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Bahera (Terminalia belirica) – A Complete drug to treate various ailments in 21st Century

[1]Riddhi Patel*, [1]Jinal Prajapati,[2]Dr. Siddhi Upadhyay, [3]Dr. Umesh Upadhyay
[1]*Student, Sigma Institute of Pharmacy, Bakrol, Ajwa Road, Vadodara, Gujarat, India.*
[2]*Assistant Professor, Sigma Institute of Pharmacy, Bakrol, Ajwa Road, Vadodara, Gujarat, India.*
[3]*Principal, Sigma Institute of Pharmacy, Bakrol, Ajwa Road, Vadodara, Gujarat, India.*

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ABSTRACT: In Ayurvedic system of medicine, it is used as "health – harmonizer" in combination with Terminalia chebula and Emblica officnalis. It is a large deciduous tree found all over in Asia, mostly native to Sri Lanka. Traditionally, T. Bellerica is used for treatment of various diseases such as conjunctivitis, asthma, migraine, baldness, constipation and weak eyesight. It contains various phytoconstituents such as glycosides, flavonoids, tannins, phenolic compound, amino acids and saponins which are responsible for various pharmacological activities like anti-diabetic, anti-microbial, anti-salmonella, anti-biofilm, anticancer, hepatoprotective, anti-pyretic and anti-diarrheal. This review article provides comprehensive information on pharmacognostic, phytochemical and pharmacological properties of T. Bellerica, as a source for further research studies.[5] Terminalia belerica. Roxb (TB) is growing widely throughout the Indian subcontinent, Sri Lanka and SE Asia. In the Traditional system of medicine (TCM) like Ayurveda, Siddha and Unani, medicinal uses have been described as it is works in disease of every system. Glucoside, Tannins, Galliacid, Ellagicacid, Ethylgalate, Gallylglucose, Chebulanic acid are mainly believed to be responsible for its wide therapeutic actions..[3]

Key words: Terminalia bellerica, Bahera, Anti-microbial activity, anti-oxidant, Anti-cancer, Phytoconstituents.

I. INTRODUCTION

Plants have been used as medicines from the ancient times. Throughout the world medicinal plants are widely and successfully used. A plant with active medicinal constituents is used to treat diseases in the traditional systems like Ayurveda, Siddha and Unani. In Asia, the use of medicinal plants is well established and is well documented. The plants those are recognized internationally mostly comes from this region. Plants, plant parts and plant products those are used for the preparation of medicines serves wee to uplift the economical status of the country and they are the natural wealth of a country. Medicinal plants has got significant role in saving the lives of rural area people. In India, 45,000 plant species have been identified and out of which 15-20 thousands plants are found to have good medicinal value. Study says about 6000 traditional plants are used in Indian traditional and herbal medicines. In this paper, we selected the plant Terminalia bellerica belonging to family Combretaceae to study its pharmacological effect.[1] Terminalia bellirica found in Southeast Asia is extensively used in traditional Indian Ayurvedic medicine for the treatment of hypertension, rheumatism, and diabetes. The anti-atherogenic effect of Terminalia bellirica fruit has not been fully elucidated.[2]

According to World Health Organization (WHO) estimates, more than 80% of the people in developing countries depend on the traditional medicine for their primary health needs. It is generally estimated that over 6000 traditional plants in India are in use folk and herbal medicine, representing about 75% of the medicinal needs of the Third World countries.Conducted a comprehensive literature review of human studies that reported on a clinical outcome after ingestion of baheda. We searched for studies published in google scholar, embase, medline, pubmed, science direct, and indian medical databases. A total of 25 studies were identified that reported therapeutic effects onhelps to manage loss of appetite, thirst, bloating and flatulence.It also helps to manage constipation due to its Rechana (laxative) nature.[3]

Plant description

It is a large deciduous tree with a buttressed trunk, a thick brownish gray bark with shallow longitudinal fissures, attaining a height of between 20and 30 meters. The leaves are crowded around the end of the branches, alternately

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arranged, margins entire, elliptic to elliptic obovate, rounded tip or sub acute, midrib prominent, pubescent when young and becoming glabrous with maturity. The flowers are pale greenish yellow with an offensive odor, borne in axillary spikes longer than the petioles but shorter than leaves. The fruits are ovoid grey drupes, obscurely 5- angled, narrowed into a very short stalk.[3] The generic name 'Terminalia' comes from Latin word 'terminus' or 'terminalis' (ending), and refers to the habit of the leaves being crowded or borne on the tips of the shoots.[1]

