats and birds. The seeds float and can be carried considerable distances on the oceans and still remain viable.

Taxonomy

Current name: *Terminalia catappa*

Authority: L.

Family: Combretaceae

Antimicrobial Activity

Mudi et al., (2011) was conducted an original research on Phytochemical Screening and Antimicrobial Activities of *Terminalia catappa*, Leaf Extracts. *Terminalia catappa* extracts were found to contain some secondary metabolites. In this work, all the fractions obtained indicate presence of resins. Ethanol extract, petroleum ether, chloroform and ethyl acetate responded positively to a test on the presence of steroids. Alkaloids were detected in ethanol extract only. The distribution of tannins and reducing sugars were detected in ethanol and aqueous methanol extracts, while petroleum ether fraction showed presence of saponins. The results have provided baseline-data on the candidacy of chloroform, ethanol and aqueous methanol fractions as anti-typhoid drugs. The antimicrobial assay of n-hexane, chloroform and ethyl acetate fractions indicated a positive activity against the bacterial isolates tested. Chloroform fraction showed activity against Gram-negative *Escherichia coli* and *Salmonella typhi* at 500µg/disc, while ethanol and aqueous methanol fractions were active only on *Salmonella typhi* at concentrations of 300 – 500µg/disc. [1]

Chanda et al., (2013) was performed a study on Antimicrobial, antioxidant, and synergistic properties of two nutraceutical plants: *Terminalia catappa* L. and *Colocasia esculenta* L. In the present investigation, the methanolic extract of *T. catappa* showed good antimicrobial activity individually and in combination with standard antibiotics, i.e. it showed a good synergistic activity. [2]

Anthelmintic Activity

Nuruliani et al., (2011) was performed a study which was entitled as Determination of Anthelmintic Potential in *Terminalia catappa* by Modified Selected *In Vitro* Bioassay. Anthelmintic potential from *Terminalia catappa* leaves were determined using selected *in vitro* bioassay that was modified based on other established assays. Larvae was distributed at a concentration of 50 L3 ($n=\pm 50$) per well in a 96 multiwells plate, incubated with diluted crude extract of *T. catappa* at a ratio of 1:1 at 20°C for 3 hours and 5 hours.

Control was conducted using PBS as positive control and distilled water as negative control. After incubation, larvae motility were observed and counted using inverted microscope. All the non-motile L3 were identified in order to ensure survivality and motility of the larvae. Results showed that after 3 hours, reduction percentage for *T. colubriformis*, *C. curticei* and *H. contortus* was 70%, 63% and 73% respectively while at 5 hours incubation, reduction percentage for each species was at 77%, 67% and 80% respectively. Reduction percentage is calculated by comparing the number of L3 before and after incubation period. Control showed no reduction in terms of motility with standard deviation at 5-10%. From the results, it could be suggested that *T. catappa* leaves are a potential alternative to be used as anthelmintic. [3]

Anti-tumor Activity

Saroja M et al., (2011) was studied about Antitumor activity of methanolic extract of *Terminalia catappa* leaves against ehrlich ascites induced carcinoma in mice. It was found that, the methanolic extract of *T. catappa* has a significant response against ehrlich ascites induced carcinoma cells only at higher concentration. At concentration 75mcg and 100mcg produced 100% death. The methanolic leaf extract was produced a concentration dependent cytotoxic effect to EAC cells. [4]

M. Saroja et al., (2012) was perform a research work on Evaluation of Antitumor and Antioxidant activity of Flavonoid fraction of *Terminalia Catappa* against Ehrlich Ascites Carcinoma in Mice. Antitumor activity of flavonoid fraction of *Terminalia catappa* (TcFf) was evaluated against Ehrlich Ascites Carcinoma (EAC) in mice. After 24 hour tumor inoculation the extract was administered for the period of 15,th30,th45th and 60 days. After administration of the last dose followed by 18 h fasting, mice were sacrificed for observation of antitumor activity for each treatment period. [5]

