



Ethno-Phyto-Pharmacological Overview on *Rauwolfia tetraphylla* L.

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ABSTRACT

Rauwolfia tetraphylla L. (Syn. *R. canescens* / *R. heterophylla* / *R. hirsute*; Family - Apocynaceae), popularly known as ‘Be still tree’ or ‘Devil-pepper’ holds an important position in the Indian traditional system of medicine. The plant has various ethnobotanical significances and is widely used by South Indian tribes. The compiled information revealed that wide range of alkaloids have been isolated from this plant and possesses important pharmacological activities like antipsychotic, antimicrobial, anti-inflammatory, anticancer, antihypertensive, anti-diarrhoeal, antioxidant etc. These reports are very encouraging and indicate that herb should be studied more extensively for its therapeutic benefits. The present review gives an account of updated information on ethnobotanical, phytochemical and pharmacological activities of *Rauwolfia tetraphylla* L. (*R. tetraphylla*).

Key Words: *Rauwolfia tetraphylla*, Alkaloids, Ethnobotanical, Phytochemical, Pharmacological.

INTRODUCTION

Rauwolfia tetraphylla L. (Family: Apocynaceae) is a small, tree or shrub that reaches 6 feet in height. Leaves are whorled, medium to dark green in colour, occur in groups of 4 equally-sized leaves at each node and cultivated on commercial scale in India. *R. tetraphylla* is an economically important medicinal plant because of the presence of various indole alkaloids in its different parts¹. The aim of present review to focus on its phytochemical constituents and ethnopharmacological activities.



Fig.1. *Rauwolfia tetraphylla* L. (Family: Apocynaceae)².

ETHNOBOTANICAL SIGNIFICANCE

The ethnobotanical survey on *R. tetraphylla* revealed that plant possessed various significant activities and widely used by South Indian tribes.

Roots of *R. tetraphylla* are used to stimulate uterine contraction in case of difficult delivery among the *kaattu Naika* tribe of Wayanadu district of Kerala. Decotion of shoot is drunk three times a day for stomachache among *Kurichya* tribe of Wayanadu district of Kerala. Juice extracted from the root is used to treat muscular and rheumatism pain among *Paanar* tribe of kannur district of Kerala. The dark juice of the fruit furnishes a black dye used by *Paanar* tribe of Wayanadu district of Kerala. Leaf decotion is used against cough and cold, leaf paste is used for skin disease among *Kaattu Nayka* tribe of Kerala. Root paste is taken either with milk or honey on empty stomach twice a day for 21 days to cure mental disorders by the *Malapandaram* tribe of Wayanadu district of Kerala. To treat high blood pressure *R. tetraphylla* root extract is given to drink 2 to 3 times a day by the *Mullu Kuruma* tribe of Wayanadu district of Kerala.

About 10g of root powder is taken orally twice a day for seven days to cure hypertension by the *Kaattu Nayka* tribals of Thusharagiri, Calicut. The leaf decotion of the plant is used to treat anxiety, epilepsy and nervous disorders by the *Paniya* tribe of Calicut. *Kuruma* tribe of Wayanadu district of Kerala used the powdered root initially for three days to treat ulcer and as wormicidal. Root decotion and black pepper is used to expel intestinal worms in children by *Kaani* tribe of Malabar area of Kerala. An extract of the plant is mixed with castor oil to form a liniment which is prescribed for some kinds of chronic and refractory skin ailments. A decotion of the bark is employed by *Malaraya* tribes of Tamil Nadu as an external application for chronic

cutaneous diseases and to destroy parasites. The root is also used to stimulate uterine contractions and is recommended for use in difficult child birth case by *Thodar tribe* of Muthumalai forest area in Tamil Nadu.

The plant is used to treat snake bite, insect sting and animal bite by *Irular tribe* of Tamil Nadu. Crushed root are mixed with any good oil and applied to infected area touched by snake poison in the villages of *Kotta tribe* of Tamil Nadu. About 10 mL of root paste is taken orally for the treatment of snake bite by the Muthumalai forest dwellers of Tamil Nadu. The plant is used in insomnia, high blood pressure and madness in remote villages of Tamil Nadu. 100 g root paste of *Cyperous rotundus*, 100 g whole plant paste of *Polygala arillata* and 100 g root paste of *R. tetraphylla* are mixed with local alcohol and cooked. The whole mixture is given once a day for any stomach disease until recovery by *Veddar tribe* of Coimbatore district of Tamil Nadu. Juice extracted from leaves along with juice of *Andrographis paniculata* and *Azadirachta indica* with honey are used to cure malaria by *Palliyar tribes* of Tamil Nadu.

Root of *R. tetraphylla* along with root of *Cissamplelos pareira* in equal quantities with water are taken orally twice a day for five days to treat malaria by *Kaattunayaka tribes* of Mudumali hills, Tamil Nadu. Leaves and flowers of plant are consumed to treat asthma by *Kaani tribe* in Agasthamalai Biosphere reserve, South India. Root and leaf paste of plant is made into pill, sun dried and used in malarial fever by the *Bedar tribe* of Karnataka. Juice extracted from leaves of *Andrographis paniculata* and *Nyctanthes arbortristis* are mixed with *R. tetraphylla* root juice to treat scabies in *Kurumbha tribe* of Karnataka. Root paste of *R. tetraphylla* plant and *Andrographis paniculata* are used in itches, boils and eczema by *Bedar tribe* of Karnataka. *Kadu Kurumbha tribe* of Karnataka uses the fresh root juice or dried root powder of this plant along with *Adathoda vasica* soaked in water is prescribed orally in respiratory problems. In Karnataka, *Sholaga tribe* uses root and leaf juice for headache and fever, root juice is also taken with water to cure body ache and rheumatism. Root paste is applied in cuts, wounds or boils twice a day until recovery by the people of remote villages of Karnataka³.

PHYTOCHEMICAL STUDIES

A phytochemical investigation of *R. tetraphylla* has revealed the presence of several alkaloids. The alkaloids are concentrated mostly in the bark of the roots, the quantity being much less in the wood; the bark is reported to yield about 90per cent of the total alkaloidal content. The various alkaloids isolated from *R. tetraphylla* are given in Table-1⁴.

PHARMACOLOGICAL ACTIVITIES

R. tetraphylla exerts significant pharmacological activities due to presence of various alkaloidal phytochemical constituents. Various activities reported are:

Antimicrobial Activity

The antibacterial activity of dry fruit extracts was assayed against eight bacterial species using agar diffusion method. Dry fruits were extracted using petroleum ether, chloroform and ethylacetate. The study suggested that the dry fruit extracts possessed potential broad spectrum antimicrobial activity⁵.

In vitro antibacterial activity of ethanolic leaf extracts of *R. tetraphylla* was studied against pathogenic bacteria by disc

diffusion method. The result showed that the inhibitory effect was on par with standard antibiotics⁶.

In vitro antimicrobial activity of leaves and calli extract of *R. tetraphylla* were studied against pathogenic bacteria and fungi by broth dilution assay. Leaves and calli were extracted using absolute alcohol, benzene, chloroform, methanol and petroleum ether. Methanol extract showed MIC of 0.25 to 100 mg/mL against bacterial pathogens and 0.5 to 100 mg/ml against fungal pathogens⁷. The antimicrobial activity of ethanolic extract of *R. tetraphylla* was tested against various bacteria and fungi. Better antimicrobial activity was observed against *E. coli*, *E. aerogenes* and *A. niger*⁸.

Anti-inflammatory Activity

In vitro anti-inflammatory activity of orally administered different extracts of *R. tetraphylla* root bark in Carrageenan induced acute inflammation in rats was evaluated and showed good activity⁹.

Anticancer Activity

Isolation from the air-dried stems and branches of *R. tetraphylla* and structural elucidation of new labdane diterpene, 3 β -hydroxy-labda-8(17),13(14)-dien-12(15)-olide was reported. Labdane diterpene showed significant antitumor and anticancer activity when tested against human cancer cell lines such as KB cells, leukaemic T cells, A549 and Hep-2 cells and breast cancer cell lines¹⁰.

Antipsychotic Activity

The methanolic leaves extract of *R. tetraphylla* was evaluated for antipsychotic activity on female Swiss albino mice. The antipsychotic activity was evaluated against dopaminergic (DA-D₂) and serotogenic (5-HT_{2A}) receptors in-vitro and amphetamine induced hyperactive mouse model in-vivo. Further toxicity and safety evaluation studies of methanol extracts of *R. tetraphylla* leaves at different doses (10, 100, 300 and 2000 mg/kg) on female Swiss albino mice and showed that methanol extract is non toxic. The isolated alkaloids could serve as a promising lead structure for drug development of treating psychotic conditions in human¹¹.

Antioxidant Activity

Leaves of all reported five species of *Rauwolfia* (*R. beddomei*, *R. densiflora*, *R. micrantha*, *R. serpentina* and *R. tetraphylla*) from Southern Western Ghats were chosen to investigate their antioxidant activities, phytochemicals and nutrient composition. The five species were then screened for their antioxidant potentials using various in-vitro models such as total antioxidant capacity, 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity, reducing power and superoxide anion scavenging activity at various concentration. *R. tetraphylla* revealed the highest concentration of β -carotene and Lycopene¹².

Antihypertensive Activity

The roots are useful in the treatment of hypertension and other cardiovascular diseases¹³.

Miscellaneous Activities

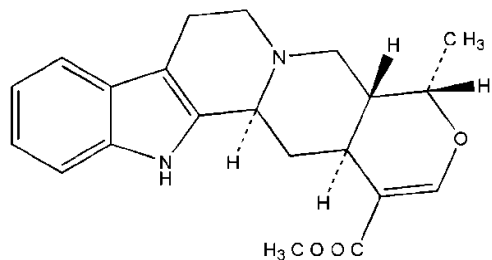
The leaf extract is used in the treatment of cholera, intestinal disorders, diarrhoea, dysentery, eye disease and fever¹⁴. The plant extract mixed with castor oil is prescribed for refractory ailments while the bark decoction is used for

chronic refractory, skin disease and to destroy parasites¹⁵. The roots are used to stimulate uterine contraction hence recommended for use in difficult cases of child birth¹⁶.

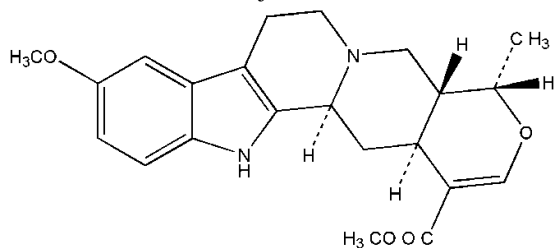
CONCLUSION

The review reveals that *R. tetraphylla* is an important source of many pharmacologically and medicinally important chemicals. The plant has been widely studied for its

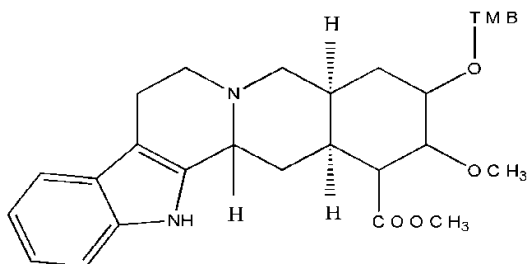
pharmacological activities and regarded as versatile plant having a wide spectrum of medicinal activities. As the global scenario is now changing towards the use of non toxic plant products, development of modern drugs from *R. tetraphylla* should be emphasized. It is also important to recognize that it can be used as substitute for important plant *R. serpentina*.



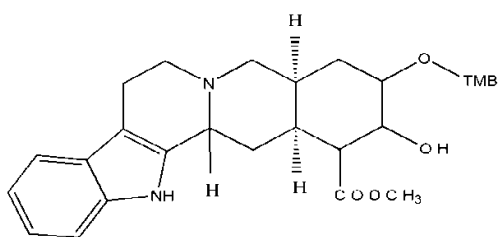
Ajmalicine



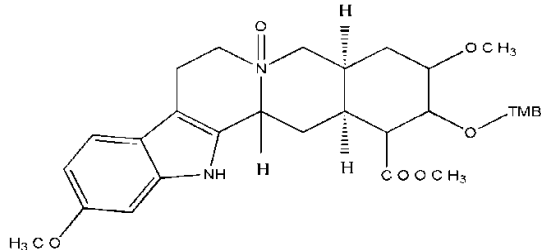
Aricine



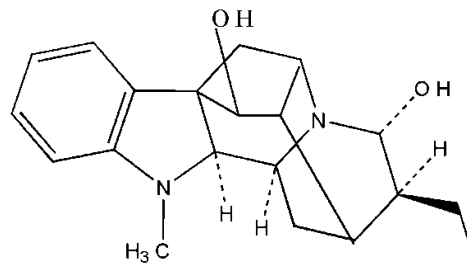
Deserpidine



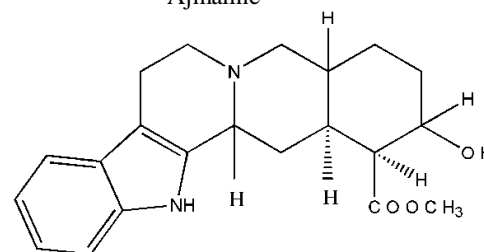
Raujeminine



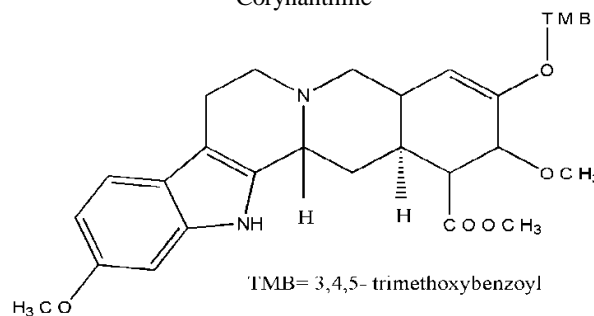
Renoxidine



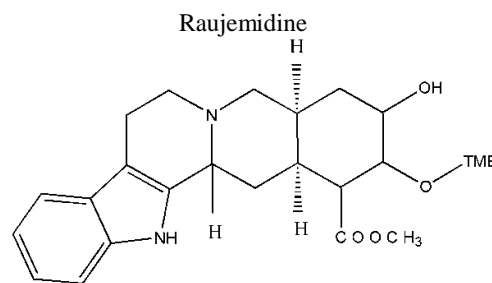
Ajmaline



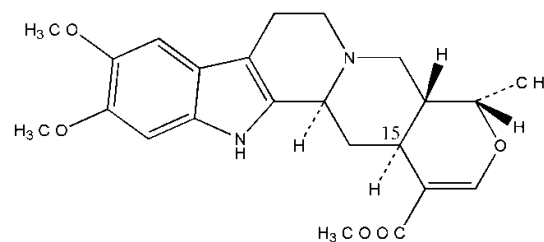
Corynanthine



TMB= 3,4,5- trimethoxybenzoyl



Isoraunescine



Isoreserpiline

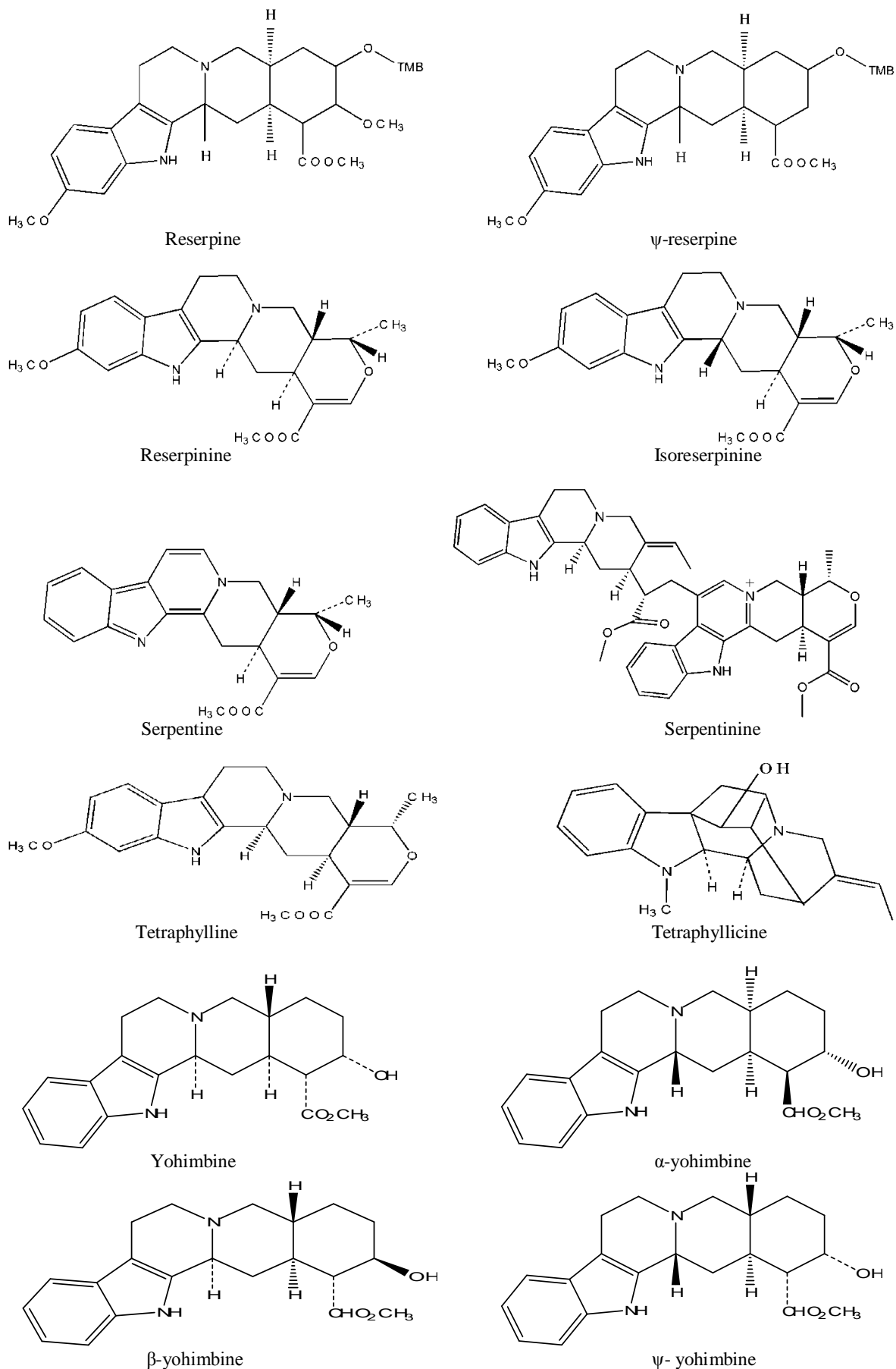


Fig.2. Structures of various alkaloids isolated from *Rauwolfia tetraphylla* L.

Table-1: Alkaloids isolated from *Rauwolfia tetraphylla* L.

Sr. No.	Alkaloids	Molecular formula	Melting point (C)	[α] _D ⁽²⁵⁾
1	Ajmalicin	C ₂₁ H ₂₄ N ₂ O ₃	253-254	-62
2	Ajmaline	C ₂₀ H ₂₆ N ₂ O ₄	180-183	-97
3	Aricine	C ₂₂ H ₂₆ N ₂ O ₁	190	-59
4	Corynanthine	C ₂₁ H ₂₆ N ₂ O ₃	231-232	-85
5	Deserpidine	C ₃₂ H ₃₈ N ₂ O ₈	228-232	-137
6	Raujemidine	C ₃₃ H ