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TRIUMFETTA RHOMBOIDEA: A REVIEW ON ITS PHYTOCHEMICAL AND PHARMACOLOGICAL PROFILE

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ABSTRACT: *Triumfetta rhomboidea*, often known as diamond burbark or Chinese bur, is a member of the Tiliaceae family. The plant is known as a weed, but a number of medicinal properties have been reported for its different parts. It is a tropical and subtropical shrub that can be found in India, Ceylon, the Malay Peninsula, China, Africa, and America. According to phytochemical analysis, it contains carbohydrate glycosides, phytosterol, steroids, flavonoids, tannin & phenolic compounds, and triterpenoids, which can be associated with various pharmacological properties such as antioxidant, antimicrobial, antitumor, antibacterial, diuretic, anti-diabetic, antiproliferative, anti-inflammatory, antitubercular, anthelmintic and lactogenic properties. This review mainly focuses on the traditional uses of various plant parts, phytochemical constituents and reported pharmacological activities.

INTRODUCTION: Nature is the most valuable, necessary, and diverse system on the planet, as well as the backdrop for the emergence, evolution, and existence of life. Traditional or folk medicine has always played an important role in the worldwide health care system. Traditional medicine continues to play a significant role, particularly in rural regions, despite the demand for traditional medicines growing worldwide and will continue to do so in the future. Traditional medicine encompasses a wide range of health practices and approaches, as well as compiled knowledge, skills, and practices related to animals, plants and minerals, beliefs, spiritual remedies, manual practice/procedures, and ancient indigenous experiences that were used to maintain health and comfort, as well as cure, diagnose, and prevent illness. Indian traditional medicinal system is one of the oldest traditional medicinal systems in the world. India is unique enough that it comprises a variety of well-known traditional medical systems, including Ayurveda, Siddha, Unani, Yoga, naturopathy, and homoeopathy. There is a growing interest in the pharmacological evaluation of various plants used in Indian traditional systems of medicine.

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Traditional medicinal systems based on medicinal plants are playing an essential role in providing health care to a significant segment of the population, particularly in developing nations. The plant *Triumfetta rhomboidea* (Family: Tiliaceae), a tropical and subtropical shrub which can be found in India, Ceylon, the Malay Peninsula, China,

Africa and America [1]. This plant had an important role to play in ancient medicinal therapy, and is still used in some parts of the world for its medicinal properties. The plant's most commonly used therapeutic parts include the flower, leaves, bark, root, and fruit. This plant's root has a bitter and acidic flavour and is used as an aphrodisiac, tonic, and cooling agent. The leaves and stem are applied on tumours as a poultice. All parts of this plant are employed in natural medicine in the tropics. *Triumfetta rhomboidea* roots have traditionally been used to treat diarrhoea, intestinal ulcers, and as a diuretic. Tumors, gonorrhoea and leprosy are treated using the leaves, flowers, fruits, and stem. While powdered leaves of the plant are used to treat anaemia in East Africa.

2 Patients suffering from a severe cold are given a daily sauna with boiling leaves. The pounded roots and fruit are intended to help during childbirth. Boils can be treated with crushed flowers as a poultice. In folklore remedy, the plant was used in the treatment of cancer among the tribal population in Kolli Hills, South India. However, fewer reports are available with respect to the pharmacological properties of the plant [2]. Soups with the leaves are occasionally served. It was once used as a famine meal. It was employed in Livingstone (Zambia) and was thought to be particularly appetising due to its tomato-like flavour. Mucilage is obtained from the stem and green bark, which is used to make slimy soups and sauces. Mucilage is frequently used as a baby meal and for young children who cannot consume coarse starchy foods. Because of its high energy content, the soup is frequently served as the first meal to new mothers.

It's also served as an appetizer. The bark is softened in hot water and then kneaded in a small amount of clean water to extract the mucilage. Mucilage is released into the water during kneading, subsequently added to stews to make them sticky. The stem bark can be peeled and saved for further use. Antihypertensive, astringent, diuretic, mucilaginous and emollient are all properties of the leaves. The root and bark of the plant and a decoction of the plant in rice water are used to cure diarrhoea, dysentery, internal haemorrhages, and gonorrhoea [3]. *Triumfetta rhomboidea,* often known as diamond burbark or Chinese bur, is a tropical shrub that has become widely naturalised. It is believed to have arrived in Australia from China.