Chiou Y et al., (2003) was perform a research work on Antimutagenicity of Supercritical CO₂ Extracts of *Terminalia catappa* Leaves and Cytotoxicity of the Extracts to Human Hepatoma Cells. When the Ames test was applied to examine

the antimutagenic potency of supercritical carbon dioxide (SC-CO₂) extracts of *Terminalia catappa* leaves at a dose of 0.5 mg/plate, toxicity and mutagenicity were not detected. The antimutagenic activity of SC-CO₂ extracts increased with decreases of temperature (60, 50, and 40 °C) and pressure (4000, 3000, and 2000 psi) used for extraction. The most potent antimutagenicity was observed in extracts obtained at 40 °C and 2000 psi. At a dose of 0.5 mg of extract/plate, approximately 80% of the mutagenicity of benzopyrene (BP, with S-9) and 46% of the mutagenicity of N-methyl-N ϵ -nitroguanidine (MNNG, without S-9) were inhibited. Media supplemented with SC-CO₂ extracts at a range of 0-500 μ g/mL were used to cultivate human hepatoma (Huh 7) and normal liver (Chang liver) cells. The viability of the cells was assayed by measuring cellular acid phosphatase activity. A dose-dependent growth inhibition of both types of cells was observed. The SC-CO₂ extracts were more cytotoxic to Huh 7 cells than to Chang liver cells. The observation that SC-CO₂ extracts of *T. catappa* leaves did not induce mutagenicity at the doses tested while exhibiting potent antimutagenicity and were more cytotoxic to human hepatoma cells than to normal liver cells is of merit and warrants further investigation. [6]

Antibacterial Activity

Opapa F.N et al., (2012) was performed a study on Preliminary Phytochemical Screening and Antibacterial Activities of Leaf Extracts of *Terminalia Catappa* for determining the antibacterial activity of *Terminalia Catappa*. Antibacterial screening with 24hours cultures of clinical isolates of *Salmonella typhi*, and type cultures of *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*, using agar-cup diffusion method indicated that *P. aeruginosa* was the most sensitive while *S. typhi* the least; ethanolic extract was relatively more active than water extract. Minimum bactericidal concentration test showed that ethanolic extract exerted bactericidal effect at 62.5mg/ml on *S.aureus*, but was static on the rest test microorganisms at the said concentration. Water extract exhibited bactericidal activity at 125mg/ml on *S. aureus* and *P. aeruginosa*, but was static on *E. coli* and inactive on *S. typhi*. From the activity obtained,

S.aureus and *P.aeruginosa* were more sensitive to ethanolic extract than water extract. [7]

Neelavathi et al., (2013) was conducted an work on Antibacterial activities of aqueous and ethanolic extract of *Terminalia catappa* leaves and bark against some pathogenic bacteria. The investigation was carried out to evaluate the antibacterial activities of aqueous and ethanolic extracts of *Terminalia catappa* leaves and bark against four bacterial pathogens namely *Escherichia coli*, *Bacillus subtilis*, *Staphylococcus aureus* and *Enterobacter aerogenes* respectively. Antibacterial activity was assessed by agar disc diffusion method. The activities of the extracts were measured by zone of inhibition and compared with a standard antibiotic Ciprofloxacin. Among the various concentrations (100,200,300 μ g/ml), 300 μ g/ml was found to be very effective. [8]

Anti-diabetic/ Hypoglycemic Activity

Ahmed et al., (2005) was carried a significant research work on Anti-Diabetic Activity of *Terminalia catappa* Linn. Leaf Extracts in Alloxan-Induced Diabetic Rats. Ad-ministration of alloxan (150 mg/kg, i.p) led to 1.5-fold elevation of fasting blood glucose levels, which was maintained for period of 3 weeks. Three weeks of daily treatment of extracts led to a dose-dependent fall in blood sugar levels by 25-62%. Effect seems to reach maximum after 15 days of treatment and remained con-stant in third week. In view of suggested anti diabetic potential, effect of aqueous and cold extracts of *Terminalia catappa* Linn (Combretaceae) leaves, on fasting blood sugar levels and serum biochemical analysis in alloxan-induced diabetic rats was investigated. All the extracts of *Terminalia catappa* produced a significant anti diabetic activity at dose levels of 1/5th of their lethal doses. Concurrent histological studies of the pan-creas of these animals showed regeneration by aqueous and cold extracts which were earlier necrosed by alloxan. [9]

