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REVIEW ARTICLE

Plant Profile on Terminalia Species- A Review

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ABSTRACT
Restorative plants are the principle hotspot for creating remedial specialists from antiquated opportunity to fix infections. *Terminalia* is the second biggest variety having a place with the family *Combretaceae*. A wide assortment of restorative properties and pharmacological activities has been ascribed to the plants of the class *Terminalia*. Phytochemical research has prompted the disconnection of various classes of mixtures including tannins, flavonoids, phenolic acids, triterpenes, triterpinoidal glycosides, lignins and its subsidiaries. The current review manages the three different Terminalia species with respect to their morphology, phytochemical studies and pharmacological examinations.
Keywords: Terminalia, tannins, flavonoids, triterpenes, glycosides, lignins.

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1. Introduction

Traditionally, usage of plants in curing illness has deep roots in man's history and is as ancient as human civilization. In recent years, there has been growing interest in their safety, economical and effective use. The World Health Organisation has estimated that more than 80% of the world population in developing countries depends primarily on herbal medicine for basic health care needs. In India, 45000 species have been identified and out of which 15-20 thousand plants are found to have good medicinal value. The family *Combretaceae* is comprised of 20 genera and about 475 species and have valuable medicinal activities. Aftercombretum, *terminalia* is the second largest genus of the family that contains 200 species including *Terminalia bellerica, Terminalia chebula, Terminalia mulleru, Terminalia arjuna, Terminalia racemosa* and so many others. Among these plants, we put our attention on *Terminalia bellerica, Terminalia chebula* and *Terminalia arjuna*. These plants have credited with many medicinal properties like antioxidant, anti-mutagenic, antimicrobial, antidiabetic, cardioprotective, neuroprotective, antifungal, antiviral, hepatoprotective, anticonvulsant activities etc. Indeed, the Indian species *Terminalia chebula* is known as the king of plants in Ayurveda due to its broad range of medicinal uses. It is the chief ingredient of Triphala, a combination of three tropical fruits comprised of equal parts of *Terminalia bellerica, Emblica officinalis.*

Terminalia Chebula:

Taxonomy:[1]

Kingdom : Plantae
Division : Mangoliophyla
Class : Mangoliopsida
Order : Myrtales
Family : Combretaceae
Genus : Terminalia
Species : Chebula

Vernacular Names:[4]

Sanskrit -Haritak
Bengali - Haritaki
Hindi - Harana, Harad
Marathi - Harada, Divya
Gujarati - Harada, Harido
Telugu - Karakchettu
Tamil - Kadukkaya
Malayalam - Manjaputeri
Kannada - Pachetu

Habit& Habitat

In India, it is found in the sub-Himalayan region from Ravi east ward to west Bengal and Assam, ascending up to the altitude of 1500 mts (4900 feet) 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. Its habitat includes dry slopes up to 900 mts (3000 feet) in elevation. In Madhya Pradesh, it is particularly grown on metamorphic rocks in open forests or villages, and occurs on other geographical formations. In Maharashtra, it is common on the deccan trap, and on the laterite of Mahawar plateau at an altitude of 1370 meters, it is one of the principal constituents of the low elfin-wood forest[14].

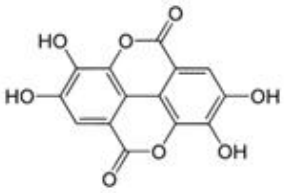
2. Morphology

Terminalia chebula is a big tree with 25-30 metres in height. Its wood is hard and bulky[4]. Leaves are 10-20 cm long, sub-opposite, simple; exstipulate; petiolate; laminae broadly elliptic to elliptic-oblong, rarely ovate, the bases obtuse, the margins entire, the tips acute, glabrescent. Flowers are yellowish white in colour, terminal spikes. Fruits are a drupe, glabrous, subglobose to ellipsoidal, 2.5-5.0 cm by 1.5-2.5 cm, usually smooth are frequently 5-angulate, ridged, wrinkled, turning blackish when dry. Fruits contain astringent substances- tannic acid, chebulinic acid, gallic acid etc. resin and a purgative principle of the nature of anthraquinone and sennoside are also present. Seeds are hard and pale yellow in colour. These are single, ellipsoidal, rough, 1.0-2.0 cm by 0.2-0.7 cm and without ridges[12].

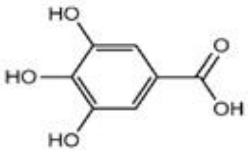
Fig: 1 Terminalia chebula

Chemical constituents:

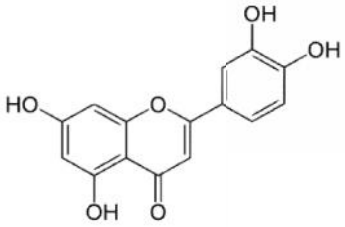
Terminalia chebula is an important source of tannins (25-32%). The tannins are of pyrogallol type, which on hydrolysis yields chebulic acid and d-galloyl glucose. Many glycosides have been isolated from haritaki including the triterpenes arjun glucoside 1, arjungenin and he chebulosides I and II. Other constituents include coumarin conjugated with gallic acid called chebulin, as well as other phenolic compounds including ellagic acid, 2,4-chebulyl-β-D-glucopyranose, chebulinic acid, gallic acid, ethyl gallate, punicalagin, terflavin A, luteolin and tannic acid. Chebulic acid is a phenolic acid compound isolated from the ripe fruits. Luetic acid can be isolated from the bark[3].



