ABSTRACT

India is one of the richest floristic regions of the world and has been a source of plants and their products since antiquity and man uses them in different ways according to his needs, particularly as food or as medicine. Tecomella undulata is a popular medicinal plant has long been used in ayurvedic system of medicine. The plant has been found to exhibit diverse pharmacological activities. The present review presents the recent scientific update on this plant with therapeutic potential.

Keywords: Tecomella undulata, Phytochemistry and Pharmacological activity.

INTRODUCTION

Man uses plants in many ways to meet his basic needs food, clothing and shelter. Wild plants supply medicines, crafts and cosmetics to rural and urban communities. In addition, wild plants are the sources of income and employment to the rural areas [1]. Important herbal products are spices, herbal teas, functional food ingredients, medicinal raw materials, aromatic plants, essential oils, flavoring, fragrant products and dietary supplements. Plants have also been used as medicines for thousands of years all over the world. WHO estimates indicate that 80% of the population, mostly in developing countries still relies on plant-based medicines for primary care WHO 1978. The different systems of medicinal usage practiced in India, Ayurveda, Siddha, Unani, Amchi and local health traditions, utilize a large number of plants for treatment of human and animal diseases. Those plants used were called as medicinal plants. India is a country with a vast reserve of natural resources and a rich history of traditional medicine. Medicinal plants contain numerous biologically active compounds which are helpful in improving the life and treatment of disease. Compounds such as carbohydrates, proteins, enzymes, fats, oils, terpenoids, flavonoids, sterols simple phenolic compounds etc. Natural products are the source of synthetic and traditional herbal medicine and are still the primary health care system. The presence of various life sustaining constituents in plants made scientists to investigate these plants for their uses in treating certain infective diseases and management of chronic wounds [2, 3].

Several hundred genera of plants are used medicinally mainly as herbal preparations in the indigenous systems of medicine in different countries which have stood the test of time, and therefore, modern medicines has not been able to replace most of them. The World Health Organization reported that 80% of the world population relies chiefly on traditional medicines involving the use of plant extracts or their active constituents [4]. It has been estimated that in developed countries such as United States, plant drugs constitute as much as 25% of the total drugs, while in fast developing countries such as China and India, the contribution is as much as 80%. Thus, the economic importance of medicinal plants is much more in countries like India than in rest of the world. In the last few decades, the field of herbal medicine is getting popularized in both developed and developing countries [5,6]

Vernacular Name

Baluchistan: Rohi, Bolan: Parpuk; Bombay: Lohera, Lohuri, Rakhthreora, Rugtroara, Roiraa; Hindi: Rugtrora, Lasbala: Lahira; Marathi: Rakhtroda, Rakhtarohida, Marara: Rohira, Roiraa; Punjab: Lahura, Luar, Rohira, Roiraa; Puusha: Raiddwan, Rebdan, Rebdun;

Sanskrit: Chalachhada, Kushalmali, Kutashalmali; Sind: Khen, Lahero, Lohuri [7].

Synonyms

Tecomella undulata G. Don, Bignonia undulata Sm.

Trade Name

Rohida tree, Desert teak, Marwar teak.

Scientific Classification

Kingdom: Plantae; Order: Lamiales; Family: Bignoniaceae; Genus: Tecomella; Species: T. Undulata; Binomial Name: Tecomada Undulata [8, 9].

It is a shrub or small tree with drooping branches and stellately grey-tomentose innovations, otherwise glabrous. The leaves are simple 5-12.5 cm in length and 1-3.2cm in width, narrowly oblong, obtuse, and entire with undulate margins. Flowers are in corymbose few flowered racemes, terminating short lateral branches, pedicles are 6-13 mm long, Calyx 9.5 -11 mm long, campanulate. Lobes are 3mm long, broadly ovate, obtuse. Flowers are 5 subequal rounded. Stamens are exerted and filaments are glabrous. Stigma are 2 lamellate, lobes are spathulate-oblong, rounded. Capsules are 20 by 1 cm slightly curved, linear-oblong, acute, smooth. Valves are thin. Seeds are 2.5 by 1 cm. Wing are very narrow round the apex of seed, absent at its base [7,9].

Habitat

The species of Tecomella undulata is restricted to the drier parts of the Arabia, southern Pakistan and northwest India. In India, it occurs mainly in Maharashtra, Gujarath, Rajasthan, Punjab and Haryana [7]. The tree is propagated from seeds or cutting and succeeded well in drained fibrous land . It is a common agro-forestry tree species in the Thar Desert of Rajasthan for its higher survival rates even in extreme drought conditions [9].