Its bark, sometimes known as burbark, is often used to produce jute. It is a competitive shrub species that disperses by means of its epizoochorous burs, and can become invasive in pastures and disturbed areas where it can form dense stands. *Triumfetta rhomboidea* is a pan-tropical weed reported from more than 100 countries. The place of origin of *T. rhomboidea* is uncertain. It has been considered either native to tropical Amer, or to the old-world tropics.

Triumfetta rhomboidea is an environmental and agricultural weed broadly dispersed in tropical and subtropical regions around the globe. This species thrives in disturbed environments and has spiny leaves, so future expansion is probable. Fruits can be easily transferred through clothing and animal fur. *T. rhomboidea* is a member of the Tiliaceae family, and is more commonly known as T. burr [4].

FIG. 1: ENTIRE PLANT OF TRIUMFETTA RHOMBOIDEA

FIG. 2: TRIUMFETTA RHOMBOIDEA

Botanical Description: *Triumfetta rhomboidea*, often known as diamond Burbank or Chinese bur, is a tropical shrub that has become widely naturalised. Its bark, sometimes known as Burbank, produces a jute-like material. This shrub usually grows to about 1.5m tall, while its leaves can vary

in size and are ovate to broadly ovate in shape. Small, yellow-colored flowers are found on this plant and can have 10-15 stamens per flower **Fig. 1**. In addition, the fruits of this plant are covered with satellite hairs. Botanist Nikolaus von Jacquin was the first to represent the taxon in 1760 effectively. According to different sources, the number of stamens varies between 8 and 15. The fruit is spherical to slightly oval in shape and measures around 6 millimetres (0.2 in) in diameter; with smooth 2 millimeters (0.1 in) long spines **Fig. 2**. Hairs in the shape of stars (stellate) cover the stems. Venkata Rao described its embryology in 1952 [5].

TABLE 1: SCIENTIFIC CLASSIFICATION OF TRIUMFETTA RHOMBOIDEA

Kingdom	Plantae
Division	Tracheophytes
Sub-division	Angiosperms
class	Eudicots
Sub-class	Rosids
Order	Malvales
Family	Malveceae
Genus	*Triumfetta*
Species	*rhomboidea*

Chemical Constituent: *Triumfetta rhomboidea* (Tiliaceae) contains carbohydrate glycosides, phytosterol, steroids, flavonoids, tannin & phenolic compounds, and triterpenoids, according to spectral analysis of the extracted phyto-components. GC and GC-MS analysis identified 71 constituents, representing about 93% of total essential oil. Of these, 87% were sequiterpenes, while the rest were monoterpenes 4% and aliphatic constituents 2%. The sesquiterpenes, trans-beta-caryophyllene (22.4%), kessane (14%) and caryophyllene oxide (13%) were shown to be the most abundant components [6]. The other minor constituents were *α*-humulene (8.5%), germacrene D (6.9%), *cis*-calamene-10-ol (6.5%), *α*-cadinol (5.4%) and *δ*-cadinene (4.8%) [27]. The compounds terpin-4-ol (0.1-4.1%) and eugenol (t-6.3%) have been commonly identified in the essential oils. *T. rhomboidea* appears to be a novel source of kessane, the derivatives of which are known to be potent sedatives. Although found in small amounts, intermedol is suspected of having potential as a therapeutic compound in human leukemia.

Phytochemical Review [7-11, 29]: *Triumfetta rhomboidea* ethanolic extract (EETR) was tested to preliminary phytochemical screening to determine several plant metabolites.

Test for Alkaloids: The small part extracts were stored separately and filtered after being treated with a few drops of weak hydrochloric acid. Various alkaloidal agents, such as Mayer's reagent (cream precipitate) and Dragendorff's reagent, were used to test the filtrate (orange brown precipitate).

Test for Carbohydrates and Glycosides: A little amount of ethanolic extract was diluted separately in 5 mL of distilled water and filtered. Molisch's technique was used to detect carbohydrates in the filtrate.

A tiny extract sample was hydrolyzed in a water bath for a few hours with weak hydrochloric acid and then submitted to the Liebermann- Burchard, legal and Borntrager tests to determine various glycosides. (The presence of glycosides is indicated by the pink to red tint).

Test for Flavonoids: A fraction of the aqueous filtrate of plant extract was treated with 5 mL of dilute ammonia solution, followed by concentrated H_2SO_4. A yellow colouring showed the presence of flavonoids in the extract.

Test for Steroids: 2 mL acetic anhydride and 2 mL H_2SO_4 were added to 0.5 g ethanolic extract. The presence of steroids was shown by the colour changing from violet to blue or green in the samples.