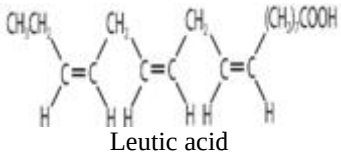
Ellagic acid



Gallic acid



Luteolin



Leutic acid

Traditional uses:

- It is one of the most commonly used plants in traditional systems of medicine in Indian subcontinent and is also called as “King of the medicine”[2].
- The dried ripe fruit of *Terminalia chebula* is an important Indian herb, used extensively in the indigenous system of medicine (Ayurvedic) for its homeostatic, antitussive, laxative, diuretic and cardiotonic activities[2].
- The herb is used as tonic, in hepatic and spleen enlargements and in skin diseases in Ayurvedic system of medicine[2].

- Its paste with water is found to be anti-inflammatory, analgesic and having purifying and healing capacity for wounds. These are used as astringents in haemorrhoids as well[2].
- Externally used in the treatment of chronic ulcers, wounds, as a gargle in stomatitis, relieves headache[4].
- It is the chief ingredient of triphala, a combination of three tropical fruits, comprised of equal parts of *Terminalia chebula, Embilica officinalis* and *Terminalia bellerica*[4].
- The dry fruit is used as tonic, carminative, expectorant, anthelmintic, anti-dysentry, sore throat, thirst, vomiting, hiccough, eye disease of the heart and bladder, vesicular calculi, urinary discharges, ascites, inflammations, tumours, gout, elephantiasis, delirium[4].
- The unripe fruit is astringent and aperient useful in dysentery and diarrhoea[4].
- The ripe fruit enriches the blood, good for ophthalmia, disease of the spleen, piles, cold in the head, strengthens the brain eye and is also used in paralysis.
- A finely powdered fruit is used as a dentifrice. A fruit, coarsely powdered and smoked in a pipe affords relief in a fit of asthma.
- The fruit in combination with other drugs is prescribed for snake bite[4].

3. Pharmacological Actions

Anti-Fungal Activity:

Fluid concentrate of *T. chebula* has been accounted for to show antifungal movement against various dermatophytes (for example *Epidermophyton, Floccosum, Microsporum, gypseum* and *Trichophyton rubum*) and yeasts (for example *Candida albicans*). Fluid, drunkard and ethyl acetic acid derivation concentrates of leaves of *T. chebula* were likewise tried against five pathogenic parasites (*Aspergillus flavus, A. niger, Alternaria brassicicola, A. alternata* and *Helminthosporiumtetramera*) utilizing paper circle technique and were viewed as successful contrasted with that of the reference standard Carbendazim [47].

Anthelminthic Activity:

The ovicidal and larvicidal activities of ethyl acetate, acetone and methanol extracts of dried leaves and seeds of *T.chebula* were tested in vitro on *Haemonchuscontortus* based on egg hatch and larval development assays at 50, 25, 12.5, 6.25 and 3.13 mg/ml. The extracts of leaves and seeds of *T. chebula* showed complete inhibition at 50 mg/ml[47].

Antinociceptive activity:

The petroleum ether, chloroform, ethanol and water extracts of *T.chebula* fruits were evaluated for their analgesic activity using the tail immersion model in mice. The ethanolic extract of the plant exhibited analgesic response at 200, 400 and 800 mg/kg body weight in acute pain studied for 15 days with maximum analgesic response on 14th day. The results suggested that *T.chebula* could be a potential candidate for bioactivity-guided isolation of natural analgesic agents in the management of chronic pain[47].

Antiulcerogenic activity:

Creatures pre-treated at 200 to 500 mg/kg body weight with hydro alcoholic concentrate of *T.chebula* showed decrease in sore record, complete impacted region and level of injury in comparision with control bunches in the headache medicine, ethanol and cold limitation stress-actuated ulcer models. The *T.chebula* separate expanded bodily fluid creation in headache medicine and ethanol-instigated ulcer models and showed antisecretory movement in pylorus ligated model prompting a decrease in the gastric juice volume, free causticity, complete corrosiveness and altogether expanded gastric PH [15].

Anti-arthritic activity:

The hydro alcoholic extract of *T.chebula* produced a significant inhibition of joint swelling as compared to control in both formaldehyde-induced and CFA-induced arthritis. *T. chebula* treatment also reduced serum TNF-alfa level and synovial expression of TNF-R1, IL-6 and IL-1beta. The authors believed that *T.chebula* could be used as a disease-modifying agent in treatment of rheumatoid arthritis.[16]

Antiviral activity:

The extracts of fruits of *Terminalia chebula* showed inhibitory effects on human immune deficiency virus-1 reverse transcriptase. Hot water extract of *T. chebula* showed anti-herpes simplex virus (HSV) activity *in vivo* and anti-cytomegalo virus (CMV) activity both *in vitro* and *in vivo* in a study. A study proved that *T. chebula* fruits contain four human HIV- type 1 integrase inhibitor such as gallic acid and 3-galloyl glucoses, and suggested that galloyl moiety had a major role for inhibition of the 3-processing of HIV-1 integrase by these compounds. It can also be used in sexually transmitted diseases and AIDS. Recently, acetone extract of *T. chebula* has emerged as a new alternative to treat pandemic swine influenza A infection due to its low cost, easy preparation and potential effect [47].