A.N. Nagappa et al., (2003) was found after a research study on Antidiabetic activity of *Terminalia catappa* Linn fruits that Methanolic and aqueous extracts of *Terminalia catappa* fruit exhibited significant antihyperglycemic activities in alloxan-induced diabetic rats. These extracts

showed improvement in parameters like body weight and lipid profile as well as regeneration of cells of pancreas and so might be of value in diabetes treatment. [10]

Free radical scavenging and Antioxidant activity

Chanda et al.,(2013) was performed a study on Antimicrobial, antioxidant, and synergistic properties of two nutraceutical plants: *Terminalia catappa* L. and *Colocasia esculenta* L. The free radical scavenging activities of acetone and methanol extracts of leaves of *T. catappa* were tested by the DPPH method and ABTS radical cation scavenging method. The acetone extract of *T. catappa* leaves showed an IC₅₀ value of 28.5 µg/mL, while the methanol extract showed maximum scavenging activity with a low IC₅₀ value (23 µg/mL), which was near that of standard ascorbic acid (IC₅₀ = 11.4 µg/mL). the maximum scavenging activity was found in the methanolic extract of *T. catappa* leaves (IC₅₀ = 8.25 µg/mL), which was near that of standard ascorbic acid (IC₅₀ = 6.5 µg/mL), followed by acetone extract (IC₅₀ = 10.25 µg/mL). The results suggest that the leaves of *T. catappa* are a good source of natural antioxidants. [11]

Metty et al.,(2011) was conducted a research work on Antioxidative and free radical scavenging activities of *terminalia* species. DPPH radical scavenging spectrophotometric assay was used in order to determine the inhibition concentration. (IC₅₀) which is described as the amount of antioxidant necessary to decrease the initial concentration of the DPPH radical by 50%. Inhibition percentage (IP) describes as the percentage of total DPPH radical which reacts with the antioxidant at the steady state of all the extract. The antioxidant activities were determined for the methanol and ethanol extracts. The results of the total phenolics determination for ethanolic extracts varied from 0.28 ± 0.01 to 1.95 ± 0.01 mg/100 gm of extracts. *T. catappa* fruit pulp (0.28 ± 0.01 mg/100 gm). From the results, it is clear that the

methanolic extracts have higher phenolics content when compared to the ethanolic extracts. *T. catappa*, when compared to ethanolic extracts of all the plant parts. It is evident from the experimental results that all the plant extracts have promising antioxidative and free radical scavenging activities, thus justifying their traditional use. [12]

Hematological Activity/ Erythropoiesis Enhancer

Aimola et al., (2011) was performed a study on *Terminalia catappa* Extract Enhances Erythropoiesis in Adult Balb C Mice. The methanolic extract of *Terminalia catappa* induced production of haemoglobin higher than that of an untreated control after 6 days. The PCV of treated and untreated mice was also assessed and found to be relatively higher in *Terminalia catappa* treated mice comparable to mice administered with folic acid. [13]

CONCLUSION

Terminalia catappa has a number of pharmacological activity that mentioned above. The potential literature review revealed that *Terminalia catappa*, is an important medicinal plant with diverse pharmacological spectrum. There are number of phytochemicals presents in this plant such as Gallic acid, allagic acid, corilagin and unidentified flavonoids. These compounds were found to be responsible for many of the pharmacological activities. Due to the presence of these types of phytoconstituents, the different extracts may show antimicrobial, antioxidant, antibacterial, antidiabetic, anthelmintic, antitumor, hematological activities. Due to the number of significant pharmacological response the plant can choose for preparation of medication and can be use instead of synthetic drugs to avoid the undesirable adverse action. Hope the modern system of medicine & manufacturer of drug-product will deals with this plant in future.

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