Test for Terpenoids (Salkowski Test): 5 ml of extract were combined with 2 ml of chloroform, and then 3ml concentrated H_2SO_4 was carefully added to form a layer. A reddish-brown colouring suggested the presence of terpenoids appeared at the interface.

Test for Saponin: 1 mL of alcoholic extract was diluted to 20 mL with distilled water and agitated for 15 minutes in a graduated cylinder. The formation of 1cm layer of foam concluded saponin presence.

Test for Tannin: When the extract was treated with vanillin-hydrochloric acid reagent, a pink or red colour was formed due to the formation of phloroglucinol.

Test for Protein Mellon's Reaction: When added to a protein solution, Million's reagent (mercuric nitrate in nitric acid with a trace of nitrous acid) normally produces a white precipitate that turns red when heated.

Test for Volatile Oil or Essential Oil: On a glass slide, a thick portion of the extract was deposited. A drop of Sudan red 3rd reagent was applied, and it was rinsed with 50 percent alcohol mount in glycerine after two minutes.

TABLE 2: DATA SHOWING THE PRELIMINARY PHYTOCHEMICAL SCREENING OF THE EXTRACTS OF TRIUMFETTA RHOMBOIDEA

Phytochemical	Presence/Absence
Carbohydrates	++
Glycosides	++
Protein & Amino Acid	--
Phytosterol and steroids	++
Flavonoids	++
Alkaloids	--
Tannins and Phenolic compounds	++

Pharmacological Activity:

Antioxidant Activity: Lipid peroxidation mediated by free radicals is considered a primary mechanism of cell membrane destruction and damage. The oxidation of unsaturated fatty acids in biological membrane leads to a reduction in membrane fluidity and disruption of membrane structure and function. MDA, the end product of lipid peroxidation was also reported to be higher in carcinomatous tissue than in non-diseased organs. Increase in the level of TBARS indicated enhanced lipid peroxidation leading to tissue injury and failure of the antioxidant Défense mechanisms to prevent the formation of excess free radicals. Methanolic extract of *T. rhomboidea* showed significant antitumor and antioxidant activity in DAL and EAC bearing Swiss Albino mice [12, 13]. Ethanolic extract of *T. rhomboidea* exhibited potent antioxidant activity in DPPH and ABTS and H_2O_2 radical methods and moderate antioxidant activity against nitric oxide radicals. Variations in activity could be a factor that can be attributable to the fact that there is a great deal of variation in the underlying chemical structure of varied phytoconstituents, so they have different levels of antioxidant action against several types of free radicals. Plant flavonoids are known to exhibit potent antioxidant activity. As a result, the antioxidant activity of *Triumfetta rhomboidea* extracts could be associated with the presence of these phytoconstituents. According to the findings, the ethanol extract of *Triumfetta rhomboidea*, a natural herb, may have antioxidant properties against a variety of oxidants [14]. The leaves, bark, and roots of methanol extracts of T. Rhomboideahave significant antioxidant action by scavenging NO and regulating pathogenic situations produced by excessive NO production and its oxidation product [15]. Methanolic extract of *T. rhomboidea* root possessed significant antioxidant activity [16]. Petroleum ether, chloroform, ethylacetate, n-butanol, and aqueous fractions of95% methanol extract of *Triumfetta rhomboidea* were showing good antioxidant activity [28].

Antibacterial Activity: In the *E. coli, S. aureus, B. cereus* Bacteria, the aqueous extract of *Triumfetta rhomboidea* has antibacterial action at various levels. Bacteria *B. cereus* was shown to be more active in the inhibitory zone, while E. coli and S. aureus were found to be less active. The results concluded that the water extract of *Triumfetta rhomboidea* possesses good antibacterial activity, and only one constituent of butanol was isolated from the water extract of *Triumfetta rhomboidea* [5]. Antibacterial activity of ethanolic extract and ether extract of *Triumfetta rhomboidea* Jacq were performed against three Gram positive bacteria, *Staphylococcus aureus* (MTCC 737), *Enterococcus faecalis* (MTCC 439), *Bacillus cereus* (MTCC 430) and three Gram-negative bacteria *Klebsiella pneumoniae* (MTCC 109), *Pseudomonas aeruginosa* (MTCC 2642), *Escherichia coli* (MTCC 1687) using agar well diffusion method. The results of the preliminary evaluation showed that *Triumfetta rhomboidea* Jacq possesses good antibacterial activity. *P. aeruginosa* and *E. coli* are resistant or less susceptible to *Triumfetta rhomboidea* Jacq [17].

