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Research Article

Rauwolfia Serpentina: Phytochemistry, Mechanisms of Action, and Clinical Implications – A Comprehensive Review

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ABSTRACT

The Indian medical system has been using the medication Rauwolfia serpentina for many generations. The medication has been referred to as Sarpgandha due to its snake-like structure. Reserpine is the main alkaloid found in Rauwolfia serpentina, despite the fact that it contains over 50 alkaloids. Even at lower dosages, reserpine is an effective antihypertensive medication. In addition to its antihypertensive and hepatoprotective properties, the stems and leaves of Rauwolfia serpentine have numerous other therapeutic applications, such as sedative, antipsychotic, antidiahoerreal, and anticancer (in breast), among others. Although the herb Rauwolfia serpentina contains the principal four Indole alkaloids, the primary goal of this context is to provide information about the primary active alkaloid Reserpine, which is more concentrated in the plant's root and plays a significant part in the plant's antihypertensive activity. Reserpine must be used at a considerably lower level in order to have an antihypertensive effect; otherwise, it may have major side effects such as sedation, lethargy, psychological depressive disorders, hypotension, nausea, bradycardia, bronchospasm, and withdrawal psychosis.

Keywords: Rauwolfia Serpentina, Sarpagandha, Reserpine, Indole Alkaloids, Traditional Indian Medicine, Medicinal Plants.

INTRODUCTION

Approximately 300 million individuals globally, or 7% of the total population, suffer from asthma, a disease that is frequently becoming worse. Additionally, it is predicted that by 2025, an additional 100 million people will be impacted [1]. Approximately 80% of the population still relies on herbal medicines for appropriate medical care. Nearly 45,000 herbal plants are found in India, and they are crucial in the treatment of numerous illnesses [2]. This article provides a brief overview of the therapeutic potential of particular medicinal plants used to treat bronchial asthma. Coughing, wheezing, shortness of breath, and tightness in the chest are all recurring symptoms of asthma, a chronic inflammatory illness of the airways. Allergies are closely associated with asthma and other respiratory conditions [3,4]. Periodic, adjustable bronchial constriction is the hallmark of bronchial asthma [5]. Some tests, such as spirometry, maximum expiratory flow (PEF), and chest x-rays, can be used to identify bronchial asthma [6]. Both hereditary and environmental variables are known to be responsible for asthma [7]. Asthma-causing substances are referred to as allergens. Smoking and second-hand smoke, infections like the flu and cold, allergens like dust, pollen, and exercise, air pollution and pollutants, medicines, weather, food additives, and emotional stress and worry are a few of the potential triggers. Often referred to as devil hot pepper, Indian snake root, or Sarpagandha, Rauwolfia serpentina, (Linn.) Plant Ex Kurz is a member of the plant Apocynaceae family. The majority of the more than 100 different species that have been identified under the category of Rauwolfia are indigenous to tropical and subtropical regions, which include Central and South America, Australia, Europe, Asia, and Africa. Southeast Asian moist, deciduous woodlands, such as those in Bangladesh, Burma, Malaysia, India, and Sri Lanka, are home to R. Serpentina, an evergreen and smooth shrub that can reach a height of 60 meters. R. Serpentina is extensively utilized in the allopathic, folk, Ayurvedic, and Unani medical systems. The root preparations of R. Serpentina have been employed in folk and

regional medicine as a laxative, uterine stimulant, diuretic, antidote, expectorant, and febrifuge since the pre-Vedic era [8]. respiratory infections, malaria, asthma, skin conditions, parasites, organ diseases, eye conditions (opacity of the cornea), circulatory problems, AIDS, rheumatism, diarrhoea, and dysentery are all treated using root extracts. R. Serpentina is a rich source of different varieties of chemical constituents. The root of this plant contains several alkaloids, which include ajmalicine, reserpine, serpentinine, ajmaline, yohimbine, ajmalicine, reserpine, desipramine, rescinnamidine, indolizine, rescanning, and serpentine [9]. Among the alkaloids, reserpine has attracted attention of researchers in the field of drug development throughout the globe. It is also useful in treating sedative insomnia, psychological disorders, excitement, epilepsy, traumas, anxiety, schizophrenia, insanity and in reducing blood pressure. Reserpine exerts antihypertensive property by depleting the catecholamine [10]. Rescanning has the same activity as reserpine. however, it inhibits angiotensin-converting enzyme (ACE) that converts the angiotensin I, resulting in a decrease of plasma angiotensin II. Ajmaline possesses antiarrhythmic effect by blocking the sodium channel. Because serpentine affects type II topoisomerase activity, it possesses antipsychotic properties. Yohimbine treats erectile dysfunction by acting as a selective alpha-adrenergic inhibitor in blood vessels [11]. Significant antidiabetic, hypolipidemic, and antibacterial effects were found in high concentrations of R. serpentina phenols. R. serpentine's flavonoids have antioxidant, anti-inflammatory, and anticancer qualities in addition to helping to prevent oxidative cell damage [12]. The homolytic effect and bind to cholesterol characteristic are caused by the presence of saponins in the system [13].