Antioxidant activity:

T. chebula is a brilliant enemy of oxidant. The watery concentrate of *T. chebula* shielded the counter oxidant proteins from receptive oxygen species (ROS) created by gamma radiation in the rodent liver microsomes and mitochondria. The ethanolic concentrate of the products of *T. chebula* diminished the degree of lipid peroxidase in pale skinned person rodents. Both treatment and pretreatment of the refined rodent essential hepatocytes with *T. chebula* watery organic product remove altogether turned around the t-BHP-incited cell cytotoxicity and lactate dehydrogenase spillage. Also, *T. chebula* extricate showed in vitro ferric-

diminishing cell reinforcement action and 2,2-diphenyl-1-picrylhydrazyl free extremist searching exercises[47] .

Antidiabetic activity:

The watery methanolic concentrate of *Terminalia chebula* natural product was found to have strong rodent gastrointestinal maltase inhibitory movement, though neither digestive sucrase nor isomaltase action was restrained by this concentrate henceforth inhibitory impact on alpha-glucosidase recommend its utilization structure Type 2 diabetes[14]. Oral organization of 75% methanolic concentrate of *T.chebula* (100mg/kg body weight) diminished the glucose level in ordinary and alloxan diabetic rodents essentially inside 4 hrs proceeded with day to day organization of the medication created a supported result [47].

Anticarcinogenic Activity:

The inhibitory activity on disease cell development by the phenolics of *Terminalia chebula* products of the soil that chebulinic corrosive, tannic corrosive and ellagic corrosive were the development inhibitory phenolics. Acetone concentrate of bark and natural product powder of *Terminalia chebula* harbours constituents with promising antimutagenic/ anticarcinogenic movement [2]. The impact of 70% methanolic natural product concentrate of *T. chebula* was concentrated on development of a few harmful cell lines including a human(MCF-7) and mouse (S115) bosom malignant growth cell line, a human osteosarcoma cell line (HOS-1), a human prostate disease cell line (PC-3) and a non-tumorigenic, deified human prostate cell line (PNT1A) involving examines for multiplication, cell suitability and cell demise [47] .

Hypolipedemic and Hypocholesterolemic Activities:

T.chebula extract administration showed hypolipidemic activity against experimentally induced atherosclerosis and hypocholesterolemic activity against cholesterol-induced hypercholesterolemia and atherosclerosis. Triphala formulation was found to have hypolipidemic effects on the experimentally induced hypercholesteraemic rats. Many other activities like hepatoprotective, cardio protective, radio protective, anti-anaphylactic and adaptogenic, cytoprotective and antiaging, wound healing, anti-plasmodial, anti-amoebic and immunomodulatory, anti-bacterial etc activities were reported on this *Terminalia chebula* plant[21].

Terminalia arjuna:

Taxonomy:[8]

Kingdom : Plantae
Division : Mangoliphyta
Class : Mangoliphyta
Order : Myrtales
Family : Combretaceae
Genus : Terminalia
Species : Arjuna

Vernacular names:

Kannada : Matthimara
Malayalam : Maheermaruthu
Tamil : Maruthamaram
Telugu : Yerramaddi
Rajasthan : Kohda
Assam : Orjun
Sanskrit : Dhanvi, kakubha
Oriya : Arjuna, sahajo
Gujarathi: Sadado
Hindi : Koha, arjuna
Marathi : Sadura

Distribution:

The arjuna is usually found growing on river banks or near dry river beds in Bangladesh, India [Uttar Pradesh, Madhya Pradesh, south & north side of India].

Morphology:

Fig: 2 ***Terminalia Arjuna***

The arjuna is around 20-25 meters tall, ordinarily has a buttressed trunk, and structures a wide overhang at the crown, from which branches drop downwards. Leaves are elongated, cone shaped leaves which are green on top and brown beneath, leaves are 4-6 inch long and 2-3 inch wide, sub inverse, glabrous and frequently in symmetrical. Edge is crenate and base is adjusted or cordate. Blossoms are light yellow blossoms which shows up among walk and June. Natural products are 1-1.5 inch in width and with 5-7 longitudinal flaps. These are glabrous with 5-7 wings, woody and stringy. Natural product is drupe and is frequently indented close to the top, set apart with diagonal vertical bending striations[8].

Chemical constituents:

Very little phytochemical work has been carried out with the plant *Terminalia arjuna.*

Stem bark:

Arjunolic acid, tomentosic acid, β-sitosterol, ellagic acid, leucodelphinidin, arjunic acid, arjunetin, arjnegnin, arjun glycoside I & II, tannins containing catechin, gallocatechol, epicatechin, epigallo catechin, arjunolone, baicalein, arjunglucoside III, terminalic acid, arjunolitin, arjun glycoside IV,V, arjuna sides A-E, 2α, 3β-dihydroxy urs-12, 18 dien-28-oic acid, 28-O-β-D glucopyranosyl ester, casuarianin, arjunophtanoloside, terminoside A, arjumin, terminarjunoside I,II.

Fruit:

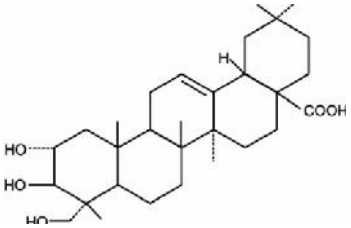
Arjunone, creasidin, β-sitosterol, friedelin, methyl oleanolate, gallic acid, ellagic acid, arjumic acid, hentriacontane, myristyl oleate, arachidic sterate, terminolation.

