Physiological and pharmacological activities of *Terminalia bellerica*

Jaya Keerthana¹, A. Jothi Priya²*, R. Gayatri Devi²

**ABSTRACT**

*Terminalia bellerica* is a large deciduous tree. It is a perennial which is grown in India. It grows up to 30, and it requires in a cold climate. Leaves are crowded toward the ends of the branches. Leaf tip is narrow pointed. Leaves are 8–20 cm long. Bark is brownish-gray in color. Flowers are greenish-yellow. Upper flowers of the spike are male. Lower flowers are bisexual. Fruit is covered with minute pale pubescence. Oil obtained from seed is useful in skin diseases, and it is a good tonic for stomach and brain. It is effective for headache chronic diarrhea and piles. It is useful in treating bronchitis and heart disease. The plant constitutes of glycosides, tannins, gallic acid, ethyl gallate, and chebulinic acid which serves as an antioxidant, antimicrobial, antidiarrheal, antioxidant, antihypertensive, hepatoprotective, and antipyretic agent. This review gives information on pharmacological and physiological activities of *T. bellerica* which may serve as a source for further studies.

**KEY WORDS:** Chebulinic acid, Ethyl gallate, Gallic acid, Physiological activities, *Terminalia bellerica*

**INTRODUCTION**

Plants are used as medicines from the ancient times. Throughout the world, medicative plants are widely and successfully used. A plant with active medicative constituents is used to treat diseases within the ancient systems such as Ayurveda, Siddha, and Unani. In Asia, the utilization of medicative plants is well established and is well documented. The plants those are recognized internationally largely come from this region. Plants, plant components, and plant product those are used for the preparation of medicines serve us to uplift the economical standing of the country and that they are the natural wealth of a country. Medicative plants have vital role in saving the lives of rural area individuals. In India, 45,000 plant species are known and out of that 15–20,000 plants are found to own sensible medicative value. A study says regarding 6000 ancient plants are utilized in Indian ancient and herbal medicines. In this paper, we selected the plant *Terminalia bellerica* belonging to family Combretaceae to check its medicine impact. Herbal medicines are ready from a spread of plant materials such as leaves, stems, roots, bark. They typically contain are also biologically active ingredients and are used primarily for treating gentle or chronic ailments. It is generally calculable that over 6000 plants in India are in use in ancient, folks, and herbal medication, representing regarding 75th of the medicative wants of the third world countries. Infectious agent warts are very common and most of the people suffer from one or a lot of at some purpose throughout their life. There are a unit over 90 subtypes on the premise of desoxyribonucleic acid sequence analysis. *T. bellerica* Roxb. happiness to family Combretaceae may be a giant deciduous tree, 10–12 m or a lot of high, unremarkably found in plain and forests up to 900 m elevation, fruits ripen toward November. The size of the fruit of Terminalia Bellerica will be around 2.5 to 4 cm in dm and it seems to be spherical in shape. The mature fruits gray or dun with slightly wrinkled appearance, the thickness from 3 to 5 metric linear unit, and therefore, the style is astringent. It is used as antidiabetics, laxative, anticancer, and antimicrobial. It is a lot of utilized in the hair product and skin product. It is inhibitor property and hepatoprotective activity. Literature review reveals that the plants possess inhibitor activity, analgesic, antipyretic and...
ulcerogenic impact, hepatoprotective activity, and antimicrobial activity.[4-7]

In Ayurveda, the drug is classified as associate medicament. It is associate integral a part of Ayurvedic laxative formulation, Triphala utilized in the treatment of respiratory disorder, raw throat, and constipation.[9] The bark is a drug and is helpful in leukoderma and anemia. The fruits are astringent, acid digestive, anthelmintic, aperient, medicament, sweet, anodyne, styptic, narcotic, ophthalmic, antiinflammatory, medicament, and rejuvenating. Unripe fruit is a gentle laxative associated ripe fruit is an astringent. Seeds are used as aphrodisiac. Oil extract from the seed pulp is employed in leukoderma and phalacrosis. Modern investigations have proven the laxative activity of the oil.[6] Triphala is associated Indian Ayurvedic herbal formulation consisting of dried and small-grained fruits of three medicative plants T. bellerica, Terminalia chebula, and Emblica officinalis. Triphala has been tested to be safe, containing active constituents that have useful physical impact such as inhibitor, anti-inflammatory, and radical scavenging activity except its curative property.[7]

**ANALGESIC ACTIVITY**

Khan et al. (2010) described the antinociceptive and analgesic activities of the crude extract of T. bellerica. T. bellerica extract at the dose varies of 300–1000 mg/kg inhibited the castor oil - elicited internal organ fluid secretion in mice. The extract was additionally added to the dependent dose (50–100 mg/kg), however it reduced the numbers of carboxylic acid acid-mediated in mice. These results indicate that T. bellerica exhibits anti-liquid body substance effects, thus justifying its medicative use in diarrhea and pain.[4]