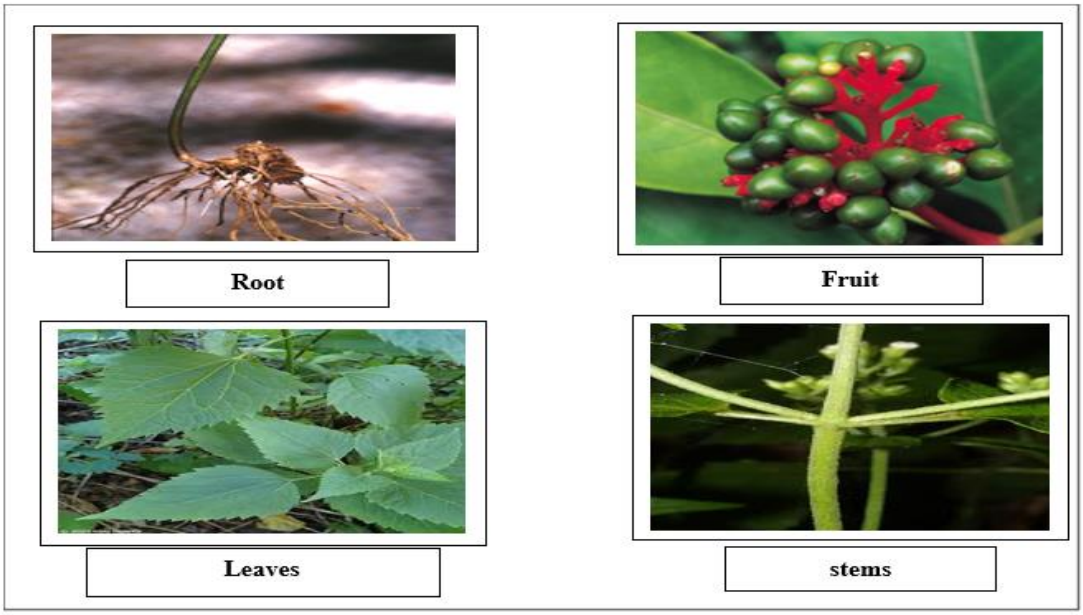


Fig 1: Rauwolfia serpentina plant (Sarpagandha)

2: Botanical description: -

Synonym's: -

2.1: Different Places the Plant Is Known As Different Names Like

Hindi	Sarpagandha, Chandrabhaga
English	Rauwolfia or Indian snake roots
Latin	Rauwolfia serpentina
Kannada	Keramaddinagaddi
Bengali	Chandra
Tamil	Chevanamalpodi
Chinese	Lu fu mu
Sanskrit	Sarpagandha

2.2: -Taxonomical Classification

Kingdome	Plantae
Phylum	Angiosperms
Subphylum	Eudicots
Order	Gentianellas
Family	Apocynaceae
Genus	Rauwolfia
Species	Serpentina

3. Cultivation of Rauwolfia Serpentina

Tropical and subtropical areas with humid, warm temperatures and evenly distributed rainfall are the primary locations for the cultivation of Rauwolfia serpentina. It thrives in loamy soil that is deep, rich in organic matter, well-drained, and has a pH that ranges from slightly acidic to neutral. Cuttings of seeds, root trimmings, or stem cuttings are frequently used for propagation; despite low germination rates, seed propagation is the most popular method. Following the rainy season, seeds are planted in nursery beds. After 6 to 8 weeks, healthy seedlings are moved to the field at the proper intervals. During the early phases of growth, regular drip irrigation, cultivation, and biodegradable manuring are crucial. The crop needs protection from waterlogging and some shade. After 18 to 24 months, when the alkaloid content is high enough, the roots are collected, washed, dried, and kept for use in medicine.

3.1 Collection of Rauwolfia Serpentina

The collection of Rauwolfia serpentina is usually carried out after the plant has reached full maturity, which occurs about 18–24 months after planting, when the roots contain maximum alkaloid content. Harvesting is done by carefully uprooting the entire plant or digging out the roots to avoid damage. The collected roots are washed thoroughly to remove soil and other impurities, then cut into suitable pieces. These pieces are dried in shade or in well-ventilated areas to preserve the active constituents. After complete drying, the roots are packed in moisture-free containers and stored in a cool, dry place for medicinal use.