Root Bark:

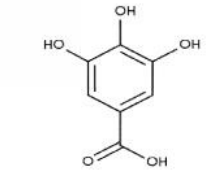
Arjunoside I & II, 8-hydroxyl hexadecenoic, oleanolic, arjumic acids, arjunolic acid, β-sitosterol, terminic acid, arjunoside III & IV,arjunoside I, arjunetin, ellagic acid, gallic acid, leucocyanidin, D-galactopyranoside.

Seeds:

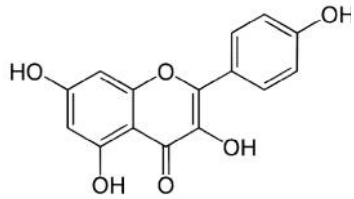
14,16-dianhydragitoxiggenin, 3-β-D-xylopyranosyl-(172)O-β-D-galactopyranoside.



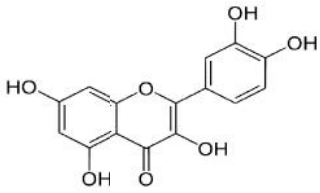
Arjunolic acid



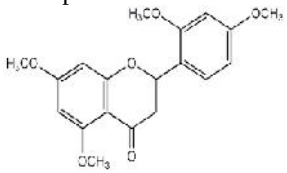
Gallic acid



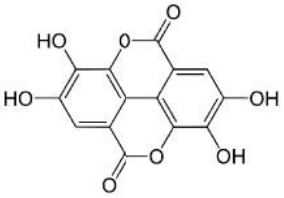
Kaempferol



Quercetin



Arjunone



Ellagic acid

Traditional Uses:[8]

Fruit: Tonic and deobstruent.

Leaves: Juice for earache.

Stem Bark:

Astringent, cooling, aphrodisiac, cardiotonic, demulcent, styptic, anti-dysenteric, urinary astringent, expectorant, alexiteric, lithotrophic tonic, in fractures, ulcers, urethrorrhea, spermatorrhoea, leucorrhoea, diabetes, anaemia, cardiac disorders, cough, tumour, fatigue, asthma, bronchitis, otalgic, diarrhoea associated with blood, cirrhosis of liver, hypertension, inflammation& skin disorders.

3. Pharmacological studies

Anti-oxidant activity:

Methanolic concentrate of *Terminalia arjuna* is utilized here and arjungenin is the most dynamic compound than others and affected the course of respiratory oxyburst and its IC worth is shown 60g/ml[29]. Cell reinforcement and free revolutionary searching limit of *T. arjuna* were concentrated by different researcher. Near concentrate on the cancer prevention agent capability of T. arjuna bark and leaves ethanolic extricate and its different dissolvable division was done by Kumar et al. The review showed that the cancer prevention agent properties because of presence of flavonoids, tannins and oligomeric proanthocyanidins. It was seen that arjunic corrosive and aglycone disengaged from the natural product were solid cancer prevention agent or free extreme scrounger and more intense than ascorbic corrosive Casuarinin extricated from *T. arjuna* safeguard Cultured Madin Darby Canine Kidney (MDCK) cell against H2O2 interceded oxidative pressure decline DNA oxidative harm and forestall the consumption of intracellular GSH in MDCK cells [22].

Heart Failure:

Fluid concentrate from bark of *Terminalia arjuna* was controlled 8 hours at a portion of 500mg. Adjuvant *Terminalia arjuna* treatment in chose patients with obstinate congestive cardiovascular breakdown, for the most part connected with idiopathic widened cardiomyopathy, seemed protected and caused durable improvement in side effects and indications of cardiovascular breakdown alongside progress in left ventricular discharge work files with unequivocal improvement in personal satisfaction[23].

Anti-carcinogenic activity:

Ethanolic and aqueous extract of *Terminalia arjuna* at a dose of 0.005-100g/ml. aqueous extract of *Terminalia arjuna* induced cardiotonic action via enhancing sarcoplasmic reticular function, a unique action minimizing the occurrence of arrhythmias, makes aqueous extract of *Terminalia arjuna* a promising and relatively safe cardiotonic beneficial to the heart and the treatment for chronic heart diseases[25].

Anti-microbial activity:

Methanol, ethanol, acetone and watery concentrate from the leaves and bark of *Terminalia arjuna*, acetone leaf remove was viewed as best against s. aureus. Natural concentrate showed practically equivalent restraint of all tried gram-negative microscopic organisms aside from p. aeruginosa. Watery concentrate of *Terminalia arjuna* bark displayed great action against aureus [26]. Solid antibacterial action was shown by the methanol concentrates of *T. arjuna* against multi drug opposition salmonella typhi. The *T. arjuna* plant remove can possibly been created as home grown ear drops to control bacterial ear disease. The leaves and bark remove as strong and viable medication against tried bacterial liable for ear contaminations than that of standard ear drop. Antibacterial and cytotoxic movement of *T. arjuna* bark fluid and methanolic separate was tentatively completed by utilizing the agar gel dispersion technique against *Escherichia coli, Klebsiella sp., Pseudomonas sp.* also, *Staphylococcus sp*. Watery and methanolic concentrate of *T. arjuna* showed hindrance against all the referenced creature in portion subordinate way [22].