It is used in several traditional medicines to cure various diseases. Glucoside, tannins, gallic acid, ellagicacid, ethylgalate, gallylglucose, chebulanic acid are mainly believed to be responsible for its wide therapeutic actions. It is known to possess medicinal activities such as analgesic, antioxidant, hepatoprotective, antibacterial, anticancer and immune-modulatory activities. In this chapter information concerning pharmacological attributes of T. Belerica has been summarized.[4]

Bahera tree

Fruits & Flowers

Fruits

Figure-1

Taxonomy [4]
Family Name: Combretaceae
Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Myrtales
Family: Combretaceae
Genus: Terminalia
Species: belerica

Synonyms [1]
Assam – bhomorabhomra, Bhaira
Eng – Beleric Myrobalan
Guj - Bahedam, Baheda
Hindi - Bahera
Kan - Shanti, Shantikayi, Tare, Tarekayi
Mal - Tanni, Tannikai
Mar - Baheda
Ori - Baheda, Bhara
Sansk - Vibhita, Aksa, Aksaka, Bibhitaki
Tam - Thanakkai, Tanri, tanrikkai, Tani
Tel - Tannikkaya, Vibhitakami, Tani

Phytoconstituents

It contains various phytoconstituents such as glycosides, flavonoids, tannins, phenolic compound, amino acids and saponins.[5] Glucoside, tannins, gallic acid, ellagic acid, ethyl galate, gallyl glucose, chebulanic acid are the main active phytoconstituents of medicinal importance. These phytoconstituents are responsible for many of the pharmacological roles. [6]

Traditional uses

The leaves enhance appetite, relieve piles, lowering cholesterol and blood pressure, boost immunity and prevent ageing. It also enhances the body resistance. It is used as popular and common traditional medicine for the above aliments by people of comibatore district.

Fruits are laxative, astringent, anthelmintic and antipyretic, also useful in hepatitis, bronchitis, asthma, dyspsia, piles, diarrhoea, coughs, hoarseness of voice, eye diseases and scorpion-sting, used for a cough. The pulp of the fruit checks dysenteric-diarrhoea, dropsy, piles and rheumatism. A decoction of the green fruit is used for a cough. Seeds are also used as an aphrodissiac, oil extract from the seed pulp is used in leucoderma and alopecia. [6]

Pharmacological effects

Anti- oxidant

Terminalia bellirica seeds, were evaluated for the In vitro anti-oxidant activity and phytochemical evaluation using different solvents such as methanol, ethylacetate, chloroform and

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aqueous. The in vitro antioxidant activity of Terminalia. Bellirica is screened by standard antioxidant assays such as 1,1-diphenyl2-picrylhydrazyl (DPPH) radicals, hydroxyl radicals and Total antioxidant activity by ABTS assay. The ethylacetate extract of T. Bellirica seed extract was found to be relatively high activity (84±0.6) than other extracts. Similarly the ethyl acetate exhibits high antioxidant status in ABTS and hydroxyl scavenging assays. In comparison to other extracts the ethyl acetate and methanolic extract found significant and prominent antioxidant activity due to the presence of high phenolic and steroid content. Finally this study concludes that all the seed extracts of T. Bellirica exhibiting high antioxidant potential with respect to dose depending manner.[7]

Antibacterial activity

Identification of novel sources for developing new antibiotics is imperative with the emergence of antibiotic resistant bacteria. The fruits of Terminalia bellirica (Gaertn) Roxb., widely used in traditional medicine, were evaluated for antibacterial activity against multidrug-resistant (MDR) bacteria, antioxidant activity and cytotoxicity. [8]

Anti-inflammatory and anti-ulcer activity

The present study was undertaken to provide the rationale for the use of Terminalia bellirica as an anti-inflammatory agent using carrageenan-induced inflammation and antiulcer agent using ethanol-acid induced gastric mucosal injury model in the Swiss albino rats. The antiinflammatory activity of the extract was evaluated using carrageenan (1% w/v) induced inflammation model at doses of 50, 120 and 300 mg/kg, p.o while using ibuprofen (20 mg/kg, p.o) as the standard drug. On the other hand, the antiulcer activity of methanolic extract of T. Bellirica leaves at the doses of 100, 250 and 500 mg/kg, p.o. Were examined against ethanol-acid induced gastric mucosal injury in the Swiss albino rats - keeping omeprazole (20 mg/kg, p.o.) As the reference. The rats were dissected, and their stomachs were macroscopically examined to identify hemorrhagic lesions in the glandular mucosa. Further, the histopathological changes of paws and stomachs were analyzed. T. Bellirica significantly (P> 0.05) reduction in the ethanol-acid-induced gastric erosion in all the experimental groups when compared to the control. These findings were further supported by the histological study. The study clearly shows that methanolic extract of T. Bellirica leaf possesses potent anti-inflammatory activity and promotes ulcer protection as ascertained by regeneration of mucosal layer and substantial prevention of the formation of hemorrhage and edema. [9]

Antimicrobial activity

Antimicrobial activities were evaluated using agar disc diffusion method and measuring their MIC value. The etoac fraction, showed strong activity in all the model systems tested and in peroxynitrite model this fraction (IC50 = 1.29±0.18 µg/ml) exerted four-fold stronger activity than standard penicillamine (IC value of 5.20±0.32 µg/ml). The reducing power of the extract was found to be concentration dependent. 50 The administration of the extract/fractions at a dose of 200 and 400 mg/kg body weight to the male Wistar rats increased the percentage inhibition of reduced glutathione, superoxide dismutase and catalase significantly. Whereas, lipid peroxidation level in hepatotoxic rats markedly decreased at a dose of 400 mg/kg body weight after 7 days. Etoac fractions showed also the highest antibacterial effect against Staphylococcus aureus with zone of inhibition 30.00±0.25 mm. The Brine shrimp lethality bioassay was used to determine the toxicity of the extracts where dichloromethane (CH Cl) fraction showed highest activity (LC = 39.02±1.16 µg/ml). 2 2 50 In conclusion, the study clearly indicated that the extract/fractions of Terminalia belerica Roxb possesses good antioxidant and antimicrobial activity along with moderate toxicity.[10]

Antihypertensive activity

Terminalia bellerica has been used as a folk medicine in a variety of ailments including hypertension. Our aim was to investigate the possible mechanism of its blood pressure (BP)-lowering effect. The crude extract of Terminalia bellerica fruit (Tb.Cr) which tested positive for flavonoids, sterols and tannins induced a dose-dependent (10-100 mg/kg) fall in the arterial BP of rats under anaesthesia. In isolated guinea-pig atria, Tb.Cr inhibited the force and rate of atrial contractions. In rabbit thoracic aorta, Tb.Cr relaxed the phenylephrine (PE, 1 µm) and K+ (80 mm)-induced contractions as well as suppressed the PE (1 µm) control peaks in the Ca++-free medium, similar to that caused by verapamil. The vasodilator effect of Tb.Cr was endothelium-independent as it was not opposed by Nω-nitro-L-arginine methyl ester in endothelium-intact rat aortic preparations

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and it occurred at the similar concentration in the endothelium-denuded tissues. These results indicate that Terminalia bellerica lowers BP through Ca++ antagonist mechanism and thus provides a sound mechanistic background for its medicinal use in hypertension. [11]

Antispasmodic activity

Tb.Cr caused relaxation of spontaneous contractions in isolated rabbit jejunum at 0.1–3.0 mg/ml. Tb.Cr inhibited the carbachol (cch, 1M) and K+ (80 mm)-induced contractions in a pattern similar to that of dicyclomine, but different from nifedipine and atropine. Tb.Cr shifted the Ca++ concentration–response curves to right, like nifedipine and dicyclomine. In guinea-pig ileum, Tb.Cr produced rightward parallel shift of acetylcholine-curves, followed by non-parallel shift at higher concentration with the suppression of maximum response, similar to dicyclomine, but different from nifedipine and atropine. Tb.Cr exhibited protective effect against castor oil-induced diarrhea and carbachol-mediated bronchoconstriction in rodents. In guinea-pig trachea, Tb.Cr relaxed the cch-induced contractions, shifted cch-curves to right and inhibited the contractions of K+. Anticholinergic effect was distributed both in organic and aqueous fractions, while CCB was present in the aqueous fraction. [12]