Phytochemistry of Tecomada undulata

Different chemical constituents such as rademachol, undulatin, lapachol, tecomelloside, stilgestorol, -sitosterol, sitosteryl acetate, campasterol and many others have been isolated from the plant. A new glycoside tecomin is isolated from heartwood and bark. Rutin, quercetin, luteolin,-7-glycoside and -sitosterol were isolated from flowers of the plant.

Vol 3 Suppl 3, August 2014 www.mintagejournals.com 20
A new iridoid glycoside-6-O-veratryl-catalaposide : [1]-lapachone was isolated from roots [11]. *T. undulata* leaves have oleaonic acid, ursolic acid, betulinic acid, triacontanol, cirsimaritin, cirtlineol, pentantriocanol and 4,5-dihydroxy-3,6,8-trimethoxy flavones [12, 13]. The seed oil contains 7.14% tannin and seed oil contains linoleic acid (53%) along with lauric acid. The kernels yield 44.5% of fatty oil [14]. Structure of some chemical constituents present in *Tecoma undulata* Linn. is shown in Table 1.

**PHARMACOLOGICAL ACTIVITY**

**Antibacterial activity**

Antibacterial activity of Hexane, chloroform and methanol extracts of *Tecomella undulata*, leaves were used for the study by agar well diffusion method against seven bacteria *Bacillus subtilis*, *Enterococcus faecalis*, *Escherichia coli*, *Klebsiella pneumonia*, *Micrococcus luteus*, *Proteus vulgaris* and *Pseudomonas aeruginosa*. were the Methanolic extract was found to be more potent as compare to n-Hexane and chloroform extracts against all tested bacteria. Hexane extract was found to be resistance against *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Micrococcus luteus* for low concentration, while *Klebsiella pneumoniae* showed intermediate activity to its high concentration. *Escherichia coli*, *Proteus vulgaris*, *Bacillus subtilis* and *Enterococcus faecalis* did not show any inhibition zones. Chloroform extract was found effective against *Klebsiella pneumoniae* and *Micrococcus luteus* showed intermediate activity against *Pseudomonas aeruginosa* irrespective of its concentrations whereas *Escherichia coli*, *Proteus vulgaris* and *Enterococcus faecalis* were resistance to low concentration and evinced intermediate activity to high concentration. thus Methanol extract proved to be the most effective broad spectrum of antimicrobial compounds from plants [15].

**SCABIEs (In-Vitro And In Vivo Study)**

Scabies is one of the notorious diseases affecting human and animal’s skin. *Sarcoptes scabiei* L. (a common itch mite) is the known cause of this disease. Scabies is a large scale disease affecting a wider section of a society throughout the world. (Burges, 1994) . The topical use of *Tecomella undulata* extract showed a moderate miticidal activity against the *Sarcoptes scabiei* mites on people and animals while in vitro study against *Sarcoptes scabiei* showed high miticidal response. This indicates that *Tecomella undulata* possess effective bio-miticidal compounds against the *Sarcoptes scabiei* mite and may be used to cure humans and animals suffering from scabies infestation. In the present study, Ivermectin showed 85% and 30% *Tecomella undulata* extract showed 80% miticidal activity in vitro and 71% protection by Ivermectin injection and 58% by 20% *Tecomella undulata* extract through topical use against *Sarcoptes scabiei* mite. The miticidal effect of *Tecomella undulata* extract against the *Sarcoptes scabiei* mite may be due to the presence of compounds such as Lapachol, flavonoids and other compounds present in this particular plant [16, 17].

**Immunomodulatory activity**

The effect of *Tecoma undulata* was evaluated on humoral response, its influence was tested on sheep erythrocyte specific haemagglutination antibody titre in mice. Cyclophosphamide was used as standard at a dose of 50 mg/kg, p.o., showed significant inhibition in antibody titre response, while ethanolic extract of *Tecoma undulata* was found to significantly enhance the production of circulating antibody titre. Thus it can be concluded that flavonoids and phenolic compounds present contribute to the effect of *Tecoma undulata* on the humoral and cell mediated immune response in the animal experiments in the present study [18].