4. Chemical constituents

4.1 Alkaloids

Alkaloids are broad group of chemical compounds which contain a structural nitrogen ring. These are caused by a variety of creatures, including bacteria and mammals, but plants create a particularly wide variety of alkaloids. About 10 % of plants species are considered to contain alkaloid as secondary metabolites, in which they operate largely in providing defence towards herbivores and pathogens. Pure isolated alkaloids and their synthesis derivatives are employed as medicinal compounds for for analgesic, antispasmodic and bactericidal properties [14]. Unlike other blood pressure-reducing medications, the alkaloids derived from the root extract directly affect the central nervous system, lowering blood pressure**.** According to reports, the root of R. serpentina contains 0.7–3.0% of total alkaloids and roughly 0.1% of the active ingredient, reserpine, an indole alkaloid. Hence, stem biomass production of these plants could be of economic importance. On the basis of the structural there are three types of compounds namely, weak basic dimethyl alkaloids, alkaloids of moderate basicity and strong an hydronium bases [15]. Ajmaline, ajmalimine, ajmalicine deserpidine inosine, indolizine, Reserpine, reserpine, reserpine, rescanning, rescinnamidine, serpentine, serpentine, & yohimbine are among the several alkaloids found in the Rauwolfia plant (Figure 1) [16]. Resperine is the primary alkaloid that exhibits a wide range of therapeutic uses [17,18]. Along with the drugs resperine, yohimbine, snakebite, deserpidine, ajmalicine and ajmaline, these drugs are used to treating hypertension and breast cancer [19,20].

4.1.1 Reserpine

It is a purified crystalline mono alkaloid, obtained from the roots of the Rauwolfia plant and was originally identified in 1952. The oleoresin fraction of the roots contains this relatively weak tertiary base, which is helpful in the treatment of neurological, cardiovascular, and hypertensive disorders [21]. The antihypertensive benefits of Rauwolfia roots are related to reserpine (3,4,5-trimethyl benzoic acid an ester of reserpine acid, an indole compound of 18- hydroxy yohimbine plant type). It is a very well-known alkaloid and is mostly used as a natural sedating agent [22,23]. Reserpine is presently being exploited as a tool in physiologic investigations of bodily functioning and in medicinal studies. by attaching to catecholamine storage vesicles

found in nerve cells, reserpine has a depressive effect on both the brain (CNS) and the peripheral nerves, which results in its antihypertensive effects. This stops serotonin and catecholamines from being stored normally when catecholamines fall. By depleting the transmitter material from the catecholamine neurons and potentially triggering the central parasympathetic nervous system, it disrupts the autonomic nervous system [24]. These chemicals are largely concerned in controlling the heart rate, cardiac contract and peripheral resistance. It also assists in sedation and decreasing of blood pressure, especially in situations of hypotension exacerbated by stress and antagonistic nervous system activity. Reserpine increases urine metabolites and releases 5-hydroxytryptamine (5-HT) from all tissues where it is typically kept.

4.1.2 Ajmaline

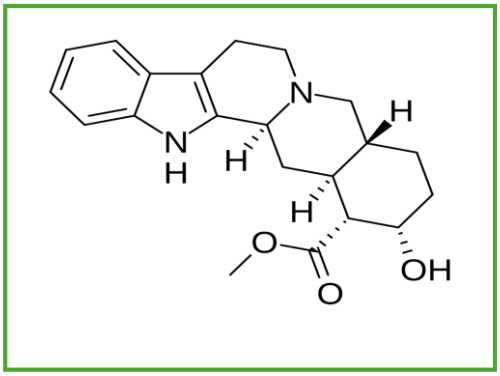
The chemical was first identified by Sacituzumab Siddiqui from the origins of R in 1931. serpentine. He was named it an ajmaline after Hakim Ajmal, the Khan, one of the South Africa's most renowned Unani practitioners Asia [25]. Composed from roots of R. serpentine pattern as a class I antiarrhythmic medication, it is very helpful in identifying Brugada Syndrome (hereditary cardiovascular disease), and discriminating between categories of patients with this disease [26]. These agents are essentially categorized into four primary groupings on the basis of their mode of action i.e. calcium channel blockade, beta-adrenergic receptor blockade, depolarization delay and calcium channel blockages blockade. Ajmaline is a calcium channel blocker that demonstrates instant activity when taken intravenously, which makes it useful for diagnostic reasons.

4.1.3 Ajmalicine

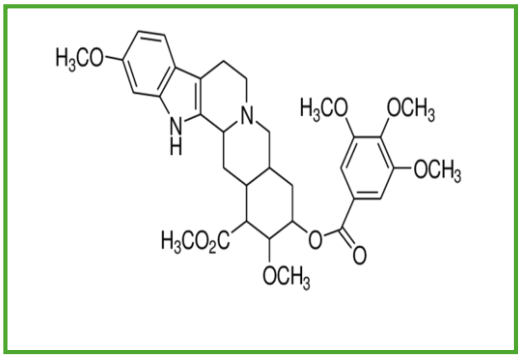
Alkaloid, ajmalicine, and its derivatives have a great variety of uses in the treatment of cardiovascular disorders, notably in providing relief to regular cerebral blood flow. It has an impact on the smooth muscle's ability to prevent strokes and in reducing blood pressure [27]. Approximately 3500 kg of the compound is obtained annually from either the species Rauwolfia or Catharanthus spp. by the pharmaceutical sector for the therapy for circulatory conditions. The synthetic route begins with geraniol, followed by iridodial smell and industrial by the the synthesis of loaning, which on oxidized produces loaning into serotonin. This helps the tryptamine to develop coronate class nucleus that culminates in the production of Tryptophan is the source of ajmalicine [28]. which is converted to tryptamine by serotonin, cat enamine and strictosamide.

