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Ethnomedicinal Potential of *Salvia moorcroftiana* Wall. ex Benth (Kallijari): a Threatened Medicinal plant of Himalayas: A Comprehensive review

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ABSTRACT: *Salvia moorcroftiana* Wall. ex Benth. Commonly known as "Kallijari" is one of the important salvia species of Himalayas. It belongs to the family *Lamiaceae.* Plants of this species are common in temperate zone of the Himalayas occurring at altitudes between 5000-9000 feet. Traditionally the leaves of *Salvia moorcroftiana* are used against itching, guinea worm infection and in the form of poultice to wounds while the seeds and roots are used in colic, cough, haemorrhoids, dysentery and boils. *Salvia moorcroftiana* is rich in flavonoid *Salvia moorcroftiana* Wall. ex Benth. The plant has antibacterial, antifungal, analgesic, antipyretic, anti-inflammatory and anticancer properties. *Salvia moorcroftiana* is one of the endangered medicinal plants of Himalayas. It has been put under critically endangered species, requiring high priority conservation. In this review we have tried to summarise all the phytochemical, pharmacological and toxicological properties of *Salvia moorcroftiana.*

Keywords: *Salvia moorcroftiana,* Antibacterial, Antifungal, Analgesic, Antipyretic, Anticancer.

I. INTRODUCTION

From time immemorial human civilization is dependent on plants and their products for curing diseases. As an estimate, about one fourth of drugs in practice have been derived from plants and more than 125 compounds of compounds that are in use have been derived from medicinal plants. More than 11% of the essential drugs designated by WHO are of plant origin. In India significant population is using medicinal plants and it is estimated that more than 80% of population is using medicinal plants [1].

Genus *salvia* (family: *Lamiaceae* comprises of more than 900 species [2]. This Genus is widely distributed in temperate and tropical regions of world particularly Europe, Asia and America. In India *Salvia moorcroftiana* Wall. ex Benth. generally known as "Kallijari". The genus is prevalent in North-western Himalayan regions ranging from Kashmir to Kumaun hills of Uttarakhand state of India.

Fig. 1. *Salvia moorcroftiana* Wall. ex Benth.

II. TAXONOMIC CLASSIFICATION

Kingdom	Plantae
Phylum	Tracheophyta
Class	Magnoliopsida
Order	Lamiales
Family	Lamiaceae
Genus	Salvia
Species	*Salvia moorcroftiana* Wall. ex Benth

III. BOTANICAL DESCRIPTION

The height of Salvia moorcroftiana is 2-3 feet approximately. It grows in sloppy areas at a height of 1600-3000 metres above mean sea level. The leaves of the plant are long and the margins are toothed. Flowers are hairy and green veins are predominant over them [4].

IV. TRADITIONAL USE

The plant *Salvia moorcroftiana* is having significant traditional use throughout the world particularly in respiratory tract infections like asthma, inflammation of bronchioles, infections of mouth and throat, cough etc. Besides these the plant is also used in various skin disorders, digestive disorders and CNS disorders like depression [5, 6]. Some species also exhibit antidiabetic, antitumor, antibacterial and antioxidant properties [7-10]. *Salvia moorcroftiana* is rich in essential oils. The paste of leaves of this plant is used in

itching and also for the treatment of wounds. The seeds and roots are used in GI disorders like colic and dysentery [11].