Anti-tumor and cytotoxic activity:

Terminalia arjuna is natural medication against ecological cancer-causing nature as the *T. arjuna* bark extricate safeguards DNA against ADR instigated harm. The watery concentrate of stem bark showed hostile to oxidant activity

on enemy of cancer-causing movement by diminishing the oxidative pressure alongside hindrance of anaerobic digestion. The arjunic corrosive was fundamentally initiated against human oral, ovarian and liver malignant growth cell lines recommending its part in enemy of disease treatment. It was accounted for that the ethanolic concentrate of bark of *T. arjuna* makes critical pain relieving and cytotoxic difference. Arjunolic corrosive segregated from *T. arjuna* showed the cytotoxic movement against carcinoma and lymphoma disease cell. The counter cancer-causing against mutagenic capability of *Terminalia arjuna* separate *in vivo* and *in vitro* was likewise examined. Hostile to disease capability of *T. arjuna* bark remove against some human malignant growth cell line was concentrated by Singh et al. The methanolic concentrate of *Arjuna* was wealthy in the flavonoids content answerable for its antiproliferative impact. It was concentrated on that phytosome complex of methanolic concentrate of *Terminalia arjuna* bark affects human bosom disease cell lines (MCF-7) when contrasted with methanolic separate [22].

Reproductive activity:

The preventive job of arjunolic corrosive, a triterpenoid saponin detached from the bark of *Terminalia arjuna*, against arsenic (sodium arsenite, 10mgkg body weight for 2 days) actuated testicular harm in mice was evaulated. Pre-treatment with arjunolic corrosive at a portion of 20 mg/kg body weight for 4 days could forestall the arsenic incited testicular oxidative pressure and injury to the histological designs of the testicles. Arjunolic corrosive had free extremist rummaging action in a without cell framework and cancer prevention agent power *in vivo*. The outcomes recommend that the chemo preventive job of arjunolic corrosive against arsenic-prompted testicular harmfulness might be because of its natural cell reinforcement property[8].

Anti- diabetic activity:

The effect of ethanol extract (250 and 500mg kg body weight) of *Terminalia arjuna* stem bark in alloxan induced diabetic rats and its lipid peroxidation, enzymatic and non-enzymatic activity was investigated in the liver and kidney tissues. The extract also causes a significant increase in superoxidase dismutase, catalase, glutathione peroxidase, glutathione-s- transferase glutathione reductase and glucose-6-phosphate dehydrogenase, reduced glutathione, vitamin A, vitamin C, vitamin E, total sulfhydryl groups (TSH) and non-protein sulfhydryl groups(NHPS) in liver and kidney of alloxan induced diabetic rats, which clearly shows, the anti-oxidant property of *Terminalia arjuna* bark. The results indicates that the extract exhibits the antioxidant activity through correction of oxidative stress and validates the traditional use of this plant in diabetic animals[29].

Anti-inflammatory activity:

Terminalia arjuna bark powder (400 mg/kg, PO) fundamentally diminished formalin-incited paw edema at 24 hours however not carrageenan actuated paw edema proposing its job in counteraction of irritation [8]. Mitigating movement of *T. arjuna* bark powder was explored by Halder et al. constituents from the stem bark of *Arjuna* showed powerful cell reinforcement movement and repressed Nitric oxide (NO) creation in lipopolysaccharide invigorated rodent peritoneal macrophages. *Terminalia arjuna* bark and *Withania sominifera* root make mitigating difference and restrains the catalyst cyclooxygenase prompting hindrance of prostaglandin amalgamation utilizing aggravation at third stage[22].

Cardiovascular Activity:

The effect of aqueous extract of *Terminalia arjuna* bark at 63,125 and 250 mg /kg for antifibrotic and antioxidant effects in rats along with the selective beta adreno receptor agonist isoprenaline (5mg/kg sc) for 28 days were evaluated. The *Terminalia arjuna* bark extract significantly prevented the isoprenaline- induced increase in oxidative stress, decline in endogenous antioxidant level and prevented fibrosis but not the increase by chronic β-adrenoceptor stimulation. Several other activities like antitumour, gastric activity, hepatoprotective, wound healing, anti- bacterial, anti- viral, anti- atherosclerotic, anti- neoplastic etc were reported on this *Terminaliaarjuna* plant[8].

Gastric Activity:

The methanolic bark concentrate of *T. arjuna* showed a huge expansion in the disciple bodily fluid of the gastric divider and in the protein bound carb edifices of the gastric juice in rodents treated with diclofenac sodium. Hostile to ulcer impact of methanol concentrate of *T. arjuna* against *Helicobacteron pylori* lipopolysaccharide instigated gastric harm in rodent were assessed by Devi et al., The discoveries of the outcome proposed that *Arjuna* has capacity to battle factor that harm the gastric mucosa[22].

Wound Healing Activity:

The effective use of *T. arjuna* bark hydro liquor extricate on rodent dermal injuries utilizing *in vivo* models was surveyed the injury recuperating limit of *T. arjuna*. The outcome unequivocally reported that the useful impact was because of its tannin content. Natural plan of Himax treatment and salve containing *T. arjuna* separate was assessed for its injury mending potential and the outcome was similar to the standard medication nitrofurazone. The *T. arjuna* bark powder blend in with coconut oil was viewed as possibly compelling against persistent injury [22].