4.1.4 Yohimbine

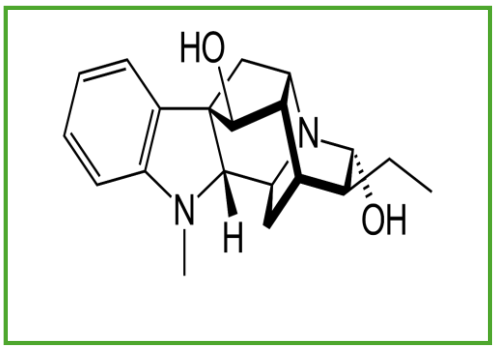
Yohimbine, a pharmacologically well-characterized alkaloid, is used to treat erectile dysfunction by acting as a particular Alpha-adrenergic receptor antagonist or a beta-blocker in the blood vessels. It dilates blood vessels and improves blood movement in the penis, which assists in improving erectile function [29]. Additionally, yohimbine was investigated as a treatment for diabetes in human and animal models with α2A-adrenergic receptor gene polymorphisms. Blood pressure is lowered and smooth muscle is relaxed when these receptors are antagonistic. It dilates the pupils of the eye by raising specific substances in the body



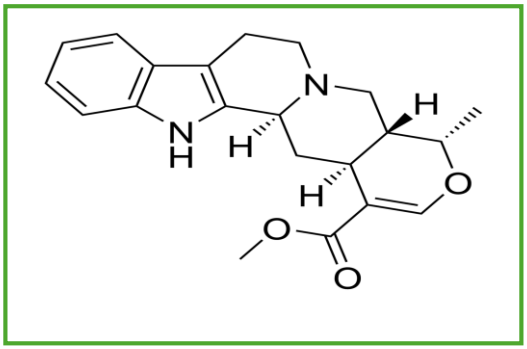
Structure of Reserpine [30].



Structure of Ajmaline [31].



Structure of Ajmalicine [32].



Structure of Yohimbine [33].

Figure 2: Chemical Constituents Of Rauwolfia Serpentina Plant [30,33]

5. Clinical trial

A cursory review of literature on hypertension reveals well more than 100 so-called hypertensive therapies that are said to have the ability to lower blood pressure. In 1930, Ayman Ali could collect almost two hundred testimonies on the effective treatment of hyperpiesia through different hypotensive treatments.

Considering the consistently high death rate from hypertension despite the numerous interventions suggested for this condition, the best course of action is still unknown. Evans and Loughnan, after a rigorous analysis or trial of thirteen various preparations in seventy instances involving elevated blood sugar levels (essential hypertension), were obliged to confess the uselessness of them all. In their perspective, modest sedative measures are sometimes better than the considerably more expensive and stylish goods actively exhibited on the market. The choice of R. Serpentine for the present investigation has not been wholly coincidental. A number of things have prompted me to conduct this investigation. The demand for tablets made from dried roots of the serpentine plant has increased in India during the brief ten years that these pills have been available. Serpentina root preparations have become incredibly popular for cases of hypertension in the country that almost every patient without high blood pressure has experienced its effects in one way or another. Over 50 million capsules of the drying root have reportedly been sold by one manufacturing company alone. One of the focuses of the present study has consequently been to assess if this enthusiastic response of the medicine is justifiable. As early ago 1940, I had made another mention to regarding the topic of R. Serpentina as therapy in those with hypertension: Following an exploration of this medication one finds it effective in a percentage of hypertension cases only; the drug's indications and case suitability have not yet been determined." Since then, I've had the chance to witness this medication's effects in numerous instances [34].

5.1 Clinical Trial Data

Study/Trial Title	Authors	Indication /Outcome	Summary	Reference
A clinical trial of Rauwolfia serpentina in essential Hypertension	Rustom Jal Vakil et al., 1949	Hypertension	One of the earliest clinical trials showing R. serpentina root extract (containing active alkaloids like reserpine) lowers blood pressure in patients with essential hypertension.	[35]
Rauwolfia serpentina in the control of anxiety	Paul Leninger, et al, 1957	Anxiety Control	Compared formulations (reserpine, scleroxcylon, crude root) in anxiety patients, showing equivalent effectiveness for overt anxiety; reported minor toxic symptoms manageable clinically	[36]
Antidiabetic Potential of	R. Kavitha,	Diabetes models	Demonstrated inhibition of α- amylase / α-glucosidase and reduced blood glucose	