Antidepresion activity

The present study was undertaken to investigate the effect of aqueous and ethanolic extracts of T. Bellirica on depression in mice using forced swim test (FST) and tail suspension test (TST). The extracts were administered orally for 10 successive days in separate groups of Swiss young male albino mice. Aqueous extract (50, 100 and 200 mg/kg) in a dose-dependent manner and ethanolic extract (100 mg/kg) significantly reduced the immobility time of mice in both FST and TST. The extracts were without any significant effect on locomotor activity of mice. The efficacies of aqueous extract (200 mg/kg) and ethanolic extract (100 mg/kg) were found to be similar to that of imipramine (15 mg/kg, po) and fluoxetine (20 mg/kg, po) administered for 10 successive days. Both extracts reversed reserpine-induced extension of immobility period of mice in FST and TST. Prazosin (62.5 µg/kg, ip; an α1-adrenoceptor antagonist), sulpiride (50 mg/kg, ip; a selective D2 receptor antagonist) and p-chlorophenylalanine (100 mg/kg, ip; an inhibitor of serotonin synthesis) significantly attenuated the aqueous and ethanolic extract-induced antidepressant-like effect in TST. Thus, both the aqueous and ethanolic extracts of T. Bellirica elicited a significant antidepressant-like effect in mice by interaction with adrenergic, dopaminergic and serotonergic systems. [13]

Immunomodulatory Activity

Terminalia bellirica is one of the oldest medicinal herb of India, is an ingredient of Indian Ayurvedic formulation 'triphala' used for the treatment of digestive and respiratory disorders. Present study is aimed to evaluate the Immunomodulatory activity of ethanolic extract of T. Bellirica in mice. Immunomodulatory activity of ethanolic extract of T. Bellirica (150 and 350 mg/kg, p.o.) Was carried out by testing delayed type hypersensitivity (DTH) reaction, phagocytic index, cyclophosphamide induced neutropenia and relative organ weight. Pretreatment with both the doses of ethanolic extract of T. Bellirica showed significantly ($p< 0.05$) protection against cyclophosphamide induced neutropenia. Furthermore, significant ($p<0.01$) increase in relative weight of spleen at 350mg/kg was observed but there was no remarkable change in thymus index was observed in tested doses of plant extract. So, the study demonstrated that T. Bellirica triggers both non-specific and specific cellular immunity. [14]

Antisalmonella activity

Fruits of T. Belerica were extracted with petroleum ether, chloroform, acetone, alcohol and water and efficacy of extracts against Salmonella typhi and Salmonella typhimurium was evaluated. Alcoholic and water extracts of T. Belerica showed significant anti-Salmonella activity and MIC was 12.5 mg/ml against S. Typhimurium. Aqueous extracts of Picrohiza kurroa and Vitits vinefera also showed low anti-Salmonella activity where as aqueous extracts of Asparagus racemosus and Zingiber officinale showed no anti-Salmonella activity. Extracts of T. Belerica, Picrohiza kurroa and Vitits vinefera with other solvents such as chloroform and petroleum ether showed insignificant activity. Results showed that aqueous extract of T. Belerica was bactericidal at high concentrations where as low concentrations showed bacteriostatic property. In vitro cellular toxicity studies showed no cyto-toxicity associated with T. Belerica extracts. Pretreatment of mice with aqueous extract of T. Belerica conferred protection against experimental Salmonellosis and 100% survival of animals has been reported when

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challenged with lethal doses of S. Typhimurium. [15]

Anticancer activity

The mechanism underlying the efficacy of the TB extract against oral squamous cell carcinoma (OSCC) is yet to be explored. The present study established a connecting link between the TB extract induced apoptosis and autophagy in relation to reactive oxygen species (ROS). Our study revealed, that Gallic acid in the TB extract possess a strong free radical scavenging capacity contributing towards the selective anti-proliferative activity. Furthermore, TB extract markedly enhanced the accumulation of ROS that facilitated mitochondrial apoptosis through DNA damage, indicating ROS as the vital component in regulation of apoptosis. This effect was effectively reversed by the use of a ROS scavenger, N-acetyl cysteine (NAC). Moreover, it was observed to induce autophagy; however, it attenuated the autophagosome-lysosome fusion in Cal33 cells without altering the lysosomal activity. Pharmacological inhibitors of autophagy, namely, 3-methyladenine and chloroquine, were demonstarated to regulate the stage-specific progression of autophagy post treatment with the TB extract, favouring subsequent activation of apoptosis. These findings revealed, presence of gallic acid in TB extract below NOAEL value causes oxidative upset in oral cancer cells and promote programmed cell death which has a potential therapeutic value against oral squamous cell carcinoma. [16]

