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A Review on Secondary Metabolites of *Rosa laevigata* Michaux: An Important Medicinal Plant

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Abstract

Rosa laevigata is a white aromatic rose inhabitant to Southern China and Taiwan and growing offensively as invasive in the United States of America. It is herbaceous climbing shrub, growing over the other shrubs and reaching upto 5-10 metre in height. In 1780's, it gained its English name Cherokee rose from America. This review was aimed to analyze various active secondary metabolites of *Rosa laevigata* with their medicinal value. The study infers that plant possess novel secondary metabolites i.e., polysaccharides, flavonoids, steroids, tannins, laevigatins E, F, G, triterpenoids, 11α-hydroxytormentic acid, 2α-methoxyursolic acid, 6-methoxy-β-glucopyranosyl ester, tormentic acid and 5α-diol 3-*O*-β-D-glucopyranoside with their antibacterial, anticancer, astringent, depurative and anti-inflammatory activities. A profound efforts has been done in past to address the active secondary metabolites, but still consistent struggles are required to explore the volatile compounds present in *Rosa laevigata* and their medicinal and therapeutic values should be investigated in future.

Keywords: Secondary metabolites; Laevigatins; Triterpenoids; Anti-inflammatory; Hepatoprotective

Introduction

Plants are considered as an essential component of global sustainability due to different ecosystem services of plants like provision of fuel, food, medicine, shelter, condiments, aromas and perfumes. Plants control the atmosphere, preserve hydrological cycle, feed the animals and provide raw materials for pharmaceutical and scientific purposes. Plants have been the basis for life saving drugs for medical treatment in human history and medicinal plants are the most exclusive source for the majority of the world's population and the use of plants as a medicine is as old as human civilization. The connection between man and his search for plant derived drugs from nature continue to the far past, of which clearly evidenced from various sources: preserved monuments, written documents, and even original plant medicines practiced now a day's also. The knowledge of the development of ideas and evolution of awareness related to the usage of medicinal plants in traditional healthcare systems is a result of the many years of struggles against diseases due to which man learned to use plant mediated drugs from roots, leaves, barks , seeds, fruit bodies, and other parts of the plants.

Origin of *Rosa laevigata*

Rosa laevigata commonly known as Cherokee rose belongs to family Rosaceae. It is native to Southern China. Its fruit is eatable and extensively consumed in China as a ingredient of some Traditional Chinese Medicines (TCM), and its leaves are broadly utilize to cure burns, skin tumors and ulcers [1,2].

Distribution of *Rosa laevigata*

Rosa laevigata is an evergreen a perennial plant having erected stem reaching up to a height of about 10 feet. It is widely dispersed in deciduous forests. It is native to China but also found in Asia and Australia. In Australia, it is known as sleeper weed due to its smaller height. This species is highly valuable because of its medicinal properties [3,4].

Taxonomic classification of *Rosa laevigate*

Morphology description of *Rosa laevigata*: The plant is evergreen

Figure 1: (a) Stomata of diploid plant (b) Stomata of tetraploid (c) Comparison of leaves between diploid and tetraploid (d) Comparison of leaves between diploid and tetraploid (e) Comparison of leaves between diploid and tetraploid (f) Comparison of leaves between diploid and tetraploid (g) Bud of diploid and tetraploid (h) Flower of diploid and tetraploid (i) Germination of pollen grains from tetraploid (j) Comparison of plants[17].

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scented perennial shrub with height about 6m (20 feet). It has vine growth habit. Its leaves are smooth and bright lustrous green. Its flowering season is June to July. Aromatic flowers with pure white petals and stamens are yellow [1,5] (Figure 1 and Table 1).

Harvest period of *Rosa laevigata*: *R. laevigata* is harvested in two periods; the first is when it matures, and the second is when it is to some extent yellow but not yet ripe [1].

