# Standarization & Identification of Sarpgandha (*Rauwolfia serpentina* )

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**ABSTRACT**

*Sarpagandha* is an important *Ayurveda* drug used for treating many diseases including anxiety, insomnia, hyperactive people as well as antihypertensive effects. *Sarpagandha* is considered to be a later entry into Indian Materia Medica. *Rauvolfia serpentina* is the genuine source plant for *Sarpagandha* and it is a critically endangered species belonging to the family Apocynaceae. The root of *Rauvolfia serpentina* is the genuine source drug of *Sarpagandha*. *Sarpgandha* is mainly indicated in the *Ayurvedic* texts in *Vata rogas, Apasmara* and *Unmada*. It also acts as an antidote to poison.

**Keywords: -** *Sarpgandha, Rauwolfia serpentina*, Hypertension, Insomnia, *Unmada, Apasmara*.

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**Introduction:-**

*Rauvolfia serpentina* is a species of flowering plant in the family Apocynaceae. This genus is represented by 74 species along with many synonyms, which are distributed across the tropical countries of the world, and most of the species are native to Asian and African bio geographical regions. It is a perennial under shrub widely distributed in India in the sub Himalayan tracts up to

1,000 meters as well as, in the lower ranges of the Eastern and Western Ghats and in the Andamans.[1]

*Sarpagandha* (*Rauvolfia serpentina*) has been traditionally used for the treatment of hypertension and other neurological diseases in Ayurveda since last many years. The root gained popularity for its effect on hypertension in the recent years after its validation on hypertensive patients. Thus, primarily Rauvolfia was extracted and afterward reserpine was isolated with an objective of conventional and better effectiveness in the management of hypertension.[2]The name *Sarpgandha* was originated due to strong odor of *Sarpgandha* (*Rauwolfia serpentina*) the snakes won't stay near the plant and it acts as antidote for snake venom.[3]

*Sarpagandha* is used for the treatment of hypertension, insomnia, asthma, acute stomach ache and painful delivery and for mental illness such as neuropsychiatric disorders, psychosis, and schizophrenia. The useful part is root of *Rauvolfia serpentine*. It is also used in the treatment of snake-bite, insect stings, mental disorders, gastric tumor, general weakness, goiter, hysteria, insomnia, insanity, lipoma, paraplegia, paratyphoid, piles, pneumonia, splenomegaly, stomach disorder, tonsillitis, traumatic wound, tuberculosis, and vertigo.[4]

*Rauvolfia serpentina* is distinguished for the existence of indole alkaloids. 80 alkaloids are isolated from Rauvolfia species among them reserpine is most important principal active constituent. Reserpine is the most important of these alkaloids and is helpful in the management of hypertension, cardiovascular diseases, nervous disorders, and as a tranquilizing agent that is in immense demand by modern pharmaceutical industries.[5]

The plant is identified to produce an array of indole alkaloids such as reserpine, ajmaline, amalicine, etc. which show enormous pharmacological and biomedical connotation. Many Rauvolfia species such as *R. serpentina*, *R. tetraphylla*, *R. verticillata*, and *R. vomitoria* of this genus were extensively studied for their pharmacological activities, such as antimicrobial, antioxidant, antiprotozoal, antitrypanosomal, antipsychotic, cardioprotective, cholinesterase inhibitory, and hepatoprotective action.[1]

**Synonyms[2]**:- Sanskrit: *Nakuli*, *Chandrika*, *Chandramara*; English: Rauvolfia Root, Serpentina Root; Hindi: Chhotaa Chaand, Dhavalbaruaa

**Types/ Bheda (Varieties) of Sarpagandha[6]:-**

Some Vaidyas say Ishvara moola - *Aristolochia indica* Linn. as *Sarpaghandha*.

Raja Nighantu mentions *Ishvaramoola* as one of the synonyms of *Sarpagandha*.

Dhanwantari Nighantu [7]- 2 Types

1. *Nakuli- Rauwolfia serpentina* Benthex Kurz.

