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Review Article

Phytochemical and pharmacological studies of *Leptadenia pyrotechnica*

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Abstract

Traditional healing systems which mainly rely on plants, herbs and shrubs always played a vital role in the global health system. As the natural products are usually less toxic, have less side effects and easily available so the demand for plant base drugs is increasing. This ultimately provides a base for the drug research. Leptadenia pyrotechnica is a shrub found in desert areas belonging to the family Asclepiadaceae. It is an important medicinal plant and all parts of the plant are used in folk medicines. The present article is having a detail about phytochemistry, pharmacological activities of the plant and isolated constituents with their structures. The updated information included in this article will be helpful for the researchers.

Keywords: Phytochemistry, *Leptadenia pyrotechnica*

Introduction:

Leptadenia pyrotechnica is an erect, ascending, shrub from family Asclepiadaceae. It is up to 1.5m-3m high with green stem and pale green alternating bushy branches with watery sap (figure: 1). In Pakistan it is commonly known as kheep or khip. While it's common name in English is Broom bush. Leaves are rarely found, when present more or less linear, 2-5 cm long and about 3 mm broad, sessile. Flowers are greenish yellow in cluster lateral umbellate cymes.

The genus Leptadenia consists of the following accepted species namely *Leptadenia arborea*, *Leptadenia madagascariensis*, *Leptadenia hastata*, *Leptadenia abyssinica*, *Leptadenia pyrotechnica*, *Leptadenia reticulate* (Verma *et al*., 2014).

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Distribution: *Leptadenia pyrotechnica* is abundantly found throughout the sandy areas of Pakistan. It is distributed in Sindh, coastal areas of Karachi and Baluchistan, Southern districts of Khyberpakhtunkhwa, Cholistan and Thal desert of Punjab. Cholistan desert is mainly occupied by Bahawalpur division while Thal desert include districts of Jhang, Muzaffargarh, Layyah, Khushab, Mianwali and Bhakkar (Marwat *et al*., 2011; Niaz *et al*., 2013; Qasim *et al*., 2014).

Detection of phytochemicals:

As a result of phytochemical screening glucose, sucrose, fructose, ionositol and fucose were detected from stem exudate, stem and root tissues of *Leptadenia pyrotechnica* (Basalah*et al*., 1984). Polyphenolic compounds namely vanillic acid, epicatechin, gallic acid, caffeic acid, and quercetin-3-β-d-glucoside were detected from the aqueous, ethylacetate, n-butanol and ethanolic extract of aerial parts of *L. pyrotechnica*, vanillic acid, epicatechin and quercetin-3-β-d-glucoside were found to be in highest concentration while

ethyl acetate retains maximum amount of compounds (Khasawneh*et al*., 2011).

Isolation of phytochemicals:

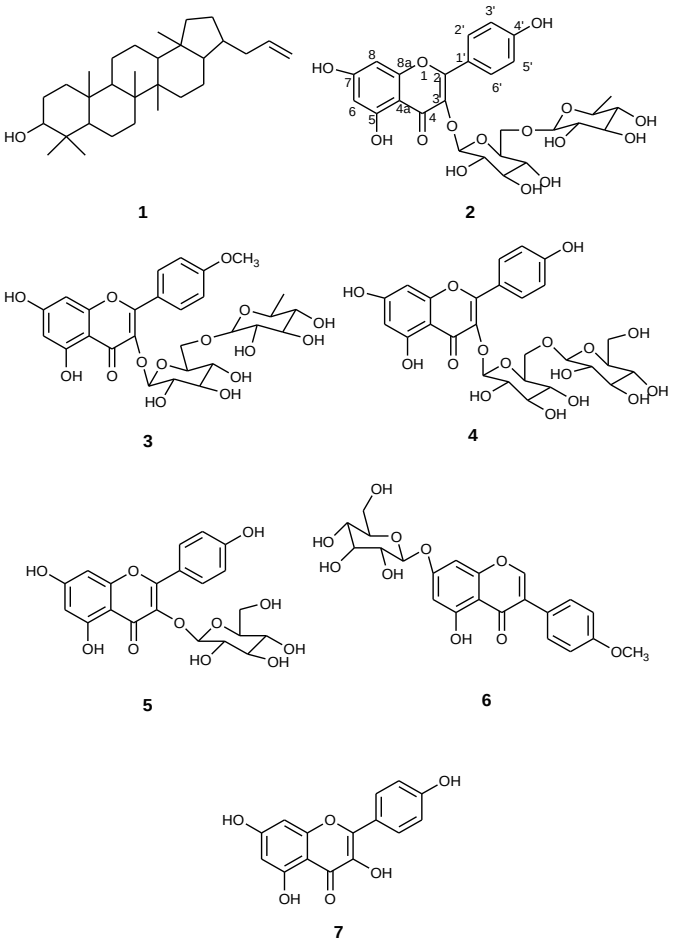
About twenty four alkaloids were isolated from the dichloromethane extract of aerial parts of the *Leptadenia pyrotechnica*. Majority of the alkaloids belonged topyrazine, pyridine, pyrrole, and indole types which were characterized by using gas chromatography coupled with mass spectrometry technique (Moustafa *et al.*, 2009a). A pentacyclic triterpenoid compound named leptadenol-I (**1**) was isolated from hexane extract of the whole plant of *L. pyrotechnica* (Noor *et al.*, 1993). Investigation of chemical constituents in ethyl-acetate extract of aerial parts of *L. pyrotechnica* with the help of preparative paper chromatography, Sephadex LH-20 low pressure liquid chromatography and high performance liquid chromatography results in isolation of six flavanoids namely kaempferol-3-O-α-L-rhamnopyranosyl(1’’’→6’’)-O-β-D-Glucopyranoside (**2**), kaempferol 4’-methyl ether 3-O-β-D-rutinoside(**3**), kaempferol-3-O-β-D-glucopyranosyl(1’’’→6’’)-O-β-D-glucopyranoside (**4)**, kaempferol-3-O-β-D-glucopyranoside (**5)**, texasin 7-O-β-D-glucopyranoside (**6**) and kaempferol (**7**) (Moustafa*et al*., 2009b). Eighteen pregnane glycosides (**8-25**) from the methanol-chloroform extract of whole plant of *L. pyrotechnica* were isolated with sarcostin, 11-hydroxysarcastin and deacetylmetaplexigenin as the aglycon moieties and acetyl, benzoyl, cinnamoyl, coumaroyl and nicotinoyl ester moieties linked at C-12 and/or C-20 of the aglycon and hexopyranose, 6-deoxy-3-O-methylhexopyranose and 2,6-dideoxy-3-O-methylhexopyranose sugars linked at C-3 of their aglycon (Cioffi *et al*., 2006). Vernolic acid (**26**) was isolated from the seeds extract of *L. pyrotechnica* and identified as well as characterized by using standard gunstone’s method of direct acetolysis (Sherwani*et al.*, 2009). Various lipid constituents were also reported from the extract of aerial parts of the *L. pyrotechnica.* The compounds were characterized as three terpenes namely Phytol (**27**), taraxerol (**28**) and Squalene (**29**); five sterols namely cholesterol (**30**), campasterol (**31**), stigmasterol (**32**), β-sitosterol (**33**) and Fucosterol (**34**); fifteen fatty acids, eleven n-alkanol, series of n-alkane, one n-alkene named as 3-tetradecene (**35**) and eighteen aromatic hydrocarbons were isolated in which 5-phenyl-undecanes (**36**) and 6-phenyl-tridecane (**37**) were the major constituents (Moustafa*et al.*, 2007). A glycerol-oleanolic acid conjugate named Pyrotechnoic acid (**38**) was found in the butanol soluble part of the ethanolic extract of leaves of *L. pyrotechnica* (Ali *et al.*, 2001). Three cardiac glycosides from the methanol and defatted methanol extract of aerial parts of *L. pyrotechnica* were isolated and characterized as 14, 19-dihydroxycard-20(22)-enolide-3-O-[β-D-glucopyranosyl-β-D-digitoxoside] (**39**), 14, 19-dihydroxycard-20(22)-enolide-3-O-[β-D-glucopyranosyl-β-D-glucopyranoside] (**40**) and 14, 19-dihydroxycard-20(22)-enolide-3-O-β-D-digitoxoside (**41**). Rotation locular counter current chromatography and high performance liquid chromatography techniques were used for the identification and isolation of the above mentioned compounds while the their structures were established by electrospray ionization, fast-atom bombardment, mass spectrometry and nuclear magnetic resonance. The chemical structures of compounds so far isolated from Lipyroedica are shown in figure 2 (Moustafa*et al.*, 2009c).