***Terminalia Bellerica**:*

Taxonomy:

- Kingdom: plantae
- Order : myrtales
- Family :combretaceae
- Genus : Terminalia
- Species : bellerica

Synonyms:[10]

- Assam: bhomora, bhomra, bahira
- English : beleric myrobalan
- Gujarat :bahedam, baheda
- Kannada: shanti, shantikayi, tarekayi
- Malayalam : tanni, tannikai
- Oriya : baheda, bhara
- Sanskrit: vibhinta, aksa, aksaka, bibhitaki
- Tamil : thanakkai, tanri, tannikai, tanni
- Telugu : tannikkaya, vibhitakami, tani

Occurrence:

Terminalia bellerica, belonging to family *Combretaceae* is a deciduous tree found throughout the forests and plains in southeast Asia.

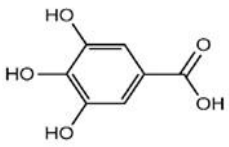
Morphology:

Terminalia bellerica is an enormous deciduous tree growing up to 30-40 m high. Its width is of 3 meters with a done molded crown. The much of the time buttressed bole at the base is branchless up to 20 meters. Leaves are substitute comprehensively elliptic or elliptic - obovate, puberulous when youthful yet glabrous on development and the nerves are conspicuous on the two surfaces. Blossoms are greenish white, axillary, thin spikes longer than the petioles yet more limited than the leaves. Calyx flaps are pubescent outside. Natural products are green and expanded when youthful and yellowish and recoil when mature. Just a single seed is available in one organic product. Round molded, dim brown to dark in variety. The nut is stony.

Fig:3 *Terminalia bellerica*

Phytochemical constituents:

Glucoside(bellerican), Gallo- tannic acid, colouring matter, resins and a greenish yellow oil. Ellagic acid, gallic acid, lignin's (termiligan and thannilgnin). 7- hydroxy3,4-(methylenedioxy) flavone and anolignan-B, tannins, ellagic acid, ethyl gallate, galloyl glucose and chebulic acid, phyllemblin, β-sitosterol, mannitol, glucose, fructose and rhamnose.[10]



Gallic acid

Ellagic acid

Traditional uses:

Organic products are diuretic, astringent, anthelmintic, and hostile to pyretic, helpful in hepatitis, bronchitis, asthma, dyspepsia, heaps, loose bowels, hacks, roughness of voice, eye sickness and scorpion-sting, utilized as a hair tonic. Decoction of the green natural product is utilized for hack. Mash of the natural product is valuable in dysenteric-the runs, dropsy, heaps and disease. Half ready natural product is utilized as laxative. Bit of the natural product is opiate. Organic products are utilized in feminine confusion in khagrachari. Seed oil is utilized in stiffness. Gum of the bark is demulcent and laxative. The triterpenoid activity and its delayed use was very much endured in mice.

Pharmacological studies:

Antipyretic activity:

The antipyretic action of ethanolic and fluid concentrates of *Terminaliabellerica* natural products (200 mg/kg, p.o.) was concentrated in brewer's yeast-initiated fever models in mice and rodents. The two concentrates showed a huge restraint of raised internal heat level when contrasted with comparing control [32].

Analgesic activity:

ArifUllah Khan et al., (2010) portrays the antisecretory and pain relieving exercises of the unrefined concentrate of *Terminalia bellerica*. *Terminalia bellerica* extricate at the portion scope of 300-1000 mg/kg repressed the castor oil-instigated gastrointestinal liquid discharge in mice. The concentrate additionally portion conditionally (50-100 mg/kg) where it decreased the quantities of acidic corrosive interceded in mice. These outcomes demonstrate that *Terminalia bellerica* show antisecretory and antimocciceptive impacts, henceforth supporting its restorative use in looseness of the bowels and torment [38].

Anti diarrhoeal activity:

The counter diarrhoeal action was performed utilizing castor oil instigated looseness of the bowels, PEG2 incited entero pooling and gastrointestinal motility test (Bimlesh Kumar et al.,2010). Fluid and ethanolic concentrate of organic product mash of *Terminalia bellerica* at the dosages of 334 mg/kg, 200 mg/kg, 143 mg/kg were utilized. Examination of rate security in these models uncovered that the concentrates have more conspicuous enemy of secretory impact than the decrease in gastrointestinal motility [42].

Antimutagenic activity:

Water, acetone, and chloroform concentrates of *Terminalia bellerica* were inspected for their antimutagenic intensity utilizing the Ames Salmonella/microsome measure. Acetone extract showed variable inhibitory action of 65.6% and 69.7% with 4-O nitrophenylenediamine (NPD) and sodium azide, separately (as immediate acting mutagens), and 81.4% with 2-aminofluorene (2AF) (a S9-subordinate mutagen), in the preincubation method of trial and error.

Hindrance with chloroform and water removes was fairly inconsequential [33].

Antidepressant activity:

Fluid concentrate (50, 100 and 200 mg/kg) in a portion subordinate way and ethanolic separate (100 mg/kg) altogether decreased the fixed status season of mice in both constrained swim test and tail suspension test. The efficacies of fluid concentrate (200 mg/kg) and ethanolic separate (100 mg/kg) were viewed as like that of imipramine (15 mg/kg, p.o.) and fluoxetine (20 mg/kg, p.o) managed for 10 progressive days with practically no huge impact on locomotor action of mice[34].