**Anticancer Activity**

Four polyherbal formulations were prepared using different proportion of extract of stem bark of *tecomella undulata*, *bauhinia variegata*, *oroxyllum indicum* and leaves of *indigofera tinctoria* all the four formulations were evaluated for their cytotoxic effect using mt (3-(4,5-dimethylthiazolyl)-2)-5-diphenyltetrazolium

<table>
<thead>
<tr>
<th>Chemical constituents</th>
<th>Structure</th>
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<tr>
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bromide) assay on cell lines of human colon adenocarcinoma (caco-2) and human breast adenocarcinoma (mcf-7). among all the four formulation the one containing t. undulata as the major component is reported to have significant effect on cancer cells (in vitro and in vivo) by selectively increasing cytotoxicity through apoptosis without disturbing toxicities and could render prospective candidate for the therapy of cancer [19].

Antiproliferative activity
In this study Induction of apoptosis was done by chloroform extract of Tecomella undulata bark (CTUB) which was determined by MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide), Annexin V and caspase activation assays. The cell cycle analysis was done by flow cytometer and nuclear staining by DAPI. Results clearly showed that the induction of apoptosis by CTUB in K562 c. K562,chronic myeloid leukemia cells) was found to be dose dependent, having IC50 of 30 μg/ml with activation of FAS (TNF receptor super familymember 6) , FADD (Fas-associated protein with death domain), caspase 8, caspase 3/7 and fragmentation of DNA. The bioactive CTUB was determined to possess 0.03% (w/w) of quercetin [20].

Hepatoprotective activity
Studies was conducted on the leaves of plant tecoma undulata to validate the hepato protective activity against 30% alcohol and paracetamol-induced hepatic damage. The methanolic extract of T. undulata leaves was tested against liver damage of albino rats. Levels of serum marker enzymes i.e. AST, ALT (aminotransferases), ALP (alkaline phosphatase), GGT (gamma glutamyl transpeptidase) and total bilirubin in serum alongwith the activities of LPO (lipid peroxidation), SOD (superoxide dismutase), CAT (catalase), GSH (reduced glutathione) and GPx (glutathione peroxidase) in liver homogenate from treated rats were monitored, respectively. And the result revealed that The supplementation of T. undulata extract restored the depleted SOD, CAT, GSH and GPx contents near normalcy and also brought down to elevated levels of AST, ALT, ALP, GGT and total bilirubin. Thus it can be concluded that the possible mechanism of hepatoprotective effect through antioxidant activity of T. undulata might be due to the presence of flavonoids, quinones and other active constituents [21].

Antimicrobial activity
Cold macerated petroleum ether (60 – 800C), acetone, alcohol and water extracts of bark of tecoma undulata were used for carrying out the antimicrobial studies against two gram positive and two gram negative organisms. The method used was the cylinder plate technique and the result revealed that maximum antibacterial activity was shown by water extract of tecoma undulata [22].

Antioxidant activity
The methanolic extract of different plant parts (leaves, stems, bark and roots) of Tecomella undulata (family Bignoniaceae), was evaluated for their antioxidant activity and was used for quantitative estimation of the total phenolics as Gallic Acid Equivalent (GAE) per gram dry weight and total flavonoids as Quercitin Equivalent (QE) per gram dry weight and the result revealed that maximum total phenolic content was recorded in stems (13.75±0.125 mgGAE/gdw) While maximum total flavonoid content was found in leaves (71.875±18.393 mQE/gdw) and Highest radical scavenging activity is observed in stems with IC50 value 92.29±7.693. Conclusion: It signifies that the Plant-derived phenolics and flavonoids represents good sources of natural antioxidants. From the above results it seen that this plant exhibits significant antioxidant activity [23].

Antihyperglycemic activity
The present study was conducted to access the antihyperglycemic and antioxidant activity of Tecomella undulata leaves extract on STZ induced diabetic rats. STZ diabetic model is widely used for elucidation of type 2 antidiabetic activity the result indicated that indicated that Tecomella undulata extract produced antihyperglycemic activity in a dose dependent manner. Further at a dose of 500 mg/kg b. wt the extract produced significant antihyperglycemic activity when compared with the reference compound metformin. Here the glucose lowering activity of Tecomella undulata may be attributed to both pancreatic (enhancement of insulin secretion) and extra pancreatic (peripheral utilization of glucose) mechanisms. Antihyperglycemic activity at lower dose (200 mg/kg) may be due to anyone of the aforementioned mechanism [24].

CONCLUSION
The use of herbal medicines is wide spread among the patients in treating varieties of diseases Present review is a compilation of the research work carried out on various parts of Tecoma undulata . It reveals that this plant has great scope for future research as it has some very interesting phytochemicals moreover, isolation and purification of pure compounds should be carried out. The review on Tecoma undulata highlights the importance of its different pharmacological activities.

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