Antimicrobial Activity: The antimicrobial activity of methanol extract of *Triumfetta rhomboidea* leaves was evaluated against *Staphylococcus aureus*, *Salmonella typhi*, and *Klebsiella pneumonia*e using agar diffusion and agar dilution techniques. The results obtained showed that the crude extract exhibits a substantial antimicrobial activity against *Klebsiella pneumoniae* (which recorded the greatest sensitivity), *Salmonella typhi*

but not against *Staphylococcus aureus* [18]. Essential oils isolated from *T. rhomboidea* have been shown to possess antimicrobial activity. The antimicrobial tests showed a mild activity against *Escherichia coli* and *Enterococcus hirae* [6].

Antitubercular and Anthelmintic: The anti-tubercular activity of compounds was assessed against *Mycobacterium tuberculosis*, using Microplate Alamar Blue assay (MABA). The methanolic extract of *Triumfetta rhomboidea* showed an excellent effect on the Mycobacterial growth. The extract of *Triumfetta rhomboidea* was screened from a range of 0.8 µg/ml to 100 µg/ml. The anti-mycobacterial activity may be due to Phenolic compounds in the methanolic extract of *Triumfetta rhomboidea*. The Anthelmintic activity was performed according to the Ghosh *et al.* method on adult Indian earthworm *Endrullusenguinae*.

It has an anatomical and physiological resemblance to the intestine roundworm parasites of human beings. *Endrullu senguinae* was placed in a Petri dish containing three different concentrations (100mg/ml, 50mg/ml, 25mg/ml) of aqueous extract of the plant *Triumfetta rhomboidea* [19]. The study on the antitubercular and anthelmintic suggests that the extract of *Triumfetta rhomboidea* possess significant In-vitro Antitubercular and Anthelmintic activity. It is anticipated that this plant would be a useful pharmaceutical material to treat Tuberculosis and Helminthiasis.

Cytotoxic Activity: The extract from *Triumfetta rhomboidea* was tested for cytotoxic activity against HT-29, HeLa and C2C12 cell lines by MTT assay method. The ethanolic extract of *Triumfetta rhomboidea* exhibited moderate cytotoxic properties toward cancerous cell lines HT-29 and HeLa with CTC50 values 701.50 and 785.50 microgram/ml, respectively. Whereas against C2C12, test extract failed to exhibit cytotoxicity at test concentrations with only 32% cytotoxicity at 1000 micro g/ml. Treating cells with a cytotoxic compound can result in a variety of cell fates. The cells may undergo necrosis, in which they lose membrane integrity and die rapidly as a result of cell lysis. The cells can stop actively growing and dividingor the cells can activate a genetic program of controlled cell death (apoptosis).

Furthermore, triterpenes also induce apoptotic response on cancer cells by inhibiting nuclear factor-kappa B or by causing cell cycle disruption. In conclusion, the ethanol extract from *Triumfetta rhomboidea* possess moderate cytotoxic activity against the HT-29 and HeLa cell lines, which could be associated with its antioxidant mechanisms [20]. Antitumor efficacy of *Triumfetta rhomboidea* methanolic extract (METR) was investigated in Ehrlich ascites carcinoma (EAC) and Dalton's ascites lymphoma (DAL)-bearing Swiss albino mice. After 24 h of tumour inoculation, mice were given METR at doses of 100 and 200 mg/kg for 14 days. METR's effects on the formation of mouse tumours and the lifespan of EAC-bearing mice were investigated. The haematological profile and biochemical markers of the liver (lipid peroxidation and antioxidant enzymes) were also calculated. METR treatment increased the life duration of EAC-bearing mice by reducing tumour volume and viable cell count. *Triumfetta rhomboidea's* anticancer and antioxidant actions are attributed due to the above parameters [12, 13].

Methanolic extract of *Triumfetta rhomboidea* (TRM) treated against 7, 12-Dimethylbenz Anthracene (DMBA) Induced Breast Cancer in Sprague –Dawley Rat. Oral administration of 100mg/kg and 200mg/kgof TRM to DMBA treated rats significantly prevented the tumourincidence, total no of tumours, tumour volume. It can be concluded that *Triumfetta rhomboidea* leaves possesses anticarcinogenic and anti-oxidative potential against chemically induced mammary gland carcinogenesis inmammals. Chemo preventive activity may bedue to antioxidant/free radical-scavenging constituents present in the plant leaf extract [21]. The methanolic extract (METR) of *Triumfetta rhomboidea* leaves was tested for cytotoxic activity against HepG2 cells. HepG2 cells were exposed to METR at concentrations of 0.1, 1, 10 and 100 µg/ml and the cytotoxic effects determined using both MTT and Neutral Red assays.MTT assay results showed that extract does result in significant cytotoxic effects on HepG2cells at various concentrations [22].