Hepatoprotective activity:

Hazra et al., concentrated on the enhancing impact of 70% methanol concentrate of *T. bellerica* (TBME) on iron over-burden incited liver injury, alongside its*in vitro* iron chelating and DNA insurance studies. Iron over-burden was instigated by intraperitoneal organization of iron-dextran into mice. Treatment with various portions (50, 100 and 200 kg body weight) of TBME showed portion subordinate decrease in liver iron, lipid peroxidation, protein oxidation, liver fibrosis, serum compounds and ferritin. The cancer prevention agent catalysts levels were improved, and the reductive arrival of ferritin iron expanded essentially with continuously expanding centralizations of TBME[35].

Antiulcer activity:

The counter ulcer action of ethanolic concentrate of *Terminalia bellerica* (*Combretaceae*) organic products ETB was researched in pylorus ligation and ethanol incited ulcer models in wistar rodents. In the two models the normal boundary decided was ulcer list. ETB at portions of 250, and 500 mg/kg orally created huge restraint of the gastric sores prompted by pylorus ligation initiated ulcer and Ethanol instigated gastric ulcer. The concentrate (250 mg/kg and 500 mg/kg) showed critical ($p<0.05$) decrease in free corrosiveness and ulcer record when contrasted with control[36].

Antimicrobial activity:

The antimicrobial action of *Terminalia bellerica* was considered utilizing agar well dispersion strategy in contrast to the microbes (*Escheria coli, Pseudomonas aeruginosa, Klebsiellapneumonia, Shigella flexneri*, and *salmonella typhi*) and contagious (*Aspergillus niger, Mucor species*, *Aspergillus fumigatus, Rhizopus species* and *Aspergillus flavus*) disconnects utilizing watery, oil ether and chloroform concentrates of *Terminalia bellerica* natural products. It was seen that fluid concentrate showed huge movement against the tried bacterial and parasitic secludes, contrasted and chloroform and oil ether remove individually. The antimicrobial capability of various concentrates of leaf and stem of *T. bellerica* gathered from two unique locales was examined against five gram positive, five gram negative and four organisms. The antimicrobial action was finished by circle dissemination examine. The MIC and MBC was additionally assessed. The *T. bellerica* removes showed more antibacterial movement than antifungal action and antibacterial action was more towards Gram negative microbes than Gram positive microorganisms. The concentrates are particularly great against microscopic organisms like Corynebacterium rubrum, Staphylococcus epidermidis and Gram-negative microorganisms like *Klebsiella pneumonie, Escherichia coli* and *Salmonella typhimurium*[37].

Anti microbial and toxicity studies:

BadrulAlam et al., (2011) hypothesized that the unrefined methanolic concentrate of the products of *Terminalia bellerica*Roxb alongside the different natural parts evoked both *in vitro* and *in vivo* cell reinforcement movement as well as antibacterial action. All out cell reinforcement movement, searching free extremist, genuine peroxynitrite and it were performed to diminish power appraisal. At last they inferred that the EtOAc part evoked solid movement in every one of the model frameworks with moderate harmfulness [43].

Antioxidant activity:

Ramesh Kumar et al., (2011) proposed that the unrefined watery concentrate of the products of *Terminalia bellerica*Roxb have cancer prevention agent properties since these contains enzymatic and non-enzymatic cell reinforcements, these can be extremely viable against microorganisms causing different sicknesses. *In vitro* appraisal of the cell reinforcement action of ethanolic parts of both these plants to search 2, 2-Diphenyl-1-picrylhydrazyl (DPPH) and profoundly responsive hydroxyl revolutionaries showed that the semi unadulterated mixtures present in the portions are helpful expected wellspring of cancer prevention agents and can be utilized in the treatment of illnesses like malignant growth, coronary illness, maturing and some other sickness connected with oxidative pressure. These parts being non-harmful showed huge cancer prevention agent movement at searching free revolutionaries. They likewise essentially rummage hydroxyl extremist which is known to cause cell harm [44].

Antihypertensive activity:

Terminalia bellerica was evaluated for the counter hypertensive impact by Arif Ullah Khan et al.,2008. After organization of *Terminalia bellerica*, they saw that fall in the blood vessel BP of rodents under sedation. In segregated Guinea-pig atria, restraint of power and pace of atrial compressions were noted. In hare thoracic aorta, unwinding was seen after the enlistment of compressions which was incited by phenylephrine[38].

Anti-spasmodic and bronchodialatory properties:

Anwarul Hassan Gilani et al., (2008) hypothesized that the rough concentrate of *Terminalia bellerica* organic products inspired unwinding of unconstrained withdrawals in both confined hare jejunum and guinea-pig ileum. Defensive impact of *T. bellerica* against castor oil-instigated looseness of the bowels and carbachol-interceded bronchoconstriction

additionally saw in rodents. In guinea-pig windpipe, *T. bellerica* loosened up the CCh-prompted compressions [39].

Anti-salmonella activity:

Madani An et al., (2008) were concentrated on the impact of *T. bellerica* against *Salmonella typhi* and *Salmonella typhimurium*. *In-vitro* cell poisonousness additionally performed by them. In this review, Petroleum ether, chloroform, CH3)2CO, liquor and watery concentrate of *Terminalia bellerica* natural product taken for screening. When contrasted and different concentrates both drunkard and watery concentrates of *Terminalia bellerica* showed critical enemy of salmonella action. There was no cytotoxicity was seen in *invitro*, cell harmfulness study[40].