2. *Gandhanakuli - Ophiorhiza mungos* Linn.

Raj Nighantu [7]- 2 types

1. *Nakuli*

2. *Mahasugandha*

**Botanical name: - *Rauwolfia serpentina***

**Family**: - Apocynaceae.

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| Figure no. 1. *Sarpgandha* Plant | Figure no. 2 Sarpgandha Plant with Fruiting and flowering |

**Geographical (worldwide) distribution**

Among the multiple Rauvolfia spp., R. serpentina originated from South-East Asia and is distributed in the tropical regions of Africa and America, tropical Himalaya, India, Nepal, Myanmar, Sri Lanka, Indonesia and Malaysia. There are 131 species under the genus Rauvolfia but only five are found in India, which are R. serpentina Benth., R. beddomei Hook., R. densiflora Benth., R. micrantha Hook. and R. canescens L.. R. Serpentina grows along the lower hills of the Gangetic plains and the sub-Himalayan tracts, ranging from Shimla to Assam, Sikkim to Nepal and Bhutan. Being a plant that favours tropical climatic conditions, it mostly grows in soils that are rich in organic matter, with rainfall ranging from 200–250 cm. Also, it grows profusely in the areas all through Pune right down to Cochin and in the Western Ghats as well. It grows at altitudes ranging from the sea level to 1200 m, in moist and deciduous forests. It rarely flourishes deep inside the evergreen forests, with the exception being the forest edges. Rauvolfia has been reported to grow better where rainfall measures at least around 255 cm.[8]

**Botanical description**

According to the report of Rajbhandari (2001), the Rauvolfia plant is an erect, evergreen and perennial shrub that attains a height of about 60 to 90 cm (Fig. 2a). The leaves are 8–18 cm in length, 4–6 cm in width and borne in whorls of three to four. The leaves are lanceolate, acute, glabrous, bright green on the upper and pale on the underside (Fig. 2a). Stems are slender and unbranched and the roots are cylindrical. The taproot of a 2-year-old plant is 30–50 cm in length and 12–15 mm in diameter. Inflorescence is corymbose cymes type (Fig. 2a, b). Flowers are small, white with violet tinge, bisexual, actinomorphic and hypogynous (Fig. 2b). Calyx lobes are 1.3–3 mm long, esquamulose, deltoid to lanceolate in shape, acute at apex, often with 1 or 2 minute teeth on margin near the base, glabrous and bright red. Corolla is white with a violet tinge, 11–16-mm-long tube, salverform and slightly swollen at the location of anthers (Fig. 2b, c). Stamens are free, 3–5 mm long with very short filaments. Anthers are oblong, 1.3–1.4 mm long and thecae are rounded at the base and dehiscent at their full length. A single anther of R. micrantha holds ~ 1200 pollen grains (Rama Subbu et al. 2008). Pollen grains of R. serpentina are triangular in shape (Fig. 2e). Ovary is truncate, rounded, 1.2 mm long and glabrous (Fig. 2d, inset). Carpels unite at the base with two ovules suspended in each cell. Style is about 8 mm

long, membraneous, tunicate at the base and fringe-indusiate at the apex and the stigma contains two minute apiculi (Fig. 2d). The fruit is spherical in shape and is a drupe. The colour of the fruit varies from green to red and eventually to jet-black according to the maturity (Fig. 2f–h). Single seed occurs in each carpel that is oval, flattened, 6 mm long with copious and soft endocarp. Embryo is erect with aplanate cotyledons, which is 2 mm long and 1.8 mm broad. The placentation is axile type.[8]

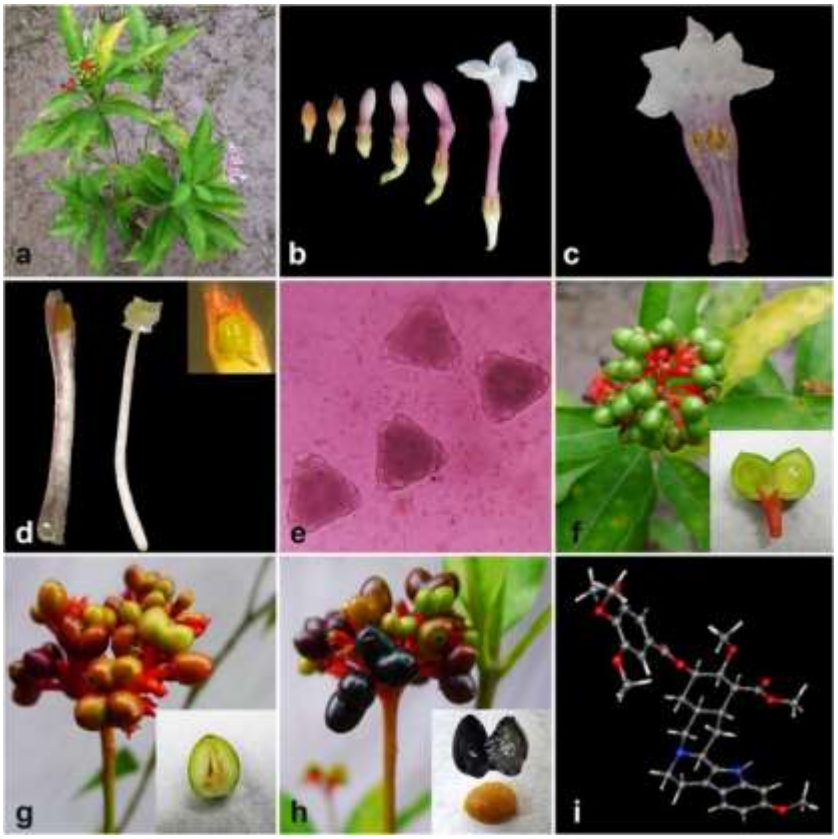


Figure 3: Predominant botanical and phenological features of Rauvolfia serpentina. a Full grown Rauvolfia plant its flowering stage b Successive develomental stages of Rauvolfia flowers c Stereomicroscopic view of full bloom Rauvolfia flowers d Complete reproductive structure including stigma and anthers (inset: ovary). e Pollen morphology. f–h Successive developmental stages of Rauvolfia fruits. i interactive chemical structure of reserpine (structure source: PubChem) (photographs are not in scale) (source: unpublished photographs of Saikat Gantait)

**Cultivation Technology:** The plant requires slightly acidic to neutral soils and rich in organic matter. It prefers loam to sandy-loam soils and partial shade is best suited for its cultivation. It

can be propagated by seed, stem and root cuttings. Soaking of seed for atleast 24 hours in water/gomutra enhances its germination. Seeds are sown in the month or May-June in nursery beds and 15-20 cm long seedlings are transplanted to fields preferably on ridges at the spacing of 30x30 cm or 45x30 cm in July-August. Irrigate the field immediately after transplanting and alter as and when required.[9]

**Harvesting:** Seeds can be collected in the month of October-November. Roots are collected after 2-3 years of plantation, when plants shed their leaves in winter.[9]

**Collection of *Sarpgandha***: - *Sarpgandha* was collected from Market due to it's non avalability in Ayurvedic Pharmacy, Faculty of Ayurveda, Institute of Medical Science, Banaras Hindu University,Varanasi.

**Part Used: -** Root

**Analysis and identification** :- Analysis and identification of *Sarpgandha* **(*Rauwolfia serpentina* )** was done in Dravyguna Department , faculty of Ayurveda , Institute of Medical Science , Banaras Hindu University, Varanasi,

**Standarization &Identification :-** Standarization & Identification of Sarpagandha **(*Rauwolfia serpentina* )** is done in the laboratory of Department of Dravyaguna, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University, Varanasi. Standarization & Identification no. is DG/21-22/376 dated 30/01/2022

**Accession no.of the Sarpgandha:-** *Sarpgandha* has submitted as a trial drug specimen in the museum of Department of Dravyaguna, Faculty of Ayurveda, Institute of Medical Science, Banaras Hindu University, Varanasi. Accession no. is provided in by the department is DG/21-22/356.

