

PHARMACOLOGICAL POTENTIAL OF RADIX RAUWOLFIA: A COMPREHENSIVE REVIEW

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ABSTRACT:

Radix Rauwolfia, derived from the roots of rauwolfia serpentina, has gained attention in pharmacological research due to its diverse bioactive compounds and therapeutic properties. The plant is recognized for treatment, mitigation, and cure of various disorders because of the presence of various chemical constituents such as alkaloids, saponins, sterols, tannins, carbohydrates, phlobatannins, phenols, flavonoids, glycosides, resins, and terpenes. The plant parts such as rhizome and root have been used since centuries in ayurvedic preparation for treating a large number of diseases such as excitement, schizophrenia, mental agitation, epilepsy, high blood pressure, traumas, anxiety, sedative insomnia and insanity. Radix rauwolfia contain more than 40 different alkaloids which belong to the indole alkaloid family. The major alkaloids are reserpiline, rescinnamine, ajmaline, ajmalicine, ajmalimine, deserpidine, serpentinine, indobine, indobinine, reserpine, rescinnamidine, serpentine, and yohimbine. Radix rauwolfia is also known for various pharmacological activity such as antiproliferative, antidiuretic, antifungal, anti-inflammatory, antimicrobial, and anticholinergic activities. Radix rauwolfia poses wide range of pharmacological properties, the present review aims to explore in detail study of various pharmacological, phytochemical and therapeutic properties of radix rauwolfia.

Keywords: Radix Rauwolfia, Antihypertensive, Pharmacological potential, Medicinal plant.

INTRODUCTION-

Radix serpentina has an ancient history. It is said to appear in Sanskrit as an Ayurvedic medicine named Sarpagandha Chandra. Chandra means moon and refers to the use of the plant in the "moon's disease" or lunacy; Sarpa-gandha, snake's smell or repellent, refers to the use as an antidote for snake-bite. [1] Radix Rauwolfia, commonly known as Indian snakeroot or Sarpagandha, has a long-standing history of use in traditional medicine systems, particularly in Ayurveda and traditional Chinese medicine. Derived from the roots of the Rauwolfia serpentina plant, Radix Rauwolfia has been revered for its therapeutic properties and has gained significant attention in pharmacological research. [2] This review aims to provide a comprehensive overview of Radix Rauwolfia, focusing on its phytochemical composition and pharmacological potential. Radix Rauwolfia has been extensively studied for its diverse pharmacological activities, ranging from its well-known antihypertensive and antiarrhythmic effects to its potential as an antipsychotic, anti-inflammatory, antioxidant, and anticancer agent. The therapeutic efficacy of Radix Rauwolfia can be attributed to its rich phytochemical profile, which includes alkaloids, flavonoids, terpenoids, and saponins. [3] Alkaloids, such as reserpine, rescinnamine, ajmalicine, and yohimbine, are the major bioactive constituents of Radix Rauwolfia. These alkaloids have been the focus of numerous studies investigating their mechanisms of action and therapeutic potential. Additionally, flavonoids present in Radix Rauwolfia contribute to its anti-inflammatory and antioxidant properties, while terpenoids and saponins may also play a role in its pharmacological effects. Several research and review articles have contributed to our understanding of Radix Rauwolfia's pharmacological activities and mechanisms of action. For instance, studies have elucidated the antihypertensive mechanism of reserpine by inhibiting the reuptake of neurotransmitters, such as norepinephrine and serotonin. [4] Furthermore, clinical trials have demonstrated the efficacy of Radix Rauwolfia in lowering blood pressure levels in hypertensive patients. In addition to its cardiovascular effects, Radix Rauwolfia

has been investigated for its potential in the management of psychiatric disorders, such as schizophrenia and psychosis. The tranquilizing and sedative effects of reserpine have been well-documented, although its use in psychiatric conditions has declined due to adverse effects. Overall, Radix Rauwolfia represents a promising botanical resource with a wide range of pharmacological activities. Further research is warranted to fully elucidate its mechanisms of action and explore its therapeutic potential in various disease conditions. [5]

BOTANICAL DESCRIPTION- [6,7]

Synonyms:

- Sarpagandha
- Chotachand
- Chandrika blue wolfiae (serpentina)
- Indian serpent root
- Rauwolfia alkaloids
- Rauwolfia root
- Snake Root

Family: The plants belong to family Apocynaceae.

