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Phytochemistry, Pharmacology and Therapeutic Importance of Desert Rohida Tree (*Tecomella undulata* Sm.)

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ABSTRACT

Most of the area of Rajasthan comes under the Thar Desert but rich in biodiversity. Various plants found in Rajasthan having medicinal properties. Rohida is well-known for its wide range of therapeutic activities like hepatoprotective, antibacterial, antimicrobial, antifungal and anti-termite, immunomodulatory, anticancer, cytotoxic, analgesic, antiinflammatory, anti-obesity, etc. This well accepted agroforestry tree of the arid regions is heading towards extinction due to its increasing demand in timber and pharmacological industries coupled with negligible conservation efforts. This species has now been designated as "threatened" in Rajasthan, India. Various compounds have been isolated from the plant parts mainly bark and leaves, viz Radermachol, lapachol, tecomaquinone-I, α -lapachone, β -lapachone, stigmasterol, β -sitosterol, oleanolic acid, ursolic acid and betulinic acid. In the present review, the information concerning the medicinal uses, biological activities and hepatoprotective studies on this plant are precisely delineated.

Keywords: Antiinflammatory, Anti-obesity, Immunomodulatory, Tecomaquinone-I, α - & β -lapachone and Stigmasterol.

INTRODUCTION

Medicinal plants are used for health care from ancient time. Phyto-constituents isolated from plants are used directly as drug or base material for drug synthesis since long time. Huge numbers of plants are unexplored or underestimated for their medicinal utility. Modern synthetic medicine causing various side effects, leads to different health problems (Kali, 2014).

There is immense need of research in scientific way to explore medicinal utility of different plants. Need to discover natural resources to combat upcoming lethal diseases and increasing problem of drug resistance (Arya, 1998). There is enormous scope for future research and further pharmacological investigation of not only this plant but also of other plants to serve the humanity. Various phytochemicals isolated from plants showed pharmacological potential used directly as drugs or provide base for synthesis of new drugs. Tecomella undulata (Seem), commonly known as Rohida (Hindi), Rohitaka (Sanskrit) and Ammora (English). Due to its presence in arid and semi-arid regions of Thar Desert, it is also known as Desert teak. Locally it is popularly known and traded by the name of Marwar teak or Desert teak. *Tecomella* (Fig. 1 & 2) is famous for its quality timber; use of its leaves, flowers and pods (Fig. 3) as fodder; and its secondary metabolites having therapeutic properties. It is also referred in great epic Mahabharata and its therapeutic uses are also mentioned in Ayurveda (Meena, 2012).



Figure 1 and 2 Tecomella undulata Sm. Trees.

Tecomella undulata is an ornamental tree. A small tree, growing upto 2-6 mt, with drooping, hairy branches. Leaves simple narrowly oblong obtuse and wavy, 5-12 cm long. In springtime, it produces beautiful showy tubular flowers in yellow, orange and red colors. Fruit is a long, thin, slightly curved capsule up to 20 cm long, with winged seeds. Susceptibility to many pathogens and pests is one of the major problems and detrimental factor in successful establishment and growth of this tree (Azam and Ghanim, 2000, Saraf and Sankhla, 2013). Conventionally, it is propagated through seeds; however, natural regeneration of plants is poor due to air dispersal of seeds to remote areas, extreme environmental conditions during seed dispersal, improper harvest and storage of seeds, and short seed viability. The tree is very slow growing and suitable vegetative propagation methods are not available for its rapid multiplication. It is widely distributed in Arabia, southern Pakistan and northwest India up to an elevation of 1200 meters. In Pakistan, it is found in Baluchistan and Sind (Jain, 2012, Ivanova, 2005).



Figure 3. Pods and Fowers on Tecomella undulata Sm. Trees.

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It occurs on flat and undulating areas including gentle hill slopes and sometimes also in ravines well adapted to drain loamy to sandy loam soil having pH 6.5-8.0. The plant thrives very well on stabilized sand dunes, which experience extreme low and high temperatures. It plays an important role in ecology acting as a soil binding tree by spreading a network of lateral roots on the top surface of the soil and also as a wind break and helps in stabilizing shifting sand dune (Jain, 2012; Ivanova, 2005).