Wound healing activity:

Saha et al., (2011) proposed that the glue of *Terminalia bellerica*Roxb have appropriate viability on injury mending. Natural glue planning showed huge ($P<0.05$) enhancement for development, wound withdrawal and epithelialization. In this way it could be reasoned that the glue acquired from *Terminalia bellerica* offers an unmistakable benefit in injury mending [45].

Immunological activity:

Aurason et al., hypothesized that *Terminalia bellerica* separate impacted T cell expansion mostly through a similar component as PHA. The concentrate with LPS and PWM likewise impacted B cell multiplication through T cell-autonomous and T cell-subordinate components individually. The outcomes showed that the concentrate impacted cell interceded resistance (CMI) as opposed to humoral intervened invulnerability (HMI) [46].

Acute and sub-acute toxicities:

Thanabhorn S. et al., (2009) were led intense and sub-intense poisonousness concentrates according to the OECD rule. Single oral organization of the ethanolic concentrate of *Terminalia bellerica* at a portion of 5000 mg/kg delivered no harmfulness. In sub-intense harmfulness, rehashed organization of 1000 mg/kg of *Terminalia bellerica* north of 14 days caused no progressions as far as broad ways of behaving, mortality, weight gain, hematological or clinical blood science boundaries. The consequences of histological assessments showed ordinary appearance of the inward organs when contrasted with those of the benchmark group[9].

Immune response *in vitro*:

In vitro Phagocytic action and lymphocyte expansion examine were completed in methanolic concentrate of *Terminalia bellerica* on the mouse resistant framework (Aurasorn Saraphanchotiwitthaya et al., 2008). In both measure, feeling of macrophage phagocytosis and maximal actuation of phytohemagglutinin were noticed. At last, the creators inferred that the methanolic concentrate of *Terminalia bellerica* impacted the mouse invulnerable framework, explicitly both the cell and humoral safe reaction *in vitro* [9].

Antibiofilm activity:

The ethanolic concentrate of a plant *Terminalia bellerica* was tried for its antimicrobial movement against the oral plague framing microorganisms *Streptococcus mutans*. It was found to fundamentally restrain biofilm development. It was found that the concentrate from *Terminaliabellerica* showed solid movement against Streptococcus mutans. The concentrate likewise forestalls the development of biofilm by the microorganisms. The review proposes potential advantages of this natural planning which repress the biofilm development by streptococci, an oral microbes[9].

Anticancer activity:

P. emblica and *T. bellerica* extricates showed development inhibitory action, with a specific level of selectivity against the two disease cell lines tried. Synergistic impacts ($CI<1$) for P. emblica/doxorubicin or cisplatin at various portion levels were shown in A549 and HeoG2 cells. The *T. bellerica*/cisplatin or doxorubicin likewise showed synergistic impacts in A549 and HepG2 cells. In certain cases, the mixes brought about adversarial impacts. The portion decrease level was unique and well defined for every mix and cell line[9].

β-lactamase inhibitor activity:

The β-lactamase inhibitor movement of 68 concentrates from Indian spices and flavors was reviewed. Most encouraging consequences of the β-lactamase inhibitor movement *in vivo* and *in vitro* were accomplished from the natural concentrates of Baheda (*Terminalia bellerica*), Ginger (*Zingiber officinale*), Brahmi (*Bacopa monnieri*), Garlic (*Alium sativum*), Gurmar (*Gymnemasylvestre*), Satavar (*Asparagus racemosus*) and Pomegranate (*Punica granatum*) strips and seeds against *Staphylococcus aureus* as the test life form [9].

Antithrombotic and Thromblytic Activity:

An *in-vitro* model was utilized to really look at the coagulation lysis and antithrombotic impact of *Terminalia bellerica* organic products alongside streptokinase as a positive control. From this review, it was observed that after expansion of Streptokinase clump development is postponed up to in excess of 90 min while after expansion of test arrangement it was observed that as the centralization of concentrate was expanded the deferral in cluster arrangement likewise increments. At 0.20 mg/dl fixation, it showed the greatest postponement (in excess of 90 min.) in cluster development. For thrombolytic action, at fixation 1.00 mg/dl the coagulation disintegration time is least i.e.58 and 66 min for fluid and alcoholic concentrates individually[41]. A few numerous different exercises like lactamase inhibitor action, immunological, injury recuperating, against disease, hostile to oxidant, against

biofilm, hostile to diarrhoeal, pain relieving, against parasitic, hostile to fruitfulness and against androgenic and so forth exercises were accounted for on this *Terminalia bellerica* plant.

4. Conclusion

Restorative plants have been recognized and utilized all through mankind's set of experiences. The investigation of customary human purposes of plants, is perceived as a viable method for finding future prescriptions. The utilization of spices to treat illnesses is practically all inclusive among non-individualized social orders and is more reasonable than buying present day drugs. The broad review of writing uncovered that the over three plants *Terminalia chebula*, *Terminalia arjuna* and *Terminalia bellerica* are significant restorative plants with assorted pharmacological range. The tremendous review done on these plants demonstrated that the plants have numerous significant phytochemical constituents like gallo-tannic corrosive, gallic corrosive, ellagic corrosive, ethyl gallate, β-sitosterol and so forth. Further examinations ought to be completed for this plant to find the concealed piece of it which might serve for the government assistance of humanity.

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