Rauwolfia serpentina (in vitro & in vivo but not human clinical)	et al., 2025		in alloxan-induced diabetic rats; suggests potential antidiabetic effects requiring clinical validation.	[37]
Rauwolfia serpentina antioxidant & antidiabetic evaluation (preclinical)	Saveena Chauhan, et al. 2017	Antioxidant & antidiabetic assays	Compared wild and cultivated plant extracts in vitro for antioxidant & alpha-amylase inhibition; not a human clinical trial but pharmacological evaluation.	[38]

5.1 Pharmacological Activity

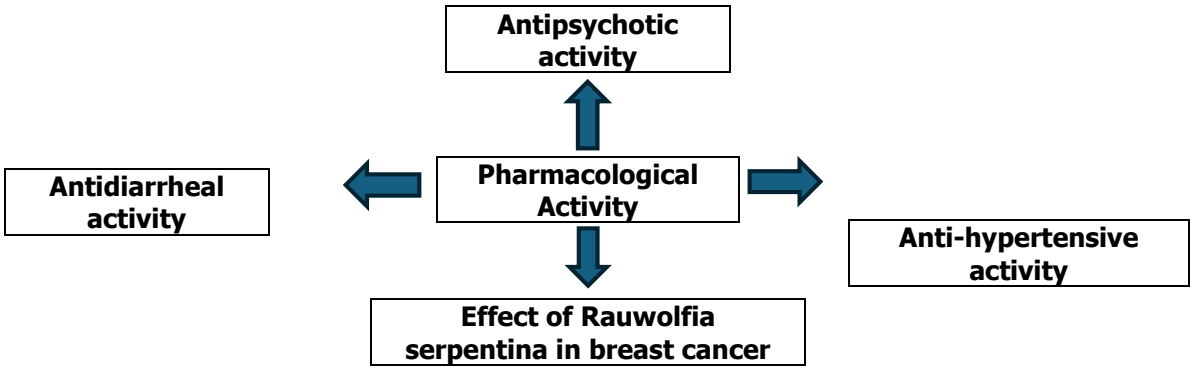


Figure 3: - Pharmacological parameters of Rauwolfia serpentina

5.1.1 Antihypertensive activity

Rauwolfia serpentina contains an alkaloid called reserpine, it is most likely recognized to be an antihypertensive medication. Reserpine is main alkaloids present greatest in root and leaflets and also the lowest portion of stem. After a given injectable administration, the onset of hypotension effect normally begins in roughly 1 hour. The maximum effect happens about four hours after an intramuscular shot and lasts for the strongest effect happens within approximately 2 weeks it may persist for a maximum of four weeks after your final dose. When used in conjugation with other underweight drugs for the treatment of serious hypertension, the usual intake ranges from 100 to 250.

Mechanism of action

Reserpine is a drug that decreases the circulatory system pulse by depleting the reserves of catecholamine at nerves terminating. It stops the reabsorption of neither enzyme at storage locations, allowing enzymatic degradation of neural transmitter [39]. Vesicular monoamine is bound by reserpine transporter (VMATs) in the organelle membranes with presynaptic Neurons [40,41]. Reserpine irreversibly inhibits the H+ coupled VMAT1 alongside and VMAT2 are circular norepinephrine transporters. VMAT1 is rich in brain and endocrine cells. VMAT2 is high in neurons. Reserpine, then, suppresses the neural system that uptake and lowers monoamine neurotransmitter reserves, nor serotonin, dopamine, histamine, or adrenaline in the synaptic vesicles of neurones.

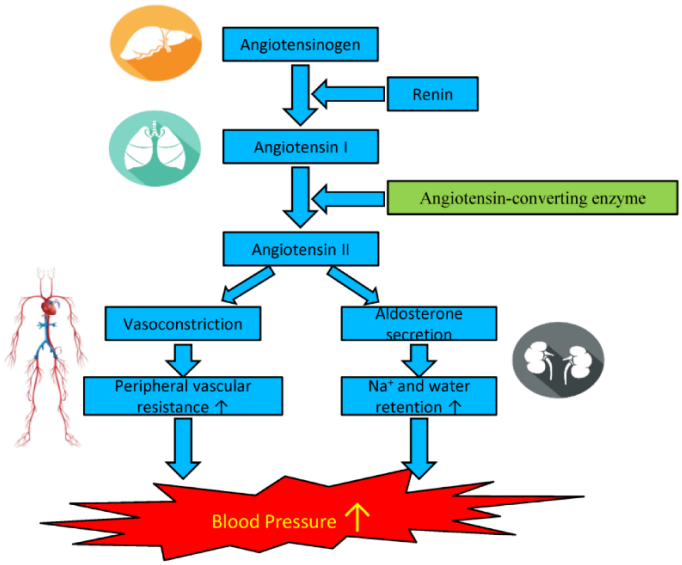


Figure 4: The renin-angiotensin-aldosterone system (RAAS) in the regulation of blood pressure and the function of angiotensin-converting enzyme (ACE) [42]

5.1.2 Anti-diarrhoeal activity

In an investigation into the anti-diarrheal properties of a methanolic extract of Serpentine Rauwolfia leaves in mice with peanut oil-induced diarrhoea, Dr. EZEIGBO, II discovered shows the extracts of its serpentine leaves has substantial Anti-diarrhoeal action.