Lactogenic Activity: Aqueous extract of *Triumfetta rhomboidea* (AETR) was investigated for lactogenic activity against nursing rats. AETR was given orally at doses of 125, 250 and 500

mg/kg body weight for the 14th day of parturition. The AETR has remarkable lactogenic activity, according to this study, since it increases milk production and prolactin levels in nursing rats [23].

Diuretic Activity: The methanol and petroleum ether extracts of Triumfetta rhomboidea Jacq dried leaves were evaluated for diuretic activity. Both the extracts (100 and 200 mg/kg) significantly increased the total volume of urine as compare to control. The extracts exhibited dose dependent diuretic effect; highest dose of methanol extract showed maximum diuretic activity [24].

Analgesic and Anti-inflammatory Activity: The analgesic and anti-inflammatory effects of the methanolic extract of the leaves of *Triumfetta rhomboidea* (50-400mg/kg) were investigated on mice and rat, respectively. The analgesic effect was determined by acetic acid-induced writhing test in mice while the anti-inflammatory activity was determined by egg albumin-induced oedema of the rat paw [25]. Anti-inflammatory activity was studied by membrane-stabilizing effect on human red blood cells (HRBC) and protein denaturation activity using 70% of methanolic extract of *Triumfetta rhomboidea*. Methanolic extract of *Triumfetta rhomboidea* plants shows anti-inflammatory activity by the inhibition of protein denaturation and membrane stabilizing activity by protecting from lysis. This activity might be due to presence of flavonoids, phenolic compounds in the extract [26].

Future Prospects: It was noticed that the plant has wide applications such as antioxidant, antimicrobial, antitumor, antibacterial, diuretic, anti-diabetic, antiproliferative, anti-inflammatory, antitubercular, anthelmintic and lactogenic activities. *Triumfetta rhomboidea* contains carbohydrate glycosides, phytosterol, steroids, flavonoids, tannin & phenolic compounds and triterpenoids, according to spectral analysis of the extracted phyto-components. GC and GC-MS analysis identified 71 constituents, representing about 93% of total essential oil. Of these, 87% were sesquiterpenes, while the rest were monoterpenes 4% and aliphatic constituents 2%. The sesquiterpenes, trans-beta-caryophyllene (22.4%), kessane (14%) and caryophyllene oxide (13%) were shown to be the most abundant components [6]. *T. rhomboidea* appears to be a novel source of kessane, the derivatives of which are known to be potent sedatives. Although found in small amounts, intermedol is suspected of having potential as a therapeutic compound in human leukemia. The data presented in this review support the methods applied by traditional healers. Awesome work has been done in the phytochemistry and pharmacology of T. rhomboidea; however, some drawbacks in the scientific literature need to be further investigated to speed up the ongoing scientific and clinical research. The crude extracts of *T. rhomboidea*have numerous biological activities, but their active chemical constituents need to be further elucidated by bioassay-guided isolation and their action mechanism remains unclear and should be further investigated. Some bioactivities of *T. rhomboidea* have been performed *in-vitro* but *in-vivo* studies following animal models to investigate their therapeutic are meager. Additionally, *T. rhomboidea* has been authenticated to possess various pharmacological potentialities, but an investigation into the action mechanism is lacking and should be further investigated. Toxicological studies are another important aspect of understanding the safety profile of herbal medicine.

CONCLUSION: The present study reviewed botanical description, traditional uses, active Phyto-chemicals, and pharmacological activities of *Triumfetta rhomboidea* Linn. Also, this plant shows significant therapeutic potential as an anticancer agent too. Further studies are desirable to evaluate *T. rhomboidea* anticancer activity through the in-vivo condition and clinical trials. In addition, a clinical test must also be conducted to determine the clinical efficacy of *T. rhomboidea* for humans. This review will help explore the plant further and expand the existing therapeutic potential of *Triumfetta rhomboidea*. This will provide convincing support toits future pharmacotherapeutic use in a clinical set-up.

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