The literature survey reveals that it is a multipurpose tree, valued for its timber, fuel wood, fodder and traditional medicine.

The local people of different parts of India especially in the northern part and other countries use this plant or its parts to cure various diseases and some significant results are witnessed. But still unsatisfactory scientific work has been carried out to prove the folklore claims and to justify the full potential of this plant. Tecomella undulata decreasing due to urbanisation and lack of awareness about the medicinal potential of this plant. It's an attempt to summarize the medicinal uses of this plant. (Katewa, 2005, Pandey, 1970, Meena, 2005). So that researchers explore bioactive constituent of this plant for medicinal purpose and prove their traditional uses. The present review is written with a view to present the recent status of various scientific studies on phytochemical and pharmacological activities of *Tecomella undulata* plant and also to focus on the future potential this plant holds in its possession.



Figure 4 a. Chemical constituents occurring in bark and leaf of *Tecomella undulate* Sm.

Prominent secondary metabolites of great therapeutic potential

Tecomella undulata has gained prominence due to presence of some prominent secondary metabolites of great therapeutic potential like stigmasterol, -sitosterol, a-lapachone, tectol isolated from heartwood, bark and leaf. The present review presents the traditional information and recent scientific update on this plant with therapeutic potential. The plant is used to cure leucorrhoea, leucoderma, enlargement of spleen, traumatic wounds, hepatitis, piles, anorexia, flatulence, tumors, worm infestations and syphilis. Leaves of the plant contain certain compounds which are effective against HIV infection. Rohitakarishta, an ayurvedic drug obtained from T. undulata, is prescribed in liver and spleen diseases, oedema and anaemia (Gupta and Mali) Seshadr Lapachol from the heartwood of Tecomella undulata and a note on its reaction (Joshi, 1974, Joshi, 1986, Hoshi, 1977). Important chemical constituents of T. undulata are radermachol, undulatin, lapachol, tecomelloside, stigmasterol, β amyrin, β -sitosterol, β -sitosteryl acetate, campasterol etc. In the indigenous system of medicine the plant is used for the treatment of leucorrhoea, leucoderma, piles, anorexia, flatulence, tumours, migraine, enlargement of spleen and worm infestations. Bark is also used as muscle relaxant, cardiotonic and choleretic. Hepatoprotective, analgesic activity, anti- inflammatory, anti- proliferative, anti- diabetic, anti- oxidant, anti- microbial and anti- obesity activities have been proven in laboratory. The plant extract include in commercial formulations for hepatoprotection like herboliv, hepato- 100, himoliv, liv- 52, livo- plus etc. Besides their medicinal utility these plants are playing important roles in life of common people. The wood of *T. undulata* is used as Ti, 2000, Verma, 1979, Gujral, 1979, Taneja, 1975).

Uses

Some of the traditional usage on various plant parts of *Tecomella undulata* in indigenous system of medicines in India are mentioned here. The bark of young branches is useful as a remedy for syphilis in Sind. Bark is also astringent, anthelmintic and refrigerant. It is used in enlargement of liver and spleen, urinary disorders, worms, leucoderma, leucorrhoea, fever, piles and anorexia. Ladies of tribal communities of Samahni valley (Pakistan) take bark powder with hot milk for abortion. Bark is also used as muscle relaxant, cardiotonic and choleretic. The seeds are acrid, refrigerant, laxative, anthelmintic and useful in ulcers, diseases of blood, eye, ear and also in muscular pain. These possess mild relaxant and cardio tonic activities. Seeds are also used against abscess and in the treatment of eczema. *Tecomella undulata* seeds crushed with pinus leaf extract are taken to cure haemorrhoids. Leaves of the plant are used to treat migraine. The paste of *Tecomella undulata* root is given internally in leucorrhoea some times its pulp is given along with rice water. Tea of flower is useful for sterile women and to reduce thirst. The whole plant is used in folklore system in different types of allergies and old wounds (Joshi, 1975, Dhir, 2012, Nath, 2011).

Phytochemicals and Ethanomedicinal value

Phytochemical studies of T. undulata isolated and identified several compounds. Some of these compound having pharmacologically value. Different parts of the plant contain different types of chemical constituent (Fig. 4^a and Fig. 4^b). Lapachol, tricontanol- 1, β - sitosterol, tectol, veratric acid Iridoid glycoside-6-O-veratryl-catalpo-side- α -lapachone have been isolated from roots whereas Tectol, Dehydro- α - lapachone were isolated from heartwood and root.