Mechanism of action

Many alkaloids in the plant (particularly rescindment, ajmaline, serpentine) inhibit calcium influx into smooth muscle cells. Reduced intracellular Ca^{2+} → decreased muscle contraction → slowed intestinal transit

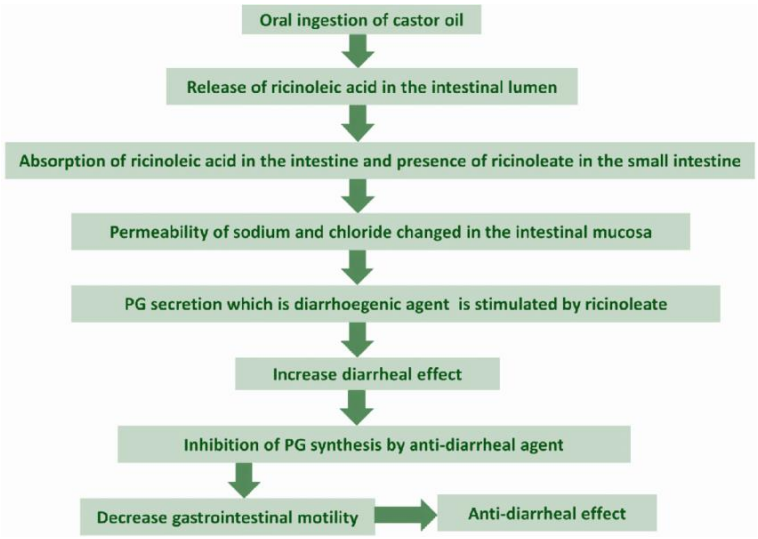


Figure 5: - Mechanism of action of Antidiarrheal activity with Serpentine [43,46]

5.1.3 Effect of Rauwolfia serpentina in breast cancer

In 1960 to 1970 A.D. and a purported association to breast carcinoma was established in medical literature in 3 case-controlled investigations, thus the employment with Rauwolfia and the Reserpine products was reduced. However, studies and analysis that remove exclusion bias reveal that Rauwolfia has no bearing on the incidence of cancer of the breast in patients. Rather than generating cancer it possesses antitumor activity [47,48].

Mechanism of action

Mitochondrial-mediated Apoptosis Alkaloids can disrupt mitochondrial membrane potential., This leads to cytochrome-c release → activation of caspase-9 and caspase-3 → apoptosis

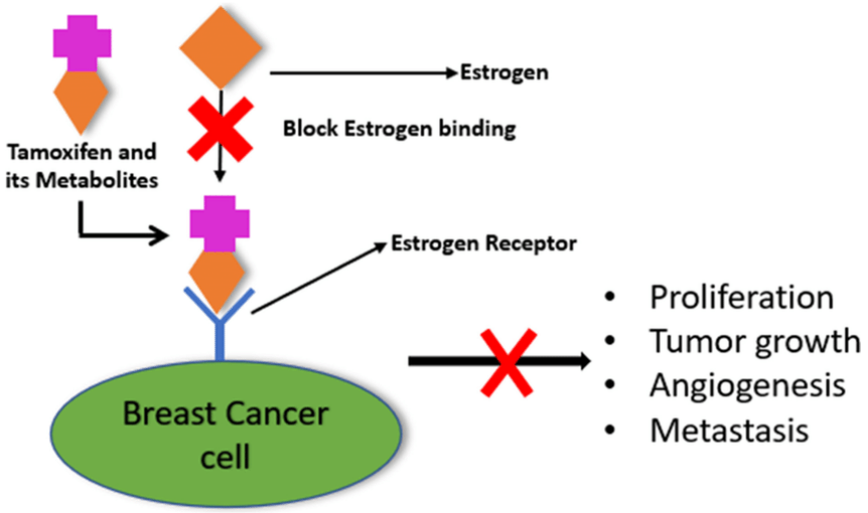


Figure 6: - Mechanism of action of Tamoxifen and its metabolites on breast cancer cells. Tamoxifen and its metabolites inhibit binding of Strogen hormone to estragon receptors of the breast cancer cells [49].

5.1.4 Antipsychotic activity

Reserpine it was additionally employed for the treatment of schizophrenic and tardive dyskinesia. It relieves fever or acts as a febrifuge drug [50,51]. The study found that a person with schizophrenia, Reserpine and chlorpromazine have comparable incidence of adverse effects however that the drug was lesser effective than the drug chlorpromazine for enhancing an individual's worldwide condition.