Medicinal properties of *Rosa laevigata:* *R. laevigata* have been recorded as source of traditional Chinese folk medicines and the roots were commonly used for the treatment of seminal weakness, uterine prolapse, urinary incontinence, menstrual problems, diarrhea, joints pain, external injury, burn injury, toothache and stomach pain [1,2,6]. Its fruits are commonly used as kidney tonic to decrease urination and curing leucorrhea. According to the Chinese Pharmacopoeia, *R. laevigata* fruit possess anti-uretic and astringent properties. When it ripe and red, it tastes sweet and loses its medicinal value. Therefore, it should be harvested when it is partly yellow or still un-ripened [7] (Figure 2).

Secondary metabolites of *Rosa laevigata*: Secondary metabolites are those metabolites which are formed in a period of successive growth, have no part in growth and development but necessary for survival of a plant species, and have remarkable structural orientation and biological actions. They are synthesized by exclusive biosynthetic pathway from primary metabolites and intermediates. Plants produce as amazing diversity of low molecular weight compounds. From 400,000 – 500,000 plant species around the globe, only few are phytochemically investigated. Secondary metabolites are frequently produced at chief levels during an evolution from active expansion to immobile phase. The plant can grow in the lack of secondary metabolites, suggesting that secondary metabolism is not necessary for short term survival. From another aspect secondary metabolism characterizes as an integral part of cellular metabolism, it depends on primary metabolism to provide the necessary substrates, enzymes and energy contributes to the long lasting survival of the plant [8]. Many active secondary metabolites with unique structural properties including anti-fungal and anti- inflammatory triterpenoids, 12 hepatoprotective flavonoids, 8–11 astringent tannins and anti-cancer polysaccharides was separated earlier [9]. Laevigatins E, F, G, 11α-hydroxytormentic acid, 2α-methoxyursolic acid, loliolide, 6, 7-diethylmalate, diethoxycoumarin have been reported from *R. laevigata* and a few studies have been explored on the cyclic changes in flavones and polysaccharides that are its non-volatile components [10-17].

Kingdom	Plantae
Sub-kingdom	Tracheobionta
Super-division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Rosidae
Order	Rosales
Family	Rosaceae
Genus	*Rosa L.*
Species	*Rosa laevigata Michaux*

Table 1: Taxonomic hierarchy of *Rosa laevigata* [4].

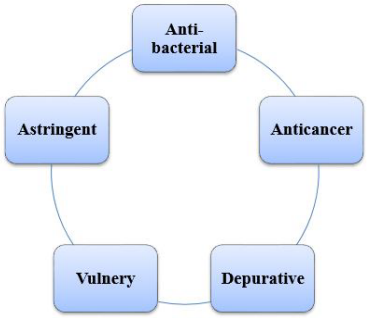

Figure 2: Medicinal uses of *Rosa laevigate*.

Secondary metabolites, which are extremely dynamic in different time of enlargement of a medicinal plant, directly manipulate their therapeutic effects [18]. Hence, the cyclic changes in secondary metabolites of *R. laevigata* have been fully studied for proper harvesting. Along with these some studies on the frequent changes in its non-volatile components (such as flavones and polysaccharides) have also been done [5,10-12,19].

Phytochemical analysis of *R. laevigata*: Earlier studies on phytochemical analysis in various parts of *R. laevigata* have exposed the presence of steroids, flavonoids, pentacyclic triterpenoids tannins, polysaccharides and ligands in this plant. Previous data on *R. laevigata* inferred that more focus was payed on the fruits, and just five triterpenoids were extracted from roots. Its root bark contains tannins [20].

From the roots of *R. laevigata* two chief types of phyto-compounds that are flavonoids and terpenoids have been reported for their strong DPPH radical scavenging power. Chemical and biological functions of roots of *R. laevigata* enhance the sensible usage of this therapeutic shrub. Fruit of different members of this genus is an abundant source of minerals as well as vitamins, especially in vitamins A, C and E, flavonoids and fatty acids. Presence of fatty acids is usually unusual to this fruit but these reduce the incidence of cancer [20].