Tecomin, iridoid glucosides tecomelloside, rutin, quercetin, luteolin- 7- glycoside and β - sitosterol, undulatoside B, Alphanamixinin and β –Sitosterol have been isolated from bark of plant. Tecomaquinone-I, Alpha-Lapachone, Tectoquinone, Deoxylapachol, Lapachole, Radermachol, 2- Isopropenylnaphtho (2, 3-b) furan-4, 9-quinone, Dehydroalpha-Lapachone, Cluytyl ferulate, Undulatin, were obtained from heartwood. Biochemical compounds veratric acid, dehydrotecol, lapachol, β-sitosterol, tecomelloside, ferulate and n-tricontanol have been isolated from heart-wood and bark. Leaves contain oleanolic acid, ursolicacid, deterpene, aphanamixol. betulinic acid, triacontanol. cirsimaritin. cirilineol. pentariacontanol and 4, 5-dihydroxy-3, 6, 8-trimethoxy flavones. Quercetin, rutin, luteolin-7-glycoside and β sitosterol were isolated from flowers. Alimonoid, rohitukin, linoleic acid, oleic acid, stearic acid, and palmitic acid were derived from seeds whereas Aphanamixin lactone, Aphanamixolide was isolated from fruitshell (et.al., 2011 Upadhyay and Kareel 2011; Kumawat et.al, 2012).

T. undulata have valuable medicinal value. Different parts of the plant are used in indigenous medicinal system. The paste of its root is used to treat leucorrhoea sometime pulp is given along with rice water. Bark is mainly used as folkloric medicine for the treatment of various diseases. The bark juice is used in conjunctivitis. Paste of its bark is applied on traumatic wound to promote wound healing. The bark of young branches used for the treatment of syphilis, as stimulant for digestive system, astringent, anthelmintic, refrigerant and possesses pain relieving properties. Bark is specially used in ascites associated with hepatosplenomegaly. Bark extract is an excellent blood purifier and cholagogue, therefore used in hepatitis. It is also used to treat enlargement of spleen, gonorrhoea, urinary disorder, leucoderma, liver diseases and syphilis. The bark powder is taken with hot milk for abortion. Decoction of bark powder and extract in clarified butter is used in treatment of jaundice; enlarge spleen, anaemia, intestinal worms, and urinary disorders.





Distillate obtained after soaking the bark and wood of stem in water for two days used to treat eczema. It is also used for treatment of piles, anorexia, flatulence, skin disorder, diabetes, obesity tumors and worm infestations.

Paste of fresh leaves is applied on head for treating migraine. Flowers are used to treat hepatitis, also used to make tea to reduce thirst. Crushed seeds and pinus leaves extract taken together to cure haemorrhoids and abscess. The seeds are used against abscess, ulcers, and diseases of blood, eye, ear, eczema and also in muscular pain. In traditional system of Ayurveda, the plant is used in various formulations for the treatment of liver and spleen diseases, oedema and anaemia etc. The plant is also used in the treatment of enlargement of liver and spleen, urinary disorders, worms, leucoderma, leucorrhoea, fever, piles and anorexia. Whole plant is used to treat different type of allergies and old wounds by local people (Jain et.al, 2012).

Research Arena and Pharmacological Findings

In recent years researchers have confirmed the traditional experiences about therapeutic potential of plants or plant extract in different clinical studies. They use different extracts of *T. undulata.* Ethanolic extract of stem showed hepatoprotective activity whereas methanolic extracts of demonstrated analgesic activity. Lapachol present in the heart wood has antifungal and anti-termite properties. The chloroform and water soluble portion of alcoholic extracts of the bark has smooth muscle relaxant activity. Whereas alcoholic and chloroform extracts of bark have exhibited cardiotonic and chloretic activity. The ethanolic extract of bark showed immunomodulaory property.

