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Rauvolfia Serpentina: A Medicinal Plant of Exceptional Qualities

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Abstract

Rauvolfia Serpentina is a medicinal plant of exceptional medicinal properties. It is a major medicinal plant in Indian and Chinese traditional therapeutics. In India, the use of this herb is almost 3000 years old and was known as Sarpagandha. The root, stem, and leaf all contain the active ingredient which has got medicinal properties. It is a tropical shrub and the height ranges from 15 centimetres to 60 CMs. It is a flowering plant. The leaves are 7-10 cm long; the flower is white and violet in color. The medicinal properties are due to the various phytochemicals found in various parts of the plant. The root contains a maximum amount of these phytochemicals. They have been classified to six major categories based on their chemical structures and characteristics. These categories include carbohydrates, lipids, phenolics, terpenoids and alkaloids, and other nitrogen-containing compounds.

The chemistry and therapeutic use of various alkaloids found in R. Serpentina have been extensively investigated and authenticated. It has shown two main pharmacological actions i.e. lowering of Blood pressure and sedative actions. Successful clinical trials have been undertaken to establish its use in neuropsychiatry, gynaecological and geriatric disorders also. The therapeutic use of R Serpentina has been studied in mental disorders like Anxiety, schizophrenia, bipolar disorder, epilepsy, seizers, insomnia and sleep disorders. The results are encouraging and consistent whether the whole root, extract or alseroxylon is used. It is also used in the treatment of Diarrhoea, dysentery and gastrointestinal motility disorders. The roots are believed to stimulate uterine contraction and help in childbirth. It has shown the variable hypoglycaemic effect in diabetic patients. The present review aims to revisit its phytochemicals and to underline its therapeutic virtues.

Keywords: Rauvolfia Serpentina; Sarpagandha; Reserpine; Phytochemicals; Alkaloids; Hypertension; Mental disorders

Introduction

It is a plant the history of which is most fascinating. It has found its place in the literature of Charak, as early as 1000-800 B.C., who has mentioned it; by its Sanskrit name Sarpgandha. It was believed that snakes run away after finding the scent of this vegetation's. According to others, the root of this plant looks like a

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serpent, but both assumptions look unrealistic and unfounded. The more appropriate reason for this name is that it has got therapeutic values in the victims of snake bite. There is popular folklore and belief that before fighting with the cobra the mangos first chew its leaf to gain strength. There is also believe that it serves as an antidote when its leaves are grounded, made a paste and applied to the toes of snake bitten victim. It was also used as a medicinal cure for insanity and aptly named as pagal-ki-dava in India.

The generic name was given in the honour of a French Botanist and a well-known sixteenth-century German Physician, traveller and author Leonard Rauwolf of Augsburg.

The Characteristics of Plant

It is a tropical shrub. The height of the plant ranges from 6 inches to two feet. The plant belongs to the family Apocynaceae. It has got lengthy roots which goes deep in the soil and do not have branches. They are 3-7 inches long; lens-shaped and are clustered. The stem is covered with thick bark. The flowers usually appear in the winter months i.e. in November-December. They are in pink or white colours and are in clumps. The fruits are attached to the drupe type and are fleshy and small. Green fruits become purple black on ripening. They are cultivated in various parts of India, Bangladesh, China, Sri-lanka and Japan. For cultivation, it requires bio-rich acidic sandy soil. The temperature between 10 to 38 degrees is ideal for the growth of this plant. It is indigenous to Tropical Himalayas and plains. It also occurs in Assam and in south India Peninsula along the Ghats of Travancore and Kerala.

Figure 1: The plant of Rauvolfia Serpentina.

Figure 2: The roots of R. Serpentina.

Figure 3: The flowers and fruits of R. Serpentina.

The Phytochemical Constituents

The phytochemical is a broad term meaning plant (phyto) chemicals referring to a wide variety of compounds occurring naturally in the plant. They have been classified to six major categories based on their chemical structures and characteristics. These categories include carbohydrates, lipids, phenolics, terpenoids and alkaloids, and other nitrogen-containing compounds. The various phytochemical compounds or secondary metabolites found in R. Serpentina include alkaloids, phenols, tannins, and flavonoids.

Alkaloids

They are a large group of organic molecules which contain heterocyclic nitrogen ring. These are secondary metabolites and are supposed to be produced by the plant to defend against herbivores and pathogens. The various alkaloids identified in Rauvolfia include ajmaline, ajmelimine, ajmelicine,

rescinnamine, rescinnamidine, serpentine, serpentinine, and yohimbine etc [1,2]. The reserpine is the principal alkaloid which has got multiple clinical applications [3,4].

Reserpine

This is a pure single alkaloid extracted from the root of R Serpentina in 1952 [5]. It is the most prominent of all the alkaloids and is used mainly as a natural tranquilizer [6]. The antihypertensive properties of reserpine are due to its depressant action on the Central nervous system and peripheral nervous system. It prevents the normal storage of serotonin and catecholamine. It also interferes with functions of Autonomous nervous system by depleting catecholamine from the adrenergic neurons; it also activates the parasympathetic system. The overall effect is a reduction in blood pressure (antihypertensive properties), sedation and bradycardia [7].