Acute and Subacute Toxicity

The study was carried out to evaluate acute and subacute toxicities of the ethanol extract from Terminalia belerica (Gaertn.) Roxb. A single oral administration of the ethanol extract at a dose of 5,000 mg/kg did not produce signs of toxicity, behavioral changes, mortality and differences on gross appearance of internal organs. In the subacute toxicity, all rats were received a repeated oral dose of 1,000 mg/kg of the ethanol extract over 14 days. The satellite group was given the ethanol extract in the same period but kept for further 14 days without dosing in order to detect the delayed effects or reversibility of toxic effects. The results showed that the extract did not cause changes in terms of general behaviors, mortality, weight gain, hematological or clinical blood chemistry parameters. The results of gross and histological examinations showed normal appearance of the internal organs when compared to those of the control group. [17]

Antibiofilm Formation Activity

Dental caries is a localized, transmissible pathological infectious disease which results in destruction of hard dental tissue. This begins with the formation of dental plaques which is a structurally and functionally organized biofilm. Streptococcus mutans is the most important bacterium in the formation of dental plaque and dental caries. Several antibiotics are available to treat oral infections but these have several undesirable side effects. Thus there is a need for alternative prevention and treatment options that are safe, effective and economical. Hence the search for alternative products continues and natural phytochemicals isolated from plants used in traditional medicine are considered as good alternatives to synthetic chemicals. The ethanolic extract of a plant Terminalia bellerica (common name = Baheda) was tested for its antimicrobial activity against the oral plaque forming bacteria Streptococcus mutans. It was found to significantly inhibit biofilm formation. In the present study it was found that the extract from Terminalia bellerica showed strong activity against Streptococcus mutans. The extract also prevents the formation of biofilm by the bacteria. The study suggests possible benefits of this herbal preparation which inhibit the biofilm formation by streptococci, a oral pathogens. [18]

Analgesic and Antipyretic Activity

The study was designed to investigate the analgesic and antipyretic activities of ethanolic and aqueous extracts of Terminalia bellirica (family: Combrataceae) fruits (200 mg/kg, p.o.) In acetic acid-induced writhing, Eddy's hot plate method and brewer's yeast-induced fever models in mice and rats. Both extracts showed a significant decrease in the number of the writhes in acetic acid-induced writhing and increase in paw licking time to heat stimuli in the hot plate method. Both extracts showed a significant inhibition of elevated body temperature when compared to corresponding control. The results suggested that the ethanolic and aqueous extracts possessed significant analgesic and antipyretic activities. [19]

Wound healing activity

The wound healing activity of ethanol extract of Terminalia belliricaroxb. Fruit wasevaluated on excision and incision wound model, in albino rats, in the form of an ointment

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withtwo concentrations (2 and 4% w/w ointment) of fruit extract insimple ointment base. Bothconcentrations of the ethanol extract showed significant response in both the wound types testedwhen compared with the control group. Nitrofurazone ointment (0.2%w/w) was used as standarddrug. [20]

II. CONCLUSION

Medicinal plants have been identified and used throughout human history. The study of traditional human uses of plants is recognized as an effective way to discover future medicines. The use of herbs to treat diseases is almost universal among non- industrialized societies and is often more affordable than purchasing modern pharmaceuticals. Crude extracts of various parts of Terminalia bellerica plant have been found to contain constituents such as Glucoside, Gallo-tannic acid, colouring matter, resins and agreenish yellow oil. Ellagic acid, gallic acid, lignans, 7-hydroxy 3'4' flavone and anolignan B. Tannins, ellagic acid, ethyl gallate, galloyl glucose and chebulic acid, phyllemblin, β- sitosterol mannitol, glucose, fructose and rhamnose. These compounds are believed to be responsible for the pharmacological activities such as antimicrobial, antioxidant, antisalmonella, hepatoprotective, antispasmodic and bronchodilatory activities. Therefore, this plant is significantly used for the treatment and prevention of diseases. Further studies should be carried out for this plant to discover the unrevealed part of it which may serve for the welfare of mankind.

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