**Descriptions:-**

Figure no. 4: *Sarpgandha* root with bark

**a) Macroscopic[10]:-** Pieces of roots mostly about 8 to 15 cm long and 0.5 to 2 cm in thickness, sub cylindrical, curved, stout, thick and rarely branched; outer surface grayish-yellow to brown with irregular longitudinal fissures; rootlets 0.1mm in dia; fracture, short, slight odour and bitter taste.

**b) Microscopic[10] :-** Root comprises of stratified cork of about 18 layers, of which the cells of 8 to 12 layers are smaller, suberized and unlignified, cells of remaining layers large, suberized and lignified; phelloderm parenchymatous, some cells packed with starch grains and prismatic and clusters crystals of calcium oxalate; secondary phloem tissue consists of sieve cells, companion cells and parenchymatous cell containing starch grains and crystals of calcium oxalate; phloem fibers absent; phloem parenchyma occasionally filled with granular substances; starch grains mostly simple but compound granules also occur with 2 to 4 components; individual granules spherical, about 5 to 15 µm in diameter, with well marked hilum simple or split in a radiate form; stone cells are absent (distinction from many other species such as R. canescens, R. micrantha, R. densiflora, R. perakensis and R. vomitoria); secondary xylem is traversed by well developed lignified medullary rays of about 1 to 5 cell wide but uniseriate rays are more prominent; vessels singly or in pairs; xylem parenchyma cells lignified; fibres present; cells of medullary rays thick walled also filled with starch grains and calcium oxalate prisms.

**Powder[10] :-** Coarse to fine, yellowish-brown, free flowing, odour slight, bitter in taste; characterized by spherical, simple to compound starch grains, calcium oxalate prisms and

clusters; vessels with simple perforation, occasionally tailed; tracheids lignified; xylem fibres irregular in shape, occurs singly or in small groups, walls lignified, tips occasionally forked or truncated; wood parenchyma cells are filled with calcium oxalate crystals and starch grains; stone cells phloem fibres absent.