**ANTIUNCONSTIPATED ACTIVITY**

The antidiarrheal activity was performed victimization castor oil elicited diarrhea, PGE2 elicited enteropooling and gastrointestinal motility test. Aqueous and ethanolic extract of fruit pulp of T. bellerica at the doses of 334 mg/kg, 200 mg/kg, and 143 mg/kg were used. Comparison of share protection in these models unconcealed that the extracts had reduction in canal motility and have a lot of distinguished antisecretory effect.[6]

**ANTIHYPERTENSIVE EFFECT**

Khan et al. (2008) postulated that the paste of T. bellerica Roxb. has correct efficacy on wound healing. Herbal paste preparation showed important (P < 0.05) improvement on maturation, wound contraction, and epithelialization. Hence, it is going to be completed that the paste obtained from T. bellerica offers a particular advantage in wound healing.[12,13] Medical specialty activity: Witthaya et al. postulated that T. bellerica extract affected lymphocyte proliferation chiefly through identical mechanism as PHA. The extract with LPS and PWM additionally affected the induction of contractions that were evoked by adrenergic drug.[4]

**ANTISPASMOMODIC AND BRONCHODILATORY PROPERTIES**

Gilani et al. (2008) were postulated that the crude extract of TB fruits evoked relaxation of spontaneous contractions in each isolated rabbit small intestine and guinea-pig small intestine. Protecting effect of TB against castor oil-induced diarrhea and carbachol-mediated bronchoconstriction additionally observed in rodents. In guinea-pig trachea, TB relaxed the CCh-induced contractions.[9]

**ANTIPYRETIC ACTIVITY**

The antipyretic activity of ethanolic and liquid extracts of T. bellerica fruits (200 mg/kg, p.o.) was studied in brewer’s yeast-induced fever models in mice and rats. Both extracts showed a big inhibition of elevated blood heat when compared to corresponding management.[10]

**ANTIOXIDANT ACTIVITY**

Kumar et al. (2011) postulated that the crude liquid extract of the fruits of T. bellerica Roxb. has inhibitor properties since these contain accelerator and non-accelerator antioxidants, these are terribly effective against microbes inflicting numerous diseases. In vitro assessment of the inhibitor activity of ethanolic fractions of both these plants to scavenge 2, 2-diphenyl-1-picrylhydrazyl and extremely reactive group radicals showed that the semi-pure compounds present in the fractions are helpful potential supply of antioxidants and might be employed in the medical aid of diseases such as cancer, coronary cardiovascular disease, aging, and the other illness associated with aerophilous stress. These fractions being non-toxic showed important inhibitor activity at scavenging radicals. They also significantly scavenge group that is known to cause cellular injury.[11]

**WOUND HEALING ACTIVITY**

Saha et al. (2011) postulated that the paste of T. bellerica Roxb. has correct efficacy on wound healing. Herbal paste preparation showed important (P < 0.05) improvement on maturation, wound contraction, and epithelialization. Hence, it is going to be completed that the paste obtained from T. bellerica offers a particular advantage in wound healing.[12,13] Medical specialty activity: Witthaya et al. postulated that T. bellerica extract affected lymphocyte proliferation chiefly through identical mechanism as PHA. The extract with LPS and PWM additionally affected
B-cell proliferation through T-cell-independent and T-cell-dependent mechanisms severally. The results indicated that the extract affected cellular mediate immunity instead of body substance mediate immunity human machine interfaces (HMI). [14]

**ANTITHROMBOTIC AND THROMBOLYTIC ACTIVITY**

An *in vitro* model was used to check the clot lysis and antithrombotic effect of *T. belerica* fruits along with enzyme as a positive management. From this study, it absolutely was found that after addition of enzyme clot formation is delayed up to more than 92 min, whereas after addition of test solution, it was found that as the concentration of extract was redoubled the delay in clot formation also will increase. At 0.20 mg/dl concentration, it showed the maximum delay (more than 90 min) in clot formation. For thrombolytic activity, at concentration 500 mg/kg body weight, the clot dissolution time is minimum, i.e., 58 and 66 min for liquid and alcoholic extracts, respectively. [15]

**ACUTE AND SUBACUTE TOXICITIES**

Thanabhorn *et al.* (2009) were conducted acute and subacute toxicity studies as per the OECD guideline. Single oral administration of the ethanolic extract of *T. belerica* at a dose of 500 mg/kg body weight failed to produce any toxicity. In subacute toxicity, repeated administration 500 mg/kg body weight of *T. belerica* over 14 days did not cause changes in terms of general behaviors, mortality, weight gain, hematological, or clinical blood chemistry parameters. The results of histologic examinations showed traditional look of the interior organs when compared to those of the control cluster. [16]

**ANTIOXIDANT, ANTIMICROBIAL, AND TOXICITY STUDIES**

Alam *et al.* (2011) postulated that the crude methanolic extract of the fruits of *T. belerica* Roxb. besides its numerous organic fractions evoked each *in vitro* and *in vivo* inhibitor activity likewise as medicament activity. Total inhibitor activity, scavenging free radical, authentic peroxynitrite, and reducing power assessment were performed. Finally, they complete that the EtOAc fraction evoked robust activity all told the model systems with moderate toxicity. [17]