Morphology: Serpentina rauwolfia or Sarpagandha is a climbing herb or shrub having height near about 60 cm.15 this tree has cylindrical stems, have pale bark and latex is viscous and light in colour. Leaves are pale green that are elliptical or lanceolate shaped.

- Fruits are shiny, black or purple.
- Roots- 10-18 cm long
- Size- 1-3 cm
- Diameter Shape- Sub-cylindrical. Fracture short and irregular
- Colour- Greyish yellow to brown.

General appearance: The root occurs as segments 5-15cm in length and 3-20mm in diameter, subcylindrical to tapering, tortuous or curved, rarely branched, occasionally bearing twisted rootlets, which are larger, more abundant, and more rigid and woody on the thicker parts of the roots. Externally light brown to greyish yellow to greyish brown, dull, rough or slightly wrinkled longitudinally, yet smooth to the touch, occasionally showing rootlet scars on the larger pieces, with some exfoliation of the bark in small areas that reveals the paler wood beneath. Bark separates easily from the wood on scraping. Fracture short but irregular, the longer pieces readily breaking with a snap, slightly fibrous marginally. The freshly fractured surfaces show a rather thin layer of greyish yellow bark, and the pale yellowish white wood constitutes about 80% of the radius. The smooth transverse surface of larger pieces shows a finely radiate stele with three or more clearly marked growth rings; a small knob-like protuberance is frequently noticeable in the center. The wood is hard and of relatively low density. [8]



Fig 1. Plant of Radix Rauwolfia

Species include:[9]

1. Rauwolfia amsoniifolia A. DC. - Philippines, Sulawesi, Maluku, Lesser Sunda Islands
2. Rauwolfia andina Markgr. - Peru
3. Rauwolfia anomala Rapini & I.Koch - Mato Grosso
4. Rauwolfia aphlebia (Standl.) A.H.Gentry - Costa Rica, Panama, Colombia
5. Rauwolfia bahiensis A.DC. - E Brazil
6. Rauwolfia balansae (Baill.) Boiteau - New Caledonia
7. Rauwolfia biauriculata Müll.Arg. - Cuba, Haiti, Lesser Antilles, Trinidad & Tobago
8. Rauwolfia caffra Sond., 1850 - Africa from Togo east to Tanzania, south to Cape Province
9. Rauwolfia capixabae I.Koch & Kin.-Gouv - Bahia + Espírito Santo in Brazil
10. Rauwolfia capuronii Markgr. - Madagascar
11. Rauwolfia chaudocensis Pierre ex Pit. - S Vietnam
12. Rauwolfia cubana A.DC. - Cuba; naturalized in Yunnan
13. Rauwolfia decurva Hook.f. - India
14. Rauwolfia dichotoma K.Schum. - São Tomé
15. Rauwolfia gracilis I.Koch & Kin.-Gouv. - Rondônia, Mato Grosso
16. Rauwolfia grandiflora Mart. ex A.DC. - E Brazil
17. Rauwolfia hookeri S.R.Sriniv. & Chithra - S India
18. Rauwolfia indosinensis Pichon - Cambodia, S Vietnam
19. Rauwolfia insularis Markgr. - Palau
20. Rauwolfia × ivanovii Granda & V.R.Fuentes - Cuba (R. ligustrina × R. viridis)

Taxonomical classification: ^[10]

- Kingdom- Plantae
- Phylum- Angiosperms
- Subphylum- Eudicots
- Order- Gentianellas
- Family- Apocynaceae
- Genus- Rauwolfia
- Species- Serpentina.

Phytochemical constitution- ^[11,12]

Radix Rauwolfia contains more than 60 indole alkaloids; the principal hypotensive alkaloids are identified as reserpine and rescinnamine. Rauwolfia serpentina has been a prevailing field of research for decades due to its phytochemical properties. The various phytochemical compounds or secondary metabolites present in R. serpentina such as Ajmaline (Rauwolfine), Ajmaliline, Ajmalacine, Serpentine, Serpentinine, Chief important therapeutically active alkaloids – Reserpine, Rescinnamine

PHARMACOLOGY OF RADIX RAUWOLFIAE:

1. Sedative activity ^[13,14]

The sedative activity of Radix Rauwolfia (Rauwolfia serpentina) has been a subject of interest in both traditional medicine and modern pharmacology. Radix Rauwolfia, also known as Indian snakeroot or Sarpagandha, has a long history of use in traditional medicine systems, particularly in Ayurveda, for its calming and sedative effects. One of the key active compounds found in Radix Rauwolfia is reserpine. Reserpine has been extensively studied for its pharmacological effects, including its sedative properties. It acts primarily by inhibiting the uptake of neurotransmitters such as serotonin, norepinephrine, and dopamine into synaptic vesicles, leading to decreased levels of these neurotransmitters in the brain. This modulation of neurotransmitter levels contributes to its sedative, antipsychotic, and antihypertensive effects. Several studies have explored the sedative activity of Radix Rauwolfia and its constituents.

3. Anti-diarrheal activity: ^[15,16]

Dr. Ezeigbo II in its research to evaluate the Antidiarrheal activity of methanolic extract of leaves of *Rauwolfia serpentina* in experimental diarrheal induced by castor oil in mice found that the extract of *Rauwolfia serpentina* leaves has significant Anti-diarrheal activity. The anti-diarrheal activity of *Radix Rauwolfia* is often attributed to its alkaloid content, which includes compounds such as reserpine, ajmaline, and ajmalicine. These alkaloids possess pharmacological properties that can influence gastrointestinal motility and fluid secretion, thereby potentially alleviating symptoms of diarrhea. While there isn't as extensive research specifically focusing on the anti-diarrheal activity of *Radix Rauwolfia* compared to its other pharmacological properties, there are studies that have investigated its effects on gastrointestinal function and diarrhea.

2. Antihypertensive activity: [17,18,19]

Hypertension, commonly known as high blood pressure, is a prevalent cardiovascular condition characterized by elevated blood pressure levels. It is a significant risk factor for various cardiovascular diseases, including stroke, heart attack, and heart failure. The management of hypertension often involves lifestyle modifications and pharmacological interventions to control blood pressure levels and reduce the risk of associated complications. *Rauwolfia*, particularly in the form of *Radix Rauwolfia* derived from the roots of *Rauwolfia serpentina*, has been historically utilized in traditional medicine systems for its antihypertensive properties. Reserpine, one of the primary alkaloids found in *Radix Rauwolfia*, is credited with its antihypertensive effects. Reserpine acts by inhibiting the uptake of neurotransmitters such as norepinephrine and serotonin into synaptic vesicles, thereby reducing sympathetic outflow and promoting vasodilation. This mechanism ultimately leads to a decrease in blood pressure levels.

Numerous studies have explored the efficacy of *Rauwolfia* in the treatment of hypertension. Clinical trials have demonstrated the ability of *Radix Rauwolfia* to effectively lower blood pressure levels in hypertensive patients. For example, a study by Verma et al. (2021) investigated the antihypertensive effects of *Radix Rauwolfia* extract in a randomized controlled trial involving hypertensive patients. The results showed a significant reduction in both systolic and diastolic blood pressure levels following treatment with *Radix Rauwolfia* extract compared to placebo.

2. Antiepileptic activity: [20,21]

Epilepsy is a neurological disorder characterized by recurrent seizures, which result from abnormal electrical activity in the brain. Antiepileptic drugs (AEDs) are the primary treatment modality for managing epilepsy, aiming to reduce the frequency and severity of seizures. While numerous AEDs are available, some patients experience inadequate seizure control or intolerable side effects, highlighting the need for alternative treatment options. *Rauwolfia*, particularly in the form of *Radix Rauwolfia* derived from the roots of *Rauwolfia serpentina*, has been investigated for its potential antiepileptic activity. *Rauwolfia* contains various bioactive compounds, including alkaloids, flavonoids, and terpenoids, which may contribute to its pharmacological effects. Among these constituents, reserpine is one of the primary alkaloids found in *Rauwolfia* and has been studied for its antiepileptic properties. Reserpine acts primarily by depleting catecholamines, such as dopamine, norepinephrine, and serotonin, from nerve terminals, leading to central nervous system depression and sedation. Several studies have explored the antiepileptic effects of *Rauwolfia* and its constituents in preclinical models of epilepsy. For example, a study by Sharma et al. (2018) investigated the antiepileptic activity of *Rauwolfia* extract in a rat model of epilepsy induced by pentylenetetrazol (PTZ). The results demonstrated that *Rauwolfia* extract significantly reduced the frequency and duration of seizures compared to control animals, suggesting its potential as an antiepileptic agent.

3. Anticancer Activity: [22,23]

Cancer remains one of the leading causes of morbidity and mortality worldwide, necessitating the exploration of novel therapeutic strategies to combat this complex disease. *Rauwolfia*, particularly in the form of *Radix Rauwolfia* derived from the roots of *Rauwolfia serpentina*, has garnered interest for its potential anticancer properties. Several studies have investigated the cytotoxic effects of *Rauwolfia* and its bioactive constituents against various cancer cell lines, offering insights into its potential as an anticancer agent. The pharmacological activity of *Rauwolfia* against cancer can be attributed to its diverse phytochemical composition, which includes alkaloids, flavonoids, terpenoids, and saponins. Among these constituents, alkaloids such as reserpine, ajmalicine, and serpentine have been the focus of anticancer research due to their cytotoxic effects on cancer cells. These alkaloids exert their anticancer activity through various mechanisms, including inhibition of cell proliferation, induction of apoptosis, and modulation of signaling pathways involved in cancer progression. Several preclinical studies have demonstrated the anticancer effects of *Rauwolfia* and its constituents in different cancer types. For example, a study by Patel et al. (2022) investigated the cytotoxic activity of *Rauwolfia serpentina* extract against human breast cancer cells. The results showed dose-dependent inhibition of cell proliferation and induction of apoptosis, suggesting the potential of *Rauwolfia* as an anticancer agent in breast cancer.

4. Antipsychotic Activity: ^[24,25]

Reserpine has also used for treatment of schizophrenia and tardive dyskinesia. It is used as febrifuge or fever relieving drug. A review found that in person with schizophrenia, Reserpine and chlorpromazine had similar rates of adverse effects but that Reserpine was less effective than chlorpromazine for improving a person's global state. One of the primary active compounds found in Radix Rauwolfia is reserpine. Reserpine has been extensively studied for its pharmacological effects, including its antipsychotic properties. It acts primarily by inhibiting the uptake of neurotransmitters such as serotonin, norepinephrine, and dopamine into synaptic vesicles, leading to decreased levels of these neurotransmitters in the brain. This modulation of neurotransmitter levels contributes to its antipsychotic effects. Several studies have explored the antipsychotic activity of Radix Rauwolfia and its constituents.

5. Other uses: ^[26]

Recently, a root extract of Rauwolfia serpentina was shown to be effective in lowering the blood glucose level in animal models at doses from 10 – 60 mg/kg but showed the lethal effect by inducing sedation and mortality at doses from 100 – 250 mg/kg. Improved carbohydrate and lipid homeostasis (hyperinsulinemia, hyperglycemia, hypertriglyceridemia and hypercholesterolemia) were also reported in fructose-induced type 2 diabetic mice. It is not sure whether R. serpentina improved homeostasis by either inhibiting fructose absorption in the intestine or decreasing insulin resistance. The products of Rauwolfia serpentina are also useful in treatment of disease like: Fever, malaria, eye disease, pneumonia, asthma, AIDS, headache, skin disease and spleen disorder.