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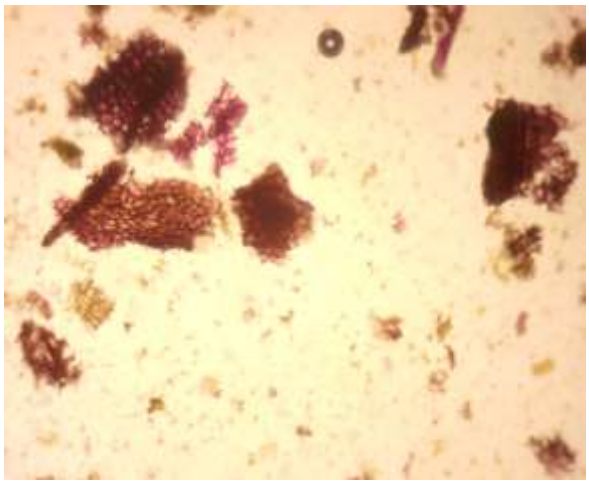
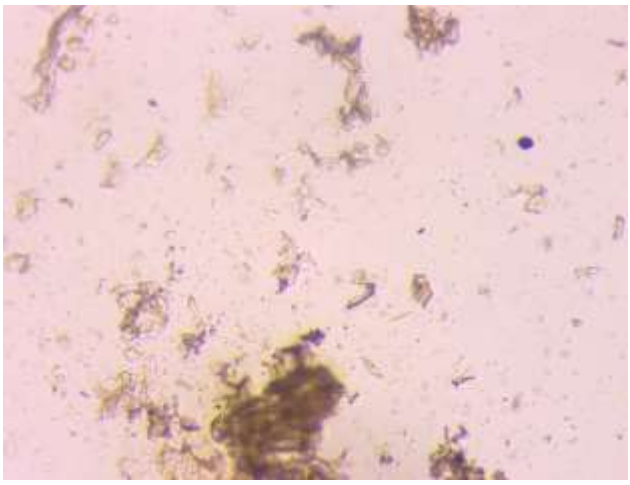
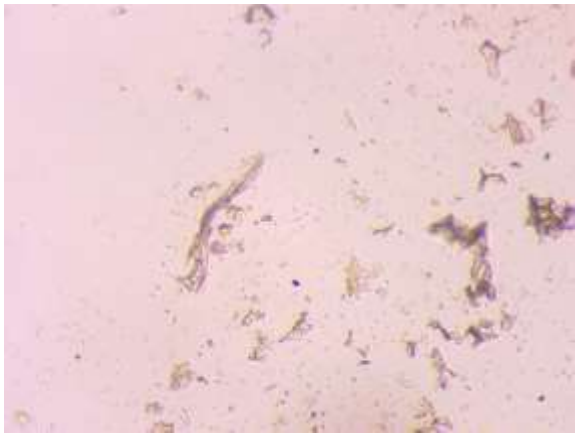
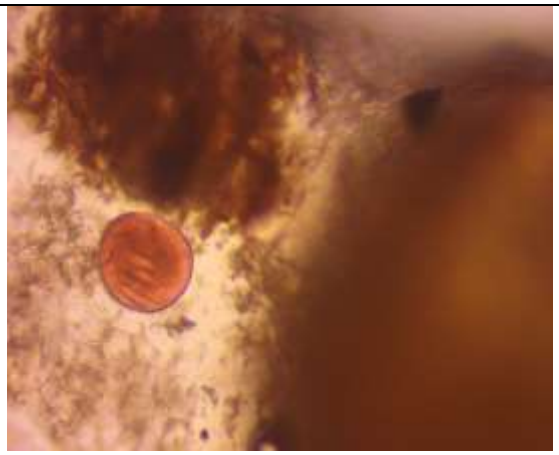
|  |  |
| **Calcium oxalates** | **Calcium oxalates** |
|  |  |
| **Calcium oxalates** | **Oil glands** |

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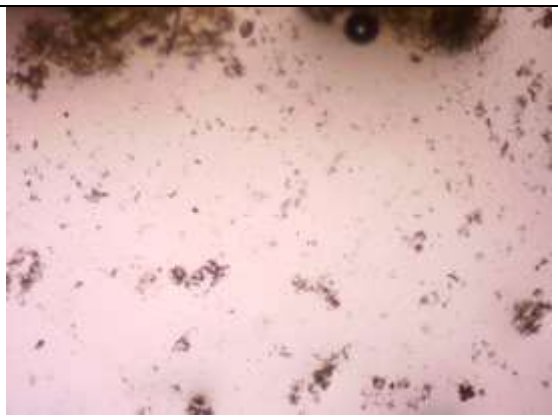
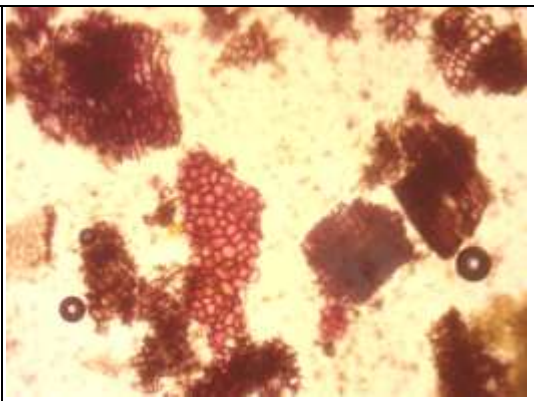
|  |  |
| **Starch cell** | **Vascular bundles** |

**Figure no.5**

**Identity, Purity and Strength[10]**

| Sl No | Analytical test | Findings | Reference (API;part 1, Vol. 5) |
|---|---|---|---|
| 1. | Purity | | Foreign material <2% |
| 2. | Loss on drying at $105^0$C | 4.04% | ------- |
| 3. | Total ash value | 5.17% | < 8% |
| 4. | Acid insoluble ash | 0.84% | <1 % |
| 5. | Hydro-alcoholic extract | 22.51% | -------- |
| 6. | Water soluble extract | 13.12% | >10% |
| 7. | Alcohol soluble extract | 8.98% | >4% |

**Phyto-constituents analysis(qualitative) [10]**

| | | | |
|---|---|---|---|
| I. | Alkaloids | +ve | ------- |
| II. | Flavonoids | -ve | ------- |
| III. | Proteins | -ve | ------- |
| IV. | Saponins | -ve | ------- |

| | | | |
|---|---|---|---|
| V. | Tannins | -ve | ------- |
| VI. | Glycosides | -ve | ------- |
| VII. | Free amino acids | -ve | ------- |

| **Sl No** | **Particular** | **Reference** |
|---|---|---|
| 1 | Foreign matter not more than 2 per cent | Appendix 2.2.2. |
| 2 | Total ash not more than 8 per cent | Appendix 2.2.3. |
| 3 | Acid-insoluble ash not more than 1 per cent | Appendix 2.2.4. |
| 4 | Alcohol-soluble extractive not less than 4 per cent | Appendix 2.2.6. |
| 5 | Water-soluble extractive not less than 10 per cent | Appendix 2.2.7. |

**Constituents** - Rauwolfia contains indole alkaloids, such as reserpine, serpentinine and ajmalicine. Reserpine is 1000 time more effective as comparative to crude route bark.[11]

**Properties[12]**

***Rasa****: Katu, Tikta; Guna: Laghu, Rukshya; Virya: ushan; Vipaka: Katu*

***Karma:*** *Deepak, Kaphahara, Mutral, Rucya, Vatahara, Nidraprada, Kamavasadaka, Hridavasadaka.*

Note: - Antihypertensive & sedative effect is due central inhibition of central nervous system not by ganglion blocker.[11]

**Important Formulations** - *Sarpagandhadi Churana, Sarpagandha yoga, Sarpagandha Vati, Sarpagandha Ghana Vati*

**Indications/ Therapeutic Uses [12, 13, 14] -** *Anidra, Apasmara, Bhootabadha, Bhrama, Jwara, Krimiroga, Medaroga, Unmada, Yonishoola, Raktavata, Manasaroga, Visuchika , Sarpavisha, Atisara*

**Dose[15] -** Powder 1-2 gm in hypertension

Powder 3-6 gm in *Unmada, Apasmara,* Mental disturbances, Sleeplessness, Insomnia & Schizophrenia.

**Effect of high dose:** Deep sedation, hypotension and coma.

## DISCUSSION

The classical text of Indian medicine mention about drug, *Sarpagandha* is included in *Aparajit Gana* which is indicated in mental disorder (*Suttartantra.60/47*). *Sarpagandha* is also included in *Ekasar Gana* (*Susruta kalpa.5/84*) useful against *visha* and for treatment of *Musaka visha* (*Susrtuta kalpa.7/29*). Also use in treatment of *Visuchika* (*vrindamadhava.6/26*). In modern era *Sarpagandha* is used as an effective Antihypertensive and it is world's first antihypertensive drug.[16]

The *Sarpagandha* is cardiodepressant, hypnotic and sedative. It is effective in hypertension, insomnia, sexual aggression and vertigo. The drug is also indicated in schizophrenia and conditions involving influence of evil spirits (*bhutabadha*).

The alkaloids obtained from the root extract acts directly on central nervous system and thereby reduces blood pressure as compared to other blood-pressure lowering agents. *R. serpentina* root is reported to contain 0.7 – 3.0 % of total alkaloids and about 0.1% of the active principle reserpine which is an indole alkaloid, present in the root.[17]

The antihypertensive actions of reserpine are due to its depressant action on central nervous system (CNS) and peripheral nervous system by binding to catecholamine storage vesicles present in the nerve cell. This prevents the normal storage of catecholamines and serotonin in decline of catecholamine. It impeded with the function of autonomic nervous system by depleting the transmitter substance from the adrenergic neurons and possibly by activating the central parasympathetic system.[18, 19, 20] These substances are mostly implicated in controlling heart rate, cardiac contraction and peripheral resistance. It also helps in sedation and lowering of blood pressure, particularly in cases of hypertension exacerbated by stress and sympathetic nervous system activity. Reserpine causes the release of 5-hydroxytryptamine (5- HT) from all tissues in which it is normally stored and results in increase of urinary metabolites.[21]

The ethanolic extract, as well as fractions of *R. serpentina root*, are potential for AChE inhibitor. The alkaloid compound may be responsible for this activity; it may be the reason for its efficacy in Alzheimer's disease (AD).[22]

The root of the Rauvolfia plant is used during treatment of fever, wound healing, worm infestation and mental disorders and it also acts as anti-venom. The root is rich in indole alkaloids viz. reserpine, serpentine, ajmaline, ajmalicine, deserpidine, recinnamine and yohimbine. Root bark is chiefly used as a hypnotic and sedative that reduces blood pressure.[23]

Ajmaline is a sodium channel blocker that shows instant action when given intravenously, which makes it ideal for diagnostic purposes. The administration of Rauvolfia alkaloid to patients with this type of arrhythmia is known as the "Ajmaline Test".[24]

It has been reported to stimulate respiration and intestinal movements. The action of ajmaline on systemic and pulmonary blood pressure is similar as of serpentine.[25]

Rescinnamine, a purified ester alkaloid of alseroxylon fraction in species of Rauvolfia; related chemically and pharmacologically to reserpine with similar uses. Rescinnamine inhibits angiotensin converting enzyme, peptidyl dipeptidase that catalyzes the conversion of angiotensin I to the vasoconstrictor substance, angiotensin II which stimulates aldosterone secretion by the adrenal cortex. Firstly it inhibits the Angiotensin Converting Enzyme (ACE) and then blocks the conversion of angiotensin I to angiotensin II. Inhibition of ACE results in decreased plasma angiotensin II. As angiotensin II is a vasoconstrictor and a negative-feedback mediator for renin activity, its lower concentration results in a decreasing in blood pressure and stimulation of baroreceptor reflex mechanisms, which ultimately results in decreased vasopressor activity and aldosterone secretion.[26]

Deserpidine is an ester alkaloid isolated from Rauvolfia. It differs from reserpine only by means of absence of a methoxy group at C-11, which is synthesized from reserpine. It is used mainly for its antipsychotic and antihypertensive properties. It is capable of reducing high blood pressure by controlling nerve impulses along various nerve pathways. As a result, they act on the heart and blood vessels to lower blood pressure and also for the relief of psychotic behaviour. Deserpidine also binds and inhibits the angiotensin converting enzyme and competes with angiotensin I for binding at the angiotensin-converting enzyme. It also blocks the conversion of angiotensin I to angiotensin II.[27]

Alkaloid, ajmalicine have a large number of applications in the treatment of circulatory diseases, especially in providing relief to normal cerebral blood flow. It affects the function of smooth muscle, prevent strokes and helps in lowering blood pressure.[28]

Root decoction is used during the treatment of ulcer and snakebite.[29] The plant also shows the use by local people of Eastern Ghats, Uttar Pradesh, Karnataka and Bangladesh against snake bite.[30]

For centuries, roots are used against nervous disorders like over exhilaration, anxiety, psychosis, insanity, insomnia, schizophrenia and epilepsy.[31]

This plant is known for its pharmacological properties, such as antihypertensive, antibacterial, antifungal, anti-inflammatory, and anticancer activities.[32]

In diarrhoea, dysentery, cholera, fever, opacity of the cornea and central epilepsy and ecbolic R. serpentina also played an important role.[33, 34]

A pharmacologically well characterized alkaloid Yohimbine, is used as a selective alpha-adrenergic antagonist or alpha-blocker in the blood vessels for the treatment of erectile dysfunction. It dilates blood vessels and increases blood flow in the penis, which helps in improving erectile function.[35, 36, 37,38]

Yohimbine was also explored as a remedy for diabetes in animal and human models carrying polymorphisms of the α2A-adrenergic receptor gene. Antagonism at these receptors relaxes smooth muscle and lowers blood pressure. It works by increasing certain chemicals in the body, which dilates the pupils of the eye.[39]

The plant is known to cure various circulatory disorders due to the presence of alkaloids.[40]
The root juices or extract is used to treat liver and abdomen pain, various gastrointestinal disorders and to expel intestinal worms from the children.[41]

Phenols are the secondary plant metabolites widely distributed in the plant kingdom mainly herbs, shrubs, vegetables and trees.[42, 43] The presence of phenols is considered toxic for the growth and development of various pest and pathogens.[44] Presence of high quantity of total polyphenolic compounds in R. serpentina shows significant antidiabetic and hypolipidemic properties.[45, 46] In medicine, it is used as an expectorant and emulsifying agent. The presence of phenolic compounds indicates that this can be used as anti-microbial agent.
The oxidation inhibiting activity of tannin is due to the presence of gallic acid and diagallic acid.[47]

Tannins have stringent properties, they hasten the healing of wounds and inflamed mucous membranes. Thus, explain the use of R. serpentina in treating many disorders by traditional medicine healers in South eastern India.[48]

Saponin has the property of coagulating red blood cells. The high saponin content of Rauvolfia serpentina demonstrates the use of this extracts to stop bleeding and in treating wounds.[49]

Rauvolfia is also known to contain a large number of macro and micro-nutrients and the most abundant macro nutrient is calcium.[50] The potential of R. serpentina to stop bleeding and its use in treating wounds can be due to its high calcium content, as it helps in blood coagulation. R.

serpentina contains low sodium content that can be an added advantage due to the direct relationship of sodium intake with hypertension in human.[51] The presence of zinc shows that plant can play valuable roles in the management of diabetes, which result from insulin malfunction.[52]

The plant extract has anti-prostate cancer activity in both in vitro and in vivo model systems which, based upon analyses of gene expression patterns of treated prostate cancer cells, may be modulated by its effects on DNA damage and cell cycle control signaling pathways.[53]

## CONCLUSION

Worldwide large number of peoples is suffering from several chronic diseases, due to significant variation in the climate and environment. Ayurveda believes in use of whole herb because of apparent benefits over the extract. To cure large number of people there is an urgent need for an herbal drug that can be utilized to treat various diseases with better cultural acceptability, compatibility with the physical body and lesser side effects. R. serpentina is a promising herbal choice in the pharmaceutical world due to the presence of significant chemical compounds in roots. It insights on the potential of R. serpentina as antioxidant, anticancerous, antidiuretic, antiarrhythmic, antidysentry, antidiarrhoeal antihypotensive, anticontractile, tranquillizing agent etc.

The whole herb has many components which can help in biotransformation into pharmacoactive forms, enhance bioavailability, reduce the possible side effects, help in smooth excretion and prevent development of possible drug resistance. These hypothesis is proved to be true in case of *Sarpagandha* as Reserpine has reported many ADRs and also human population have developed drug resistance resulting in discontinuation of Reserpine in hypertension management whereas *Sarpagandha* root is still in wide use. Hence proper identification is essential to yield better therapeutic results and to avoid drug adulteration.

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**Conflict of interest**: None

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**Conflict of Authors: -** No

**Ethical clearance: -** Not applicable

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