*In vitro* glucoamylase activity of *T. belerica* fruit rind powder was assessed for its antimicrobial activity by victimization chloroform-ethyl acetate fractions. Most zone of inhibition was ascertainment in each fraction. The fractionized compound Epigallocatechin gallate showed important antimicrobial activity against *Escherichia coli*, *Bacillus subtilis*, and *Staphylococcus aureus* (Gangadar *et al.*., 2011). [18]

**ANTIDIARRHEIC ACTIVITY**

The antidiarrheic activity was performed victimization aperient evoked symptom, PGE2 evoked enteropooling, and canal motility takes a look at Kumar *et al.*., 2010. Liquid and ethanolic extract of fruit pulp of TB at the doses of 334 mg/kg, 200 mg/kg, and 143 mg/kg were used. Comparison of share protection in these models uncealed that the extracts have a lot of distinguished antibody fluid result than the reduction in canal motility. [19]

Analgesic activity: Khan *et al.* (2010) described the antisecretory and analgesic activities of the crude extract of *T. bellerica*. *T. bellerica* extract at the dose varies of 300 - A 1000 mg/kg repressed the castor oil-induced enteral fluid secretion in mice. The extract was additionally added to the dependent dose (50–100 mg/kg), however it reduced the numbers of carboxylic acid acid-mediated in mice. These results indicate that TB exhibit antisecretory and antinociceptive effects, thus justifying its medicative use in diarrhea and pain. [20]

**HYPERGLYCEMIC AND ANTIOXIDANT ACTIVITY**

The continuous administration of TB fruits against alloxan-induced hyperglycemia and antioxidant defense mechanism was studied in rats. Significant reduction of glucose level and oxidative stress was observed. Increased levels of antioxidant enzymes such as superoxide dismutase, glutathione reductase, and catalase were observed in blood and liver. [21]

**IMMUNE RESPONSE *IN VITRO* CONDITION**

*In vitro* phagocytic activity and lymphocyte proliferation assay were carried out in methanolic extract of the mouse immune system. In both assays, stimulation of macrophage phagocytosis and maximal activation of phytohemagglutinin were observed. Finally, the authors concluded that the methanolic extract of *T. bellerica* affected the mouse immune system, specifically both the cellular and humoral immune response *in vitro*. [22]

**ANTI-SALMONELLA ACTIVITY**

Madani *et al.* (2008) were studied the effect of *T. belerica* against *Salmonella typhi* and *Salmonella typhimurium*. *In vitro* cellular toxicity also performed by them. In this study, petroleum ether, chloroform,
acetone, alcohol, and aqueous extract of TB fruit taken for screening. When compared with other extracts, both alcoholic and aqueous extracts of TB showed significant anti-salmonella activity. There was no cytotoxicity observed in in vitro cellular toxicity study.[23]

HEPATOPROTECTIVE ACTIVITY

Shukla et al. (2006) were evaluated the protective effect of TB fruit extract and its active principle, gallic acid against CCl4 intoxication. Treatment with extract (200, 400, and 800 mg/kg, p.o.) and gallic acid (50, 100, and 200 mg/kg, p.o.) showed dose-dependent recovery in biochemical parameters such as serum glutamic oxaloacetic transaminase, serum glutamic pyruvic transaminase, lipid peroxidase, and glutathione, but the effect was more pronounced with gallic acid.[24]

ANTIMICROBIAL ACTIVITY

Elizabeth et al. (2005) were conducted the antimicrobial activity of TB against nine human microbial pathogens. The aqueous extract of dry fruit at 4 mg concentration showed highest zone of inhibition against S. aureus. These pathogens were highly sensitive to the methanol extract also except E. coli (enteropathogen) and Pseudomonas aeruginosa. Finally, they concluded that TB dry fruit possesses potential.[25]

ANTIULCER ACTIVITY

The antiulcer activity of ethanolic extract of T. bellerica (Combretaceae) fruits (ETB) was investigated in pylorus ligation and ethanol-induced ulcer models in Wistar rats. In both models, the common parameter determined was ulcer index. ETB at doses of 250 and 500 mg/kg orally produced significant inhibition of the gastric lesions induced by pylorus ligation-induced ulcer and ethanol-induced gastric ulcer. The extract (250 mg/kg and 500 mg/kg) showed significant ($P < 0.05$) reduction in free acidity and ulcer index as compared to control.[26]

CONCLUSION

T. bellerica is an important medicinal plant which has many pharmacological activities such as antimicrobial, antioxidant, anti-diarrheal, anti-diabetic, analgesic, immunomodulatory, antihypertensive, anti-salmonella, hepatoprotective, anti-spasmodic, and bronchodilator activities. Further, the plant is used in the treatment of gastric ulcer, constipation, and piles. Hence, this plant provides a significant role in the prevention and treatment of diseases. Further, researches should be carried out to explore the concealed areas and their practical clinical applications, which can be used for the welfare of the humankind.

REFERENCES


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