Pharmacological activity:

The methanolic extract obtained from aerial parts of *Leptadenia pyrotechnica* has been reported to

Figure 1: A shrub of Leptadenia pyrotechnica

exhibit antitumor activity (Moustafa*et al*., 2009c).Antioxidant properties of the methanol extract of aerial parts of *Leptadenia pyrotechnica* were determined with reference to hydrogen peroxide radical scavenging and 1 , 1-diphenyl-2-picryl hydrazyl assay method. A significant correlation existed between percentage inhibition of free radicals and concentrations of the extract (Tewari *et al*., 2014). Methanol extract of the aerial parts of *Leptadenia pyrotechnica* showed hypolipidemic and anti-atherosclerotic effects when administered to cholesterol fed rabbits. The administration of methanolic extract of *L. pyrotechnica* (250 mg/kg body weight per day orally) significantly prevented the rise in serum total cholesterol, low-density lipoprotein cholesterol, triglycerides, very-low-density lipoprotein cholesterol and atherogenic index



Hepatic and aortic total cholesterol, lipid peroxidation and triglycerides were also lowered considerably in the rabbits that were treated with the extract.

The Plant extracts also effectively prevented the atheromatic changes and plaque formation in the . Hepatic and aortic total cholesterol, lipid peroxidation and triglycerides were also lowered considerably in the rabbits that were treated with the extract. Aorta and favored enhanced fecal cholesterol output (Jain *et al*., 2007). Anti-diabetic potential of methanol extract of aerial parts of *Leptadenia pyrotechnica* against streptozotocin induced diabetic rat has been studied. The extract exhibited the dose dependent lowering of blood glucose level in diabetic rats (Chaudhary *et al.*, 2011).

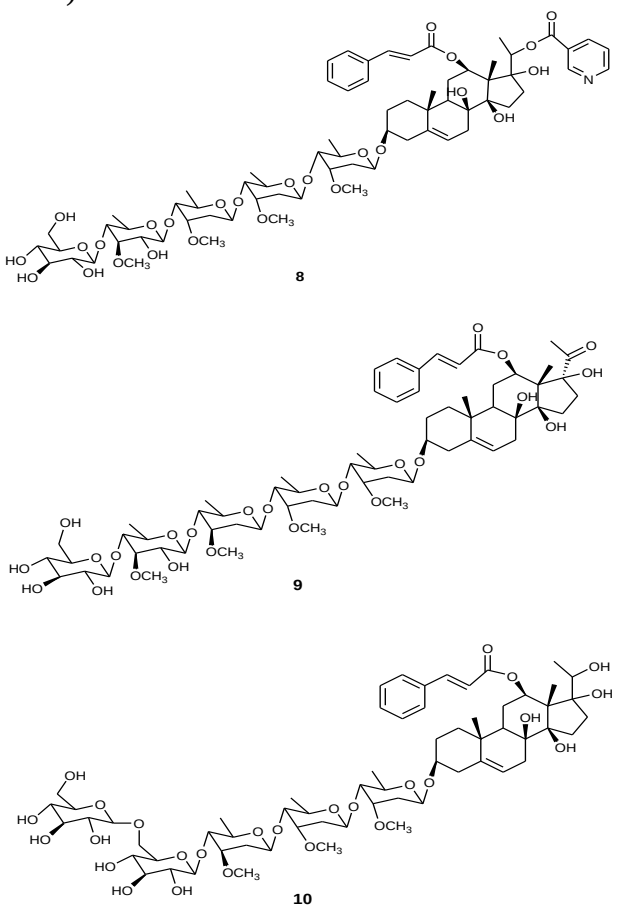


Figure 2: Chemical Structures of compounds isolated from *L. pyrotechnica* (Continued)

