

Updates on Ethnomedicinal Uses and Biological Activities of *Genus Ruellia*

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ABSTRACT

Ruellia is the genus of flowering plant comprising about 250 species, commonly called as wild pitunias. Some of the members of this genus are medicinally important and are being used traditionally to cure several ailments by tribals and local peoples. Present article deals with the discussion of various traditional uses and biological activities of members of genus *Ruellia*, reported by several scientists. These plants showed diuretic, anti-diabetic, antipyretic, analgesic, antioxidant, gastroprotective, antimicrobial, antifertility, anti-inflammatory, antinoceptive, antiulcer, cytotoxic and anticancer properties. Several members of genus *Ruellia* have traditional medicinal values and most of them are explored for their biological properties. However, the bioactive molecules of these plants are yet to be investigated fully. Some of these plants could prove significant source of medicinal potential molecules as drug candidate.

Keywords: *Ruellia*, ethnomedicinal uses, biological activities.

INTRODUCTION

Since civilization, humans are using plants and plant products for their various needs includes routine healthcare. As plants possess healing properties, they are being used as traditional medicinal plants across the globe, especially by different tribes. Due to its unique phytogenographic and environmental conditions, Indian subcontinent supports the growth and development of over 20,000 flowering plants, of which about 7000 plants are reported to have medicinal potential and are being used by local medicine men in different native communities.

Now, it's a known fact that the properties of medicinal plants are due to their active secondary metabolites. The herbal era was started after the isolation of active compounds like digitoxin, quinine, cocain and codeine from different medicinal plants. The genus *Ruellia* belongs to family Acanthaceae (Acanthus family). The members of this genus are commonly known as wild petunias¹⁻². This genus consists of over 250 species, distributed in tropical and temperate regions of both the hemispheres including Indian subcontinent. *Ruellia* is represented by 10 species from India off which two were recorded from Maharashtra State³⁻⁶. Present review article is an update on the information related to folk medicinal uses, ethnobiology and phytochemical constituents from different members of genus *Ruellia* having medicinal potential.

MATERIAL AND METHODS

We conducted an online survey of literature in different online databases and professional websites with the key

words related to our study. Initially we have searched for the ethnomedicinal uses of different members of *Ruellia* recorded by various ethno-botanists across the globe. Later we search for experimentally proven biological activities of various species of *Ruellia*. Then the data collected was interpreted in the light of recent researchers and compiled to prepare this review.

RESULTS AND DISCUSSION

Ethnomedicinal uses of members of Genus *Ruellia*

Ruellia is one of the most under rated medicinal plant genus of Acanthaceae. Some species of *Ruellia* are being used in traditional medicine preparations by different communities and also been part of Ayurveda and Ayush systems in India. The fresh leaves of the plant *Ruellia patula* is been use in earache⁷. One of the species, *R. tuberosa* has been extensively used as diuretic, anti-diabetic, antipyretic, analgesic, antioxidant⁸, to treat gonorrhoea, anti-hypertensive and gastroprotective⁹⁻¹⁰. Most of the plant species of *Ruellia* has been widely used as anti-diabetic, antipyretic, gastroprotective, antimicrobial, analgesic, anti-oxidant and anticancer against the epidermis of nasopharynx region¹¹. *Ruellia asperula* is used in bronchitis, asthma, flu, fever and uterus inflammation¹². The leaves of *R. prostrata* are being used in the treatment of chronic rheumatism, eczema, facial paralysis, cephalgia and hemiplegia; its leaf juice is an efficient remedy on colic infection in children¹³. *R. brittoniana* is being used for cardiovascular screening and also as antioxidant plant¹⁴. Choudhary¹⁵ has documented the use of *R. patula* to cure bone fracture (stem decoction with cow milk),

wound healer (leaf paste for external application) and antidote against snake bite (leaf chewing) from tribal belt of Rajasthan, India.

Biological activities of members of Genus *Ruellia*

Antimicrobial activity

The chloroform, ethyl acetate, alcohol and aqueous extracts of the whole plant of *R. tuberosa* showed significant antibacterial properties. The aqueous extract exhibited less activity against fungal organisms¹⁶. The antibacterial activities of n-hexane, dichloromethane, ethyl acetate and methanol extracts of *R. tuberosa* were explored against Gram positive and Gram negative bacteria. The ethyl acetate and methanol fractions exhibited the highest rates of antibacterial activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa*¹⁷.

Kader *et al.*¹⁸ demonstrated the antimicrobial effect of leaf extract of *R. tuberosa* indicating methanolic extract was having highest antimicrobial potential. The methanol leaf extract showed significant antibacterial activity against *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, *Bacillus subtilis*, *Proteus mirabilis* and antifungal activity against *Aspergillus sp.*, *Mucor sp.*, *Penicillium sp.* and *Fusarium sp.* Similar report was made by Senthilkumar *et al.*¹⁹ indicating the potential antimicrobial activity of methanolic extract of *R. tuberosa*. The report of Than and Maw²⁰ also support above discussion.