V. PHYTOCHEMISTRY

Salvia is rich in polyphenols and more than 150 polyphenols have been isolated from it. Besides this several polyphenols have been synthesized using caffeic acid in various condensation reactions [12]. The plant is also rich in flavonoids like genkwanin 4′-*O*-α-L-arbinopyranosyl-(1→6)-β-D-galactopyranoside, genkwanin 4′-*O*-{α-L-rhamnopyranosyl-(1→2)-[α-L-rhamnopyranosyl-(1→6)]-β-D-galactopyranoside, genkwanin 4′-[*O*-*α*-L-rhamnopyranosyl-(1→2)-*β*-D-galactopyranoside, genkwanin 4′-[*O*-*α*-L-arabinopyranosyl-(1→3)-*α*-L-rhamnopyranoside,4-hydroxy-2-isopropyl-5-methylphenyl *O*-*α*-L-rhamnopyranosyl-(1→2)-*β*-D-glucopyranoside and nonyl 4-hydroxybenzoate [13,14]. The leaves and flowers of *Salvia moorcroftiana* Wall ex Benth plant are rich in mono-sesquiterpenoids. The flowers of this plant contains 95% of the total terpenoids. Approximately 70% of terpenoids are monoterpene hydrocarbons followed by (Z)-β-ocimene (55%), followed by sabinene (11%), and β-caryophyllene (10%). Sesquiterpene hydrocarbons are predominant in leaves accounting approximately 90%. The principal components present are β-caryophyllene (52%) followed by germacrene D (19%), followed by bicyclogermacrene (7%), α-humulene (5%) and α-copaene (3.0%)[15].

VI. BIOLOGICAL ACTIVITIES

On the basis of various bioassays like lemna bioassay, brine shrimp test and anthelmintic and antibacterial properties, it was found that crude acetone extract of aerial parts of *Salvia moorcraftiana* Wall possess strong phytotoxicity activity against *Lemna aequinoctials* [16].

VII. PHARMACOLOGICAL ACTIVITIES

Antifungal activity: Crude acetone extract of aerial parts of *Salvia moorcraftiana* Wall did not showed activity against various human pathogens like *Trichophyton* spp, *Candida* spp and *Aspergillus* spp, while it showed a moderate activity against animal pathogens like *Microsporum* spp. *in dogs* and *Trichophytton* spp. and plant pathogens *Macrophomina* and *Fusarium* spp. Highest activity was reported against *Fusarium oxyporum*, which is a plant pathogen [16].

α-glucosidase inhibition activity: α-glucosidase enzyme has a great role in preventing non-insulin dependent diabetes mellitus (NIDDM).This enzyme is responsible for cleaving glucose from oligosaccharides and disaccharides. So, inhibition of this enzyme prolongs carbohydrate digestion and reduce glucose absorption rate. Compound 3 and 8 isolated from *Salvia moorcraftiana* Wall are potential inhibitors of α-glucosidase enzyme [16].

Analgesic, Antipyretic and Anti-inflammatory activity: Aqua-methanolic extracts of *Salvia moorcroftiana* showed significant analgesic activity when tested by Hot plate, flick tail and acetic acid induced writhing tests, it showed significant antipyretic activity when tested by Brewer's induced pyrexia and it also showed significant anti-inflammatory activity when tested by carageenan-induced mice paw edema test [17].

Anticancer activity: Anticancer activity was tested against A549 and MDA-MB-231 cell lines. Ethanolic extract of *Salvia moorcroftiana* roots showed concentration and time-dependent inhibition of proliferation against A549 and MDA-MB-231 cell lines with IC50 values of 129.32 µg/ml and 118.12 µg/ml, respectively. Apoptotic transformations were also observed in these cell lines. In expression studies higher caspase 3 and 9 and Bax expression observed and lower Bcl-2 expression was seen. Western blotting and transmission electron microscopy revealed formation of autophagosomes showing autophagy as revealed by high expression of LC3B-I and LC3B-II in A549 and MDA-MB-231. The decrease in reactive oxygen species in A549 and MDA-MB-231 cells indicating decrease in oxidative stress by ethanolic extract of *Salvia moorcroftiana* was seen in DCFH-DA staining [18].

VIII. CONCLUSION

Salvia moorcroftiana is an important species of genus salvus. *Salvia moorcroftiana* has been put under threatened plant list of IUCN. In our review we found that a very little work has been done to pharmacologically validate its traditional uses. Indiscriminate exploitation has put this plant under threat. There is dire need to pharmacologically validate the properties of this plant and to save this plant from extinction which is possible only by preventing its exploitation and by using modern techniques like cryopreservation of gene banks.

Conflict of Interest. The authors declare no conflict of interest.

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