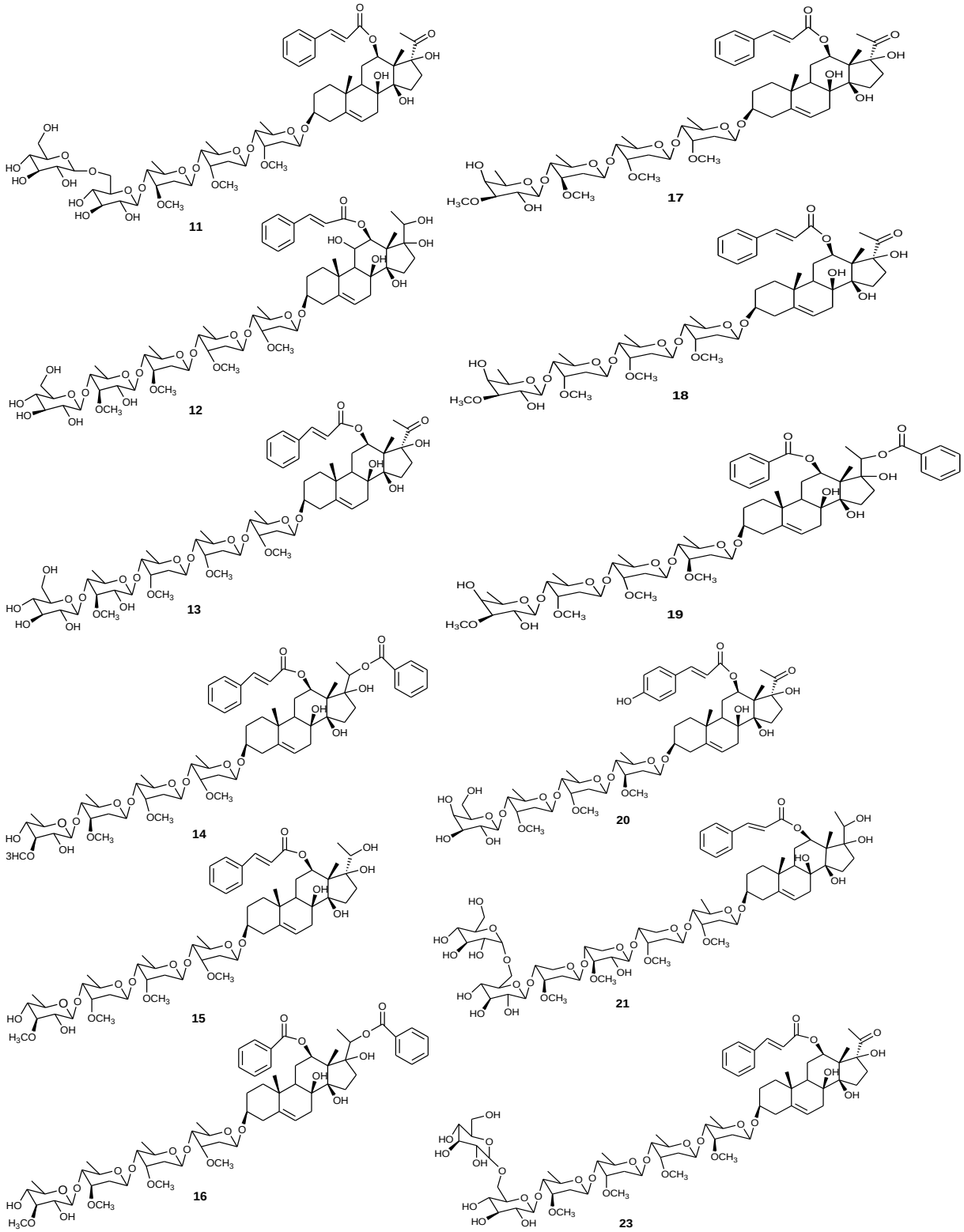


Figure 2: Chemical Structures of compounds isolated from *L. pyrotechnica* (Continued)