Mechanism of action

Serotonin (5-HT)

Reserpine irreversibly blocks **VMAT2 (Vesicular Monoamine Transporter-2)** in presynaptic neurons. This leads to depletion of: **Dopamine (DA), Norepinephrine (NE),**

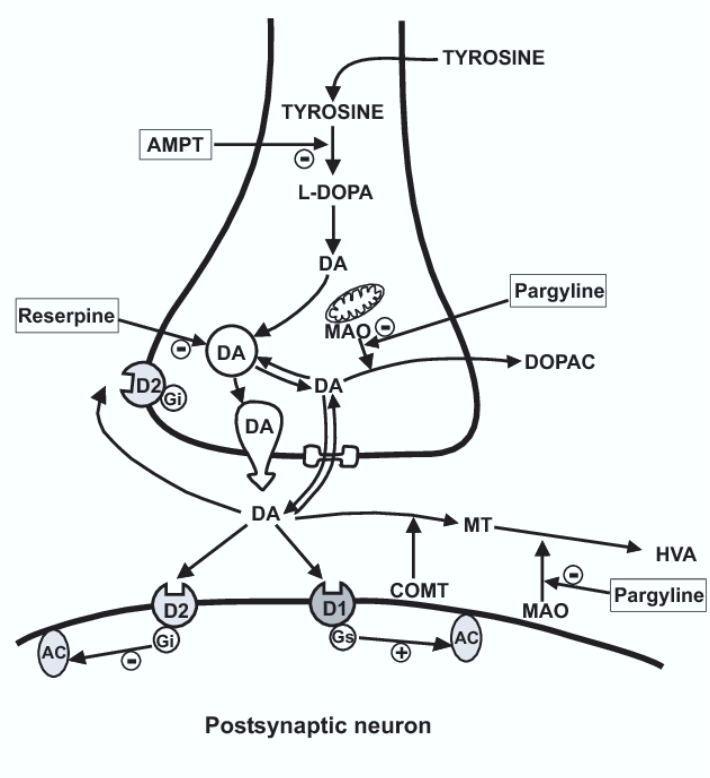


Figure 7: - Schematic Drawing Of A Dopaminergic Nerve Terminal. AMPT, Reserpine And Pargyline Are Drugs Used In The Thesis. Abbreviations: DA= Dopamine, D1= D1-Like Receptor, D2= D2-Like Receptor, Gi= Gi-Protein [52].

6: Other Pharmacological Activity

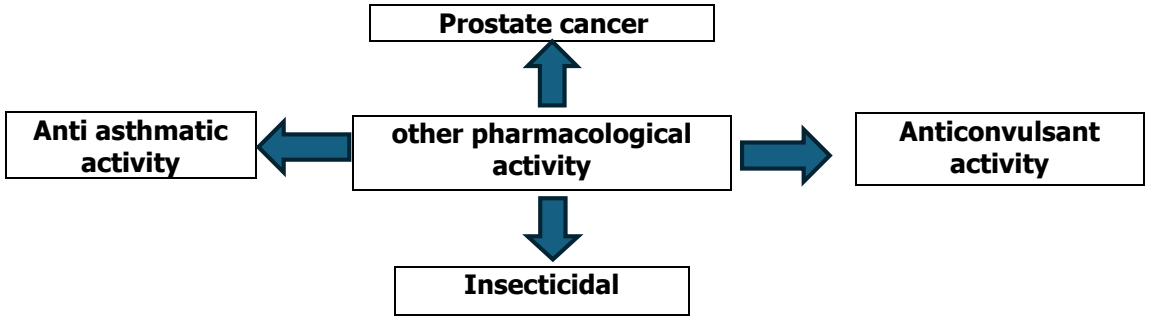


Figure 8: - Showing the other activities Rauwolfia serpentina

6.1 Prostate cancer

One of the main causes of cancer-related mortality in males is thought to be prostate cancer. Patients with prostate cancer have not benefited significantly in terms of survival from modern treatments like chemotherapy and radiation [53]. Natural products have shown to be a major repository for identification of beneficial compounds used in the treatment of a number of maladies and diseases, including cancer as opposed to chemotherapy and radiotherapy. Various portions of this plant have been used as a medicinal medicine for ages to cure a variety of maladies including fever, generalized weakness, intestinal infections, liver difficulties and mental disorders [54].

Extracts from the root bark of this plant are loaded with compounds of ß-carboline, or alkaloid family of which its main constituent is a substance called alstonine. This substance has been shown to slow the growth of tumor cells in mice injected with Ehrlich ascitic cells or YC8 lymphoma cells. 96 Based on examinations of treated prostate cancer cells' gene expression patterns [55]. the plant extract's anti-prostate cancer efficacy in on both in vitro and in vivo model cultures may be influenced by its effects on DNA damage and cell cycle regulation signalling pathways.