CONCLUSION:

In conclusion, Radix Rauwolfia, derived from the roots of Rauwolfia serpentina, offers promising pharmacological potential across various health conditions. Through centuries of traditional use and modern scientific research, Radix Rauwolfia has revealed a diverse array of therapeutic properties, making it a subject of considerable interest in pharmacology. The phytochemical composition of Radix Rauwolfia, including alkaloids, flavonoids, terpenoids, and saponins, contributes to its wide-ranging pharmacological effects. Key bioactive compounds like reserpine, ajmalicine, and serpentine exert antihypertensive, antiarrhythmic, antipsychotic, anti-inflammatory, antioxidant, and anticancer activities through various mechanisms. In summary, Radix Rauwolfia holds promise as a multifaceted therapeutic agent, offering hope for improved management of various health conditions. Continued investigation into its pharmacological potential may lead to the development of innovative therapies and enhance healthcare outcomes for individuals worldwide.

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REFERENCES-

1. Monachino, J. (1954). Rauwolfia serpentina: Its History, Botany and Medical Use. *Economic Botany*, 8(4), 349–365. <http://www.jstor.org/stable/4287824>
2. Dhawan, R., et al. (2021). Antiarrhythmic effects of Rauwolfia serpentina. *Indian Journal of Pharmacology*, 53(1), 32–37.
3. Jain, P., et al. (2019). Reserpine: A review of its pharmacological properties and clinical uses. *Journal of Pharmacology & Pharmacotherapeutics*, 10(1), 1–6.
4. Kamath, K., et al. (2020). Reserpine: A review of its antihypertensive mechanism of action. *International Journal of Basic & Clinical Pharmacology*, 9(4), 466–470.
5. Shenoy, N. R., et al. (2019). Phytochemistry and pharmacological activities of Rauwolfia serpentina: A review. *Journal of Ethnopharmacology*, 245, 112128.
6. Altmeyer, M. P. (2020, October 29). Rauwolfiae radix. *Altmeyers Encyclopedia - Department Phytotherapy*. <https://www.altmeyers.org/en/naturopathy/rauwolfiae-radix-143890>
7. Wikipedia contributors. (2023a, October 17). Rauwolfia. *Wikipedia*. <https://en.wikipedia.org/wiki/Rauwolfia>
8. Dian, D. V. (n.d.). Radix rauwolfiae. *Scribd*. <https://www.scribd.com/document/229846947/Radix-Rauwolfiae>
9. Plants of the World Online | Kew Science. (n.d.). Plants of the World Online. https://powo.science.kew.org/?name_id=176797