Chemical analysis of roots of *Rosa laevigata*: Chemical analysis on the roots of *R. laevigata* lead the separation of two new flavonoids e.g. guibourtacacidine 4-methyl ether and (+) catechin-8 acetic acid. Guibourtacacidine one known flavonoids together with seven known triterpenoids e.g. euscaphic acid, nigaichigoside, betulinic acid, kajiichigoside, rubuside, tomentic acid and rosamutin have also been explored [20].

Nutrients in *Rosa laevigata:* The *Rosa laevigata* contains important nutrients such as Citric acid¸ Laevigatin C, Laevigatin A, Laevigatin D, Laevigatin B, Laevigatin E, Laevigatin F, Laevigatin G, Oleanolic acid, Tannins, Ursolic acid and Malic acid etc. [21] (Figures 3-5).

Isolated compounds of *Rosa laevigata:* *R. laevigata* has been widely studied and more than 20 pentacyclic triterpenoids have been isolated from it along with tannins, polysaccharide, sterols and flavonoids

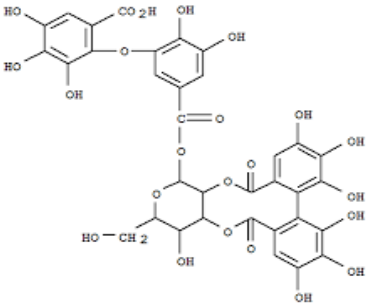

Figure 3: Laevigatin.

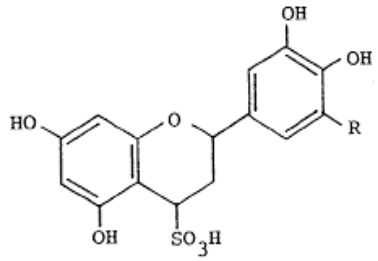

Figure 4: Tannins.

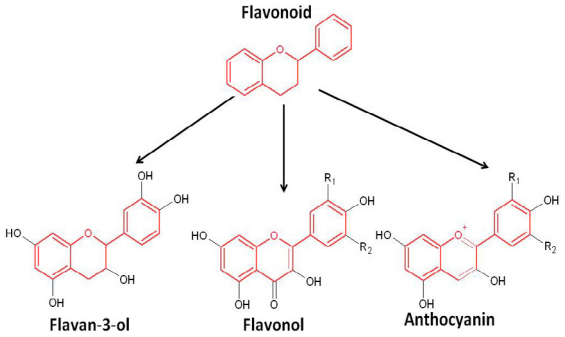

Figure 5: Flavonoids.

Plant Part	Uses
Roots	Emmenagogue
Leaves	Depurative
Root bark	Astringent
Dried fruits	Antibacterial, Carminative, Stomachic
Fresh fruits	Rich source of Vitamin - A, C and Flavanoids so act as anti-cancer.

Table 2: Plant parts (*Rosa laevigata*) along with their uses [23].

[22,23]. From *Rosa laevigata* some other important compounds were also isolated, among them few were obtained from the ethanolic extract and famous as 2 alpha, 3 beta, 19 alpha, 23-tetrahydroxyurs-12-en-28-oic acid, daucosterol, euscaphic acid and beta-sitosterol. The supplementary one was attained from the acetate emulsive layer of the petroleum ether [1] (Table 2).

Drawbacks of *Rosa laevigata*

A thin covering of hairs are found in the region of the seeds beneath the flesh of fruit. If these hairs are ingested, may cause pain to the oral cavity and digestive tract [24].

Future Recommendations

Although, this plant has been studied thoroughly but no profound work was found about the volatile components *R. laevigata*. So, it still needs more investigation regarding volatile compounds present in this plant [25].

Conclusion

Rosa laevigata is very important medicinal plant. Many important secondary metabolites are found in it which can be used as source of medicine for various diseases. Although, it is a well investigated plant but it still needs to investigate more in context of its medicinal and therapeutic value.

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