Mechanism of action

Extracts and alkaloids (especially **reserpine, ajmaline, serpentine**) have been shown to: Activate **caspase-3 and caspase-9,** Increase **pro-apoptotic proteins** (Bax), Increase **pro-apoptotic proteins** (Bax), Decrease **anti-apoptotic proteins** (Bcl-2)

Mental illness, schizophrenia, high blood pressure and other diseases

The plant's root is used as a sedative, to treat sleeplessness, high blood pressure, and mental agitation. The root extract obtained is believed to be the greatest treatment for high blood hypertension and has been accepted by the medical fraternity in various nations. The resulting alkaloids are frequently employed in medication production and have a direct impact on hypertension. Other illnesses include fever, malaria, eye conditions, pneumonia, asthma, AIDS, headaches skin diseases and spleen disorders can also be cured using R. serpentina extracts**.**

6.2 Anti asthmatic activity

Bronchial asthma is characterised by hyper reactivity of tracheobronchial calm muscle towards range of stimuli resulting in constriction of air passages often associated by enhanced secretion, mucous edam and mucus plugging. Most cases of extrinsic asthma are episodic and less likely to result in status asthmaticus. As asthmaticus is more prevalent, intrinsic asthma is more likely to be chronic. The understanding of herb botanical elements is very powerful and useful towards the treatment of numerous disorders including bronchial asthma. Among various respiratory diseases bronchial breathing problems is more typical and people suffer from chronic sickness in the respiratory [56].

6.3 Anticonvulsant activity

Rauwolfia serpentina exhibits anticonvulsant activity by producing central nervous system depression through its indole alkaloids. These alkaloids reduce neuronal excitability and suppress excessive electrical discharges in the brain, thereby helping to prevent or control convulsions. This effect is mainly attributed to alkaloids such as reserpine and ajmaline, which decrease catecholamine levels and stabilize neuronal activity [57].

Mechanism of action

The indole alkaloids present in the plant reduce neuronal excitability by interfering with neurotransmitter release and synaptic transmission in the brain. By depleting monoamines such as dopamine, norepinephrine, and serotonin, the alkaloids help stabilize neuronal firing and suppress abnormal electrical discharges responsible for seizures

6.4Insecticidal

Rauwolfia serpentina possesses insecticidal properties due to the presence of bioactive alkaloids and other phytochemicals that are toxic to insects. Extracts of the plant interfere with the nervous system of insects, causing paralysis and eventual death. Traditionally, powdered roots and crude extracts have been used to repel or kill household and agricultural pests [58]. The insecticidal effect is attributed to disruption of neurotransmission and metabolic processes in insects, making Rauwolfia serpentina useful as a natural insect control agent.

Mechanism of action

The insecticidal activity of Rauwolfia serpentina is mainly due to its indole alkaloids, which act on the insect nervous system. These compounds interfere with normal neurotransmission by disrupting ion channel function and inhibiting nerve impulse conduction. This leads to loss of coordination, paralysis, and death of the insect. Additionally, the alkaloids may inhibit key metabolic enzymes and disturb energy metabolism, further enhancing their toxic effect on insects [59].

Mechanism of action

Reduces Stress-Induced Bronchospasm with respiring depletes serotonin norepinephrine, dopamine in the CNS and Produces calmness and sedation and effect antiasthma effect triggered by stress, anxiety, emotional excitation

Future Purpose

Rich in secondary metabolites that are bioactive of the volatile indole alkaloid type, such as reserpine, ajmaline, the amino acid serpentine, and yohimbine, among others, serpentina Rauwolfia (L.) Benth. ex-Kurz., also known as Indian Snake roots or Sarpagandha, is a plant of great pharmaceutical significance (family Apocynaceae). unauthorized extraction of the plant off the wild to suit the demands of medicine companies along with poor rooting capability and low seedling viability of 2015 plant render the cultivation of the plant vulnerable based on the IUCN list [60].

CONCLUSION

In addition to being a useful plant, Rauwolfia serpentina has excellent therapeutic applications as an antihypertensive medication. The utilization of cabbage serpentina and its compounds can be further researched to bring a benefit of society to heal the sickness. The principal ingredient of Rauwolfia serpentine, or Reserpine has a considerable affinity for therapy of hypertension along with other biological activities as clearly defined in above full literature A. Although Rauwolfia serpentine is affective in hypertension however it is safe and highly effective when used at lesser dose. A patient having hyper tension should consume less than 500 mg of medicine per day, yet in most of the instance's physician recommend 250 mg per day. Rauwolfia serpentine consist contains many photochemical like alkaloid, flavono1ids, phenol compounds etc. The plant may have antimicrobial properties due to its lack of phenolic compounds. Pure isolated alkaloids as well as for synthesized derivatives may utilized as basic medicinal treatment for their medicinal, therapeutic and bactericidal properties. When given to animals, they can indicate physiological activity.

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