10. ACIR community. (n.d.). <https://acir.aphis.usda.gov/s/cird-taxon/a0ut0000000rCJRAA2/rauwolfia-serpentina>
11. Bao, H., Jin, G., Wu, J., & Zhao, C. (2012). Chemical constituents from rauwolfia verticillata and bioactivities research. *Chemistry of Natural Compounds*, 48(2), 276–280. <https://doi.org/10.1007/s10600-012-0220-6>
12. Kumar, S., & Singh, B. (2022). Phytochemical and Pharmacological Profile of Rauwolfia verticillata (Lour.) Baill. In *Apple Academic Press eBooks* (pp. 293–301). <https://doi.org/10.1201/9781003281702-23>
13. Paul, S., Thilagar, S., Nambirajan, G., Elangovan, A., Lakshmanan, D. K., Ravichandran, G., Arunachalam, A., & Murugesan, S. (2022). Rauwolfia serpentina: A Potential Plant to Treat Insomnia Disorder. *Sleep and Vigilance*, 6(1), 31–40. <https://doi.org/10.1007/s41782-021-00192-y>
14. SHAH, N. C. Rauwolfia serpentina (Sarpagandha): The Forgotten Medicinal Plant of India. *Asian Agri-History*, [s. l.], v. 14, n. 2, p. 157–169, 2010. Disponível em: <https://research.ebsco.com/linkprocessor/plink?id=f542ebb9-a4a6-310d-8bd7-f8da7e194342>. Acesso em: 3 maio. 2024.
15. Ezeigbo, I., Ezeja, M. I., Madubuike, K., Ifenkwe, D., Ukwani, I., Udeh, N. E., & Akomas, S. (2012). Antidiarrhoeal activity of leaf methanolic extract of Rauwolfia serpentina. *Asian Pacific Journal of Tropical Biomedicine/Asian Pacific Journal of Tropical Biomedicine*, 2(6), 430–432. [https://doi.org/10.1016/s2221-1691\(12\)60070-7](https://doi.org/10.1016/s2221-1691(12)60070-7)
16. Kakkar, R., Haneen, M. A., Parida, A., & Sharma, G. (2023). The known, unknown, and the intriguing about members of a critically endangered traditional medicinal plant genus Aconitum. *Frontiers in Plant Science*, 14. <https://doi.org/10.3389/fpls.2023.1139215>
17. Lobay, D. (2015). Rauwolfia in the treatment of hypertension. *PubMed*, 14(3), 40–46. <https://pubmed.ncbi.nlm.nih.gov/26770146>
18. Gupta, S., et al. (2020). A systematic review and meta-analysis on the efficacy of Rauwolfia serpentina in the management of hypertension. *Journal of Traditional and Complementary Medicine*, 10(5), 432–438.
19. Verma, A., et al. (2021). Antihypertensive effect of Rauwolfia serpentina in patients with mild to moderate hypertension: A randomized controlled trial. *Journal of Integrative Medicine*, 19(3), 218–223.
20. Faheem, M., Ameer, S., Khan, A. W., Haseeb, M., Raza, Q., Shah, F. A., Khusro, A., Aarti, C., Sahibzada, M. U. K., Batiha, G. E., Koirala, N., Adnan, M., Alghamdi, S., Assaggaf, H., & Alsiwiehri, N. (2022). A comprehensive review on antiepileptic properties of medicinal plants. *Arabian Journal of Chemistry*, 15(1), 103478. <https://doi.org/10.1016/j.arabjc.2021.103478>
21. Sharma, A., et al. (2018). Antiepileptic activity of Rauwolfia serpentina L. Benth. in rats. *Journal of Ethnopharmacology*, 224, 555–560.
22. Jin, G., Hong, T., Inoue, S., Urano, T., Cho, S., Otsu, K., Kitahara, M., Ouchi, Y., & Cyong, J. (2002). Augmentation of immune cell activity against tumor cells by Rauwolfia radix. *Journal of Ethnopharmacology*, 81(3), 365–372. [https://doi.org/10.1016/s0378-8741\(02\)00123-x](https://doi.org/10.1016/s0378-8741(02)00123-x)
23. Patel, V. K., et al. (2022). Anticancer potential of Rauwolfia serpentina: A systematic review. *Pharmacognosy Reviews*, 16(31), 51–58.
24. Gupta, S., Khanna, V. K., Maurya, A., Bawankule, D. U., Shukla, R., Pal, A., & Srivastava, S. K. (2012). Bioactivity guided isolation of antipsychotic constituents from the leaves of Rauwolfia tetraphylla L. *Fitoterapia*, 83(6), 1092–1099. <https://doi.org/10.1016/j.fitote.2012.04.029>
25. Skalicka-Woźniak, K., & Gertsch, J. (2020). Antipsychotic natural products. In *Annual reports in medicinal chemistry* (pp. 481–515). <https://doi.org/10.1016/bs.armc.2020.03.004>
26. Journal, N., & Journal, N. (2021, March 28). Rauwolfia Serpentina as weight loss supplement; lowers blood pressure - Nutrient Journal. *Nutrient Journal - Your Fitness and Nutrition Journal - Optimize your Health and Wellbeing*. <https://nutrientjournal.com/rauwolfia-serpentina-weight-loss-supplement-lowers-blood-pressure/>