Methanolic and ethanolic extract of stem, methanolic extract of leaves demonstrated hepatoprotective activity. Phytochemical betulinic acid isolated from stem showed hepatoprotective activity. Chloroform extract of stem bark exhibited anticancer potential. Butanolic extract of bark demonstrated significant anti-inflammatory activity. Ehanolic extract of the plant showed both anti- hyperglycaemic and anti- oxidant effect. Ethyl acetate extract of plant inhibited adipocyte differentiation that characterised its anti-obesity property. Methanolic extract of whole plant exhibited antiinflammatory activity. Ethanolic extract of leaves exhibited anti-hyperglycemic and antioxidant potential. Methanolic extract of plant showed significant analgesic potential. Methanolic and aqueous extracts of plant also demonstrated antibacterial activity against some gram positive as well as gram negative bacteria. Ethanolic extract of plant showed stimulatory effect on humoral and cell mediated immune response, suppress delayed type hypersensitive reaction caused by sheep RBC in mice. Aqueous and alcoholic extract of leaves and stem exhibited antibacterial activity against human pathogen Salmonella typhi (Rohilla 2014). Alcoholic extract of plant is effective against gram negative bacteria whereas acetone extract is effective against gram positive bacteria. Pharmacological values of some phytoconstituents isolated from T. undulata have been characterised. Radermacol isolated from heartwood; β - sitosterol isolated from bark, heartwood, root, leaf and quercetin isolated from flowers demonstrated anti-inflammatory activity. Lapachol from heartwood and root; β - lapachone, α - lapachone from heart wood, β- sitosterol isolated from bark, heartwood, root and leaf; quercetin isolated from flowers showed anti-cancer ~ 100 ~ Journal of Medicinal Plants Studies property. Undulatin from leaves, lapachol from heartwood and root; guercetin from flower exhibited antimicrobial activity. Lapachol, quercetin and betulinic acid isolated from the plant showed antiviral activity.

Betulinic acid and urosolic acid isolated from leaves exhibited strong anti-HIV activity. Betulinic acid, urosolic acid and oleanolic acid isolated from plant showed hepatoprotective activity. Dehydro- α - lapachone isolated from heart wood showed anti-angiogenic property. β sitosterol exhibited antipyretic and immunomodulatory activity. Octadimethyl succinate derivatives of oleanolic acid and betulinic acid also demonstrated excellent anti-HIV activity. Both the compounds Oleanolic and ursolic acid are also recognized to have antiinflammatory, anti-hyperlipidemic and anticancerous properties. Crisimaritin is a flavonoid isolated from leaves having adenosine antagonistic properties in rats (Kumar 2012).

CONCLUSION

Tecomella undulata has occupied a reputed position of having valuable medicinal properties in both folk and classical streams of indigenous medicinal systems Tecomella undulata has number of pharmacological activities, so this plant has received attention by the researcher to know phytoconstituents present in its different extracts. Phytochemical studies have been performed to investigate the composition of different plant extracts, leading to the isolation and identification of pharmacologically relevant compounds such as the heartwood contains radermachol, lapachol, cluytyl frulate, P-lapachone, a-lapachone, Dehydro-alapachone. Leaves of the plant possess cirsimaritin and cirsili. The bark contains Psitosterols, iridoid glucosides tecomelloside, rutin, quercetin, luteolin-7-glycoside and Psitosterol. Root contains lapacol, tricontanol-1, P-sitosterol, tectol, veratric acid and 6-Overatryl catalposide and quinines. The fruit shell of Tecomella undulata contains aphanamixin lactone and aphanamixolide. The seeds contain 7.14%, tannin and seed oil contains linoleic acid (53%) along with lauric acid. The kernels yield 44.5% of fatty oil. The plant is under threatened category due to its imprudent harvesting from wild. The plant holds tremendous potential of medicinal value and is used in traditional and folklore system of medicines. It has been used traditionally in various ailments like syphilis, swelling, leucorrhoea and leucoderma, enlargement of spleen, obesity, tumours, blood disorders, flatulence and abdominal pain. This review summarizes phytochemical, ethanomedicinal and pharmacological value of *Tecomella undulate* commonly found in the Rajasthan, India. Traditionally used as medicine in Ayurveda, Unani system of medicine and also as folkloric medicine. Different parts of the plants used for treating various ailments. This plant contain different types of alkaloids, terpenoids, phenols, phytosterols, flavonoids, tannin etc. The plant is under threatened category due to its imprudent harvesting from wild.

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