Ajmeline

This alkaloid was first isolated in 1931 by Salimuzzaman Siddiqui from the roots of *R. Serpentina* plant. He named it Ajmaline in the honour of the illustrious practitioner of Unani medicine Hakim Ajmal Khan [8].

It is highly useful in "Brugada syndrome" and differentiating between subtypes of the disease. The Brugada syndrome is a rare autosomal dominant inherited disease. It is caused mainly by the mutation in the SCN5A gene which encodes the α-subunit of the voltage-gated Nav1.5, the cardiac sodium channel. Ajmaline is a sodium channel blocker which shows instant action when injected intravenously. This test is called "Ajmaline test" for the diagnosis of this type of arrhythmia [9]. The action of Ajmaline is similar to serpentine on blood pressure [10].

Ajmalicine

Besides having blood pressure lowering properties it restores normal cerebral blood flow by its action on smooth muscles. It is estimated that about 3500 K.G. of Ajmelicine is isolated from Rauvolfia every year [11].

Yohimbine

This alkaloid is mainly used in erectile dysfunction. It a selective Alfa blocker, relaxes the smooth muscles of the blood vessel wall, thereby it increases the blood flow to the penis [12,13]. The other pharmacologically useful alkaloids are Serpentine, Rescinnamine and Deserpidine.

Phenols

Phenols are secondary plant metabolites. Their presence prevents the growth of pest and pathogens in the plant. It shows significant antidiabetic and hypolipidaemic properties [14].

Tannin and flavonoids

Tannins have astringent properties and they hasten the healing of wounds and control inflammation. Flavonoids are potent water-soluble antioxidants and free radical scavengers. Thus they provide anti-inflammatory and anticancer activities [15].

The Rauvolfia plant contains a large amount of macro and micronutrients. It is rich in calcium and zinc. It is a good source of ascorbic acid, riboflavin, thiamine, and niacin [16].

R. Serpentina and medicinal use

Reserpine has been classified into one of its indole alkaloid. Its chemical formula is C33H40N209; it has the molecular mass of 609 g. and a bitter taste [17]. After ingestion, the bioavailability of reserpine is around 50%, and it is widely distributed throughout the body to brain, liver, spleen kidney and adipose tissues. It has been found in mother's milk and can cross the placenta and blood-brain barrier. Hepatic metabolism accounts for approximately 62% degradation of reserpine; it is eliminated through faecal and urinary route.

The chemistry and therapeutic use of various alkaloids found in R Serpentina have been extensively investigated and authenticated. It has shown two main pharmacological actions i.e. lowering of Blood pressure and sedative actions. Successful clinical trials have been undertaken to establish its use in neuropsychiatry, gynaecological and geriatric disorders also.

R Serpentina and Hypertension

The plant is reported to contain a large number of therapeutically useful indole alkaloids located in its root. In 1949, vakil reported the study of 50 patients of hypertension treated with R Serpentina. [18] In 1952 Vida in Germany and Australia reported the successful treatment of 25 patients of hypertension with R Serpentina [18]. In a review of the Cochrane database which included 4 Randomised controlled trials (RCTs)

shows, the effectiveness of reserpine in lowering the blood pressure of hypertensive patients. These TCTs compared the reserpine monotherapy to placebo or no treatment in the patients of hypertension. It also studied the safety profile of the drug. The investigators reached to a conclusion that it can be recommended as a primary antihypertensive drug. It has also been shown to produce a reduction in mortality [19].

Mental Disorders

The root of *R. Serpentina* is rich not only in alkaloids but also contains variable quantities of oleoresin, sterol, unsaturated alcohols, oleic acid, fumaric acid, oxymethylantheraquinone, and mineral salts. In all these, the oleoresin is an active ingredient which is responsible for sedative action of the plant. The therapeutic use of R Serpentina has been studied in mental disorders like Anxiety, schizophrenia, bipolar disorder, epilepsy, seizers, insomnia and sleep disorders. The results are encouraging and consistent whether the whole root, extract or alseroxylon is used [20,21]. It has shown to improve the quality of life and substantial reduction in pain in patients of migraine [22].

Miscellaneous Use

Cardiovascular diseases i.e. hypertension, arrhythmia [23]. The other effect includes respiratory inhibition, stimulation of peristalsis, myosis. It is also used in the treatment of Diarrhoea, dysentery and gastrointestinal motility disorders. The roots are believed to stimulate uterine contraction and help in childbirth. It has shown a variable hypoglycaemic effect in diabetic patients. The root bark of this plant is rich in compounds of β-carboline alkaloid family. This compound is reported to reduce tumor growth in mice inoculated with YC8 lymphoma cells or Ehrlich ascetic cells [24].

The extract of the plant has anti-prostate cancer activity both in vivo and in vitro studies; probably it is mediated through DNA damage and cell cycle control signalling pathways [25].

Conclusion

The plant of R Serpentina is a treasure house of medicinal and therapeutic utilities. Its potential use as antihypertensive, antiarrhythmic, antidepressant, antioxidant and anticancer has been studied thoroughly by various researchers and traditional healers. This the time to authenticate and standardized the various ingredients found in the plant of *R. Serpentina.*

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