Antioxidant activity

The antioxidant activity of different extracts of stem of *Ruellia tuberosa* were investigated by various in vitro methods like 2,2-diphenyl-1-picrylhydrazyl (DPPH), free radical-scavenging assays and the hydrogen peroxide induced luminol chemiluminescence assay. The results revealed that *R. tuberosa* possesses potent antioxidant activity⁸. These finding further supported by few other workers²¹⁻²²; these reports indicate that leaf extracts of *R. tuberosa* has high antioxidant potential. Roopa *et al.*²³ studied the antioxidant potential of different organic extracts of *R. tuberosa* and stated that n-butanol extract has comparatively higher antioxidant activity. Krishna *et al.*²⁴ also presented similar report that extract of *R. tuberosa* having antioxidant property. Some other workers also reported the antioxidant potential of *R. tuberosa*²⁵.

Khachitpongpanit *et al.*²⁶ demonstrated that *R. tuberosa* leave extract had high potential to scavenge DPPH and nitric oxide radicals. Safitri *et al.*²⁷⁻²⁸ also given the experimental proof of anti-oxidant activity of hydroalcoholic and aqueous extract of *R. tuberosa*. Similar reports were made by Elgindi *et al.*,²⁹ on *R. brittoniana* and Kalaiselvi *et al.*³⁰ on *R. prostrata*. As per the report of Samy *et al.*³¹ from the five isolated compounds of *R. patula*, one compound showed high DPPH radical scavenging activities (with IC₅₀ value of $14.3 \pm 1.10 \mu\text{M}$), while other four compounds exhibited a moderate activity (with an IC₅₀ value of 37.5 ± 2.20 , 31.9 ± 3.35 , 31.7 ± 2.47 and $19.4 \pm 2.59 \mu\text{M}$, respectively). On the other hand, EtOAc fraction of *R. patula* displayed activity with IC₅₀ $25.5 \pm 2.29 \mu\text{g/ml}$

compared with the standard trolox 16.7 ± 1.86 . Wangia *et al.*³² demonstrated that methanolic extract of *R. linearibractiolata* and *R. bignoniiflora*. He also reported the antioxidant activity of aqueous and organic extracts of Kenian *Ruellia prostrata*³³.

In 2017, Ahmad *et al.*³⁴ isolated and characterized as methoxylated flavonoid on the basis of spectral data including UV, IR, GC-MS, and NMR and also demonstrated that isolated compound have DPPH free radical scavenging activity. Tejaputri *et al.*³⁵ reported that the organic extracts of *Ruellia brittoniana* flowers has significant antioxidant activity where ethyl acetate extract seems to be more promising. Similarly, Piers *et al.*³⁶ showed that the ethanol extract of *R. angustiflora* consists of phenolics and flavonoids and possesses significant antioxidant activity.

Cytotoxicity and Anticancer activity

Active compounds isolated from *R. tuberosa* showed cytotoxicity in-vitro against KB cell line and HepG2 cell line³⁷. Methanol extract of aerial part of *R. tuberosa* possessed cytotoxicity in H460 and MDAMB231 cancer cells, respectively³⁸. Anticancer activity of only *R. tuberosa* is reported so far. Arun *et al.*³⁹ showed that methanol extract of aerial part of herb *R. tuberosa* possessed cytotoxicity. Its minimum inhibitory concentration (IC₅₀) for methanol extract was found to be 3.5 and 1.9 $\mu\text{g/ml}$ in H460 and MDAMB231 cancer cells, respectively. They have also isolated Tylocrebrine from *R. tuberosa* through bioassay directed column chromatography and elucidated its anticancer and anti-inflammatory potential. Similar report was also made by Nagarjuna *et al.*⁴⁰ indicating anticancer activity of *R. tuberosa* extract. Similarly Samy *et al.*³¹ reported that methanolic extract, n-hexane and EtOAc fractions of *R. patula*, and MeOH extract, n-hexane and EtOAc fractions of *R. tuberosa* exhibited significant cytotoxic activity at a concentration of 100 μM ($\mu\text{g/ml}$) against human lung cancer cell lines A459.

Anti-ulcer activity, Anti-noceptive and anti-inflammatory activity

Shrikumar and Parthasarathi⁴¹ showed that ethyl acetate extract of *Ruellia tuberosa* has anti-ulcer property. As the economic cooperation and development guidelines, they have selected two doses 250 mg/kg (low dose) and 500 mg/kg (high dose) and Ranitidine as the standard drug (20 mg/kg). The ethyl acetate extract showed significant decrease in gastric volume, total acidity and free acidity. There was a significant ($p < 0.01$) increase in gastric pH only at high dose (500 mg/kg), when compared to control group. They further stated that the value of ulcer index decreased in a dose dependent manner, when compared to control group.