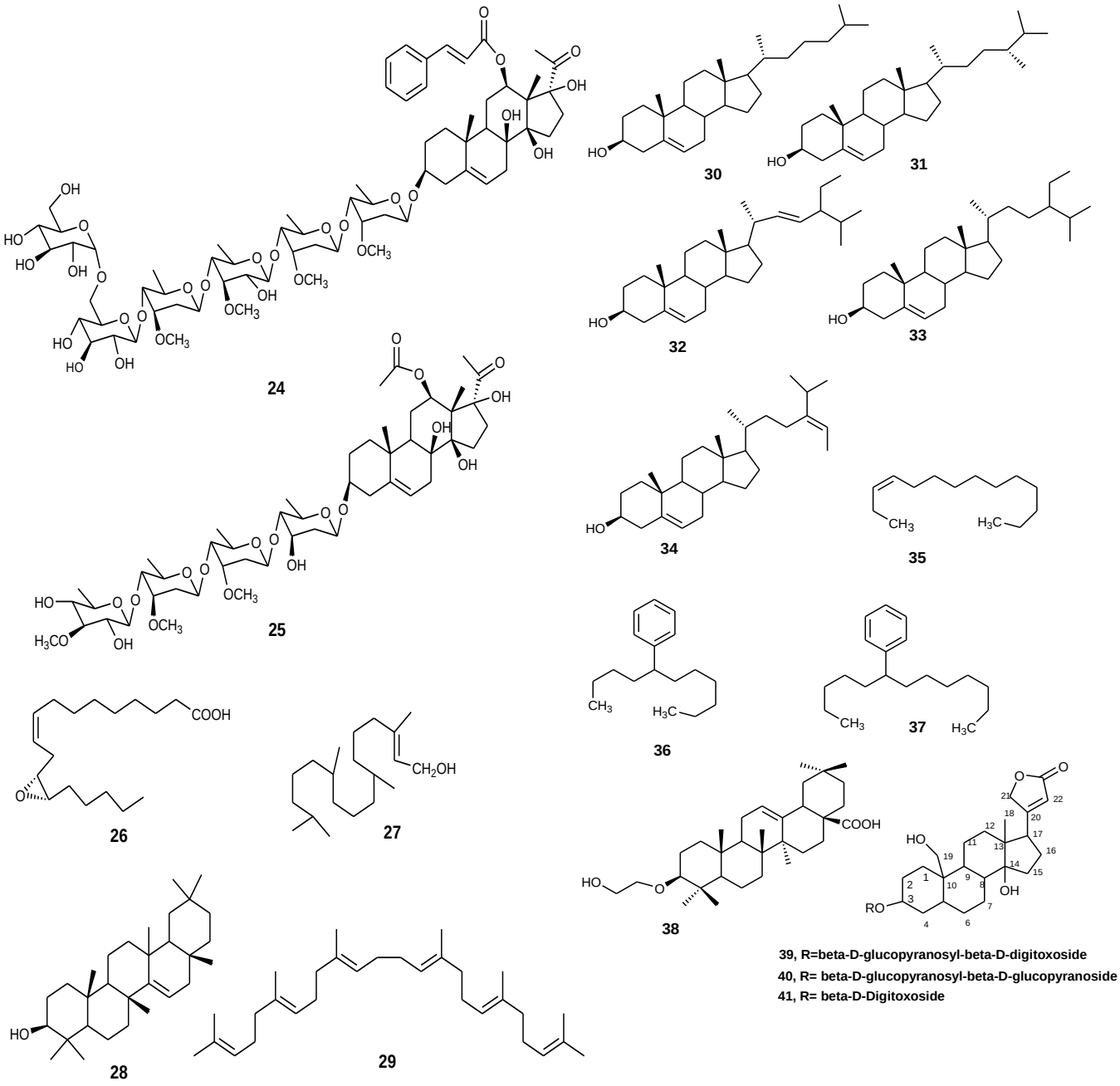


Figure 2: Chemical Structures of compounds isolated from *L. pyrotechnica*

The ethanolic extract of aerial parts of *L. pyrotechnica* proved to be effective when tested for anti-oxidant and anti-inflammatory activity. The extract produced significant reduction of carrageenan induced paw edema in rats and also showed good effects in acetic acid-induced ulcerative colitis in rats (Saleh *et al.*, 2011). Anti-oxidant, cytotoxic activity and anti-lipoxygenase of the aqueous ethanol extract of aerial parts of *L. pyrotechnica* were studied and polyphenolic

compounds with antioxidant properties were found in it. It was proved that there is a linear correlation between the antioxidant reducing capacity of plant extract and the total phenolic content and that the ethyl acetate portion showed comparatively better antioxidant properties. Higher lipoxygenase inhibitory activity (IC_{50} = 2.75µg/ml) was shown by the ethyl acetate fraction and crude ethanol extract. The higher cytotoxicity of *L. pyrotechnica* was due to the antioxidant property (Khasawneh*et al.,* 2011). Antibacterial activity of *Leptadenia pyrotechnica* roots and fruit extract was studied against two pathogens namely *Staphylococcus aureus* and *Staphylococcus epidermidis*. Agar-well diffusion assay method was adopted for this study while the solvents used for extraction were *n*-hexane, chloroform, acetone, ethyl alcohol, butanol, methanol and water. *Staphylococcus aureus* was found highly susceptible to all the solvent extracts. These parts of the plant effectively inhibited the growth of both the pathogens; however, root extracts showed a little more supremacy in this respect. The methanol extract of both parts produced the best results by inhibiting growth of both pathogens (Munazir*et al.,* 2012). The methanol extract of whole plant of *L. pyrotechnica* was evaluated for anthelmintic activity against *Pheretima posthuma*. It was concluded that it took less time to cause paralysis and death of *Pheretima posthuma* as compared to the standard drug. Consequently *L. pyrotechnica* possessed dose dependant anthelmintic activity (50 and 100 mg/kg) (kumar*et al*., 2011). *n*-Hexane, ethylacetate, methanol and aqueous extracts of leaves of *L. pyrotechnica* were subjected to antifungal assay against *Aspergillus flavus, Aspergillus niger, Fusarium oxysporium* and *Fusarium moniliformis* using disc diffusion method. *n*-Hexane and ethyl acetate extracts exhibited maximum activity against *Aspergillus niger* with inhibition zones 15mm and 12.2 mm respectively. Methanol extract showed maximum activity against *Fusarium oxysporium* and *Aspergillus flavus* with inhibition zones 13.0mm and 15mm respectively while aqueous extract showed maximum activity against *Fusarium moniliformis*with inhibition zone 9.6mm (Rekha *et al*., 2013). Antibacterial assay was done on dichloromethane, methanol and aqueous extract of whole plant of *L. pyrotechnica*. The methanol extract showed maximum antimicrobial effect against *Staphylococcus aureus* (15mm), *Bacillus subtilis* (10mm) and *Pseudomonas aeruginosa* (10mm). Dichloromethane inhibition zone for *S. aureus* was 10mm and *B. subtilis* 8 mm while aqueous extract only inhibited *S. aureus* with inhibition zone 8mm (Al-Fatimi *et al*., 2007).

Traditional Uses: *Leptadenia pyrotechnica* is traditionally used for different purposes. In Pakistan a stem decoction is taken as antihistaminic and an expectorant while in India it is used to treat gout and rheumatism. In Yemen crushed stems are applied to wounds to stop bleeding. An infusion of the aerial parts is taken as a diuretic to treat kidney disorders. Twigs are macerated and the liquid is taken to treat urinary retention. Infusion of the whole plant mixed with butter milk is given for Uterine prolapse and stomach disorders. All parts of *L. pyrotechnica* are used in folk remedies to cure skin, Musculo/skeleton and gynecological disorder. The smoke of the burnt plant is used to treat headache in Pakistan while rheumatism in Sudan. The plant sap is applied on skin to treat smallpox, psoriasis, eczema and dermatitis (Gulshan *et al.,* 2012; Schmeizer&Gurib-fakim, 2013; Niaz *et al.*, 2013; Verma *et al.,* 2014). The juice of the leaves is traditionally used for treatment of asthma, rheumatism and infantile diarrhea. To remove thorn, leaf paste is prepared and applied over the thorn injury (Gulshan *et al*., 2012; Verma *et al.*, 2014). The fruits and stem decoction is used to treat earache and chronic renal problems. It is also used as carminative and purgative (Ahmad *et al*., 2014). The roots are used for the treatment of asthma, constipation and stomach complaints. Roots are also used to treat sterility, to prevent spontaneous abortion and as a diuretic to treat venereal diseases. The root bark mixed with

cow's milk is used as purgative (Gulshan *et al*., 2012; Schmeizer&Gurib-fakim, 2013).

Conclusion

Plants are the potential source of medicinal agents and are a major part of the traditional healing systems all over the world. In different parts of the world, researchers are investigating the bioactive ingredients present in medicinal plants which are responsible for the pharmacological activities. *Leptadenia pyrotechnica* has got the potential so further studies are needed to evaluate its medicinal importance and their outcome might be helpful to make use of some of its bioactive ingredients in modern medicine.

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