The ethanol extract of *R. tuberosa* was evaluated for its antinociceptive and anti-inflammatory properties in experimental mice and rat models. In the hot plate test, the group that received a dose of 300 mg/kg for mice showed maximum time needed for the response against thermal stimuli and maximum possible analgesic was similar to that of diclofenac sodium. The extract at 500

and 250 mg/kg doses showed significant reduction in acetic acid-induced writhing in mice, which was similar to diclofenac sodium. The extract also demonstrated significant inhibition in serotonin and egg albumin-induced hind paw edema in rats at the doses of 100, 200 and 300 mg/kg⁴². The anti-inflammatory properties exhibited by the extract were comparable to that of indomethacin at a dose of 5 mg/kg⁴². *R. brittoniana* and *R. tuberosa* were reported with significant anti-inflammatory potential^{29,43}.

Antispermatic activity and antifertility action

The aqueous extract of *R. prostrata* had a 40% antifertility action in female rats at a dose of 500 mg/kg, and the aqueous and petroleum ether extracts at a dose of 100 mg/kg had a 20% antifertility action⁴³. Aqueous extract of tuberous roots of *Ruellia tuberosa* administered orally at the dose of 50, 100 and 150 mg/kg body weight for 21 days resulted in significantly decreased sperm count in male albino rats. The results suggested that the aqueous extract of *R. tuberosa* produces antispermatic effect in male albino rats⁴⁴.

Antidiabetic, antihyperlipidemic and hepatoprotective activity

As per the report of Rajan *et al.*¹³ the methanol extract of *Ruellia tuberosa* leaves at a dose of 100 and 200 mg/kg of body weight was administered at single dose per day to diabetes-induced rats for a period of 14 days. They observed that the methanol extract of *R. tuberosa* leaves elicited significant reductions of blood glucose ($p < 0.05$), lipid parameters except HDL-C, serum enzymes and significantly increased HDL-C at the dose of 200 mg/kg when compared with the standard drug glibenclamide (5 g/kg). From this they concluded that methanol extract of *R. tuberosa* leaves possesses significant antidiabetic, antihyperlipidemic and hepatoprotective effects in alloxan-induced diabetic rats. Ullah *et al.*²¹ also studied the hyperglycemic activity of different organic extracts of *R. tuberosa*. They reported that ethyl acetate fraction (100 mg/kg) showed the highest anti-diabetic activity with $34.31 \pm 0.43\%$. The *in silico* anti-diabetic activity of aqueous extract of *R. tuberosa* was shown by Safitri *et al.*²⁷ and its *in vitro* proof was given by Roosdiana *et al.*⁴⁵. The *in vitro* anti-diabetic potential of leaf extract of *R. prostrata* was confirmed through α -amylase and α -glucosidase inhibition methods⁴⁶.

Gastroprotective and analgesic activity

Aqueous extract of *R. tuberosa* roots showed a dose-dependent and robust gastroprotective activity in an alcohol induced gastric lesion model of rats. The extract also had mild erythropoietic and moderate analgesic activities and was well tolerated even with subchronic treatment⁴⁷. Similar report was made by Roopa *et al.*²³ on aqueous extract of *R. tuberosa* showing gastroprotective and analgesic activity.

Other biological activities

In pharmacological investigation, extracts of *R. brittoniana* and *R. patula* were used for cardiovascular screening. In *in vivo* experiment, extracts of *R. brittoniana* and *R. patula* showed a hypertensive activity

in pentothal sodium anesthetized rats⁴⁸. Salah *et al.*⁴⁹ demonstrated purgative effect of organic and aqueous extract of *R. praetermissa* and also reported that *R. praetermissa* has direct influence on the uterine physiology during gestation in rats; the plant extract appears to activate the myometrial cells membrane muscarinic receptors resulting in a uterotonic effect by a mode of action possibly via the cholinergic system. They further stated that the extract is possibly acting by facilitating the synthesis of endogenous estradiol which influences the stimulation of the growth of the uterine endometrium.

Methanol extract of *R. tuberosa* was investigated on uterus and gestation by using 350 mg/kg/day and was found to increase the number of implantation¹³. This study demonstrated that estrogenic effect of *R. tuberosa* extract may be due to flavonoid and sterol while cholinergic effect may be due to iridoid glycoside. Samy *et al.*,³¹ reported anti-leishmanial activity of n-hexane fraction of *R. tuberosa*.

CONCLUSION

The presented work is emphasizing on medicinal uses of different members of genus *Ruellia* and their different biological activities studied by various scientists. The discussion indicates that many members are still to be worked out for their biological activities. Secondly, the important aspect is isolation of active phytoconstituents from these members as probable agent to develop drug against specific ailments.

Conflict of Interest: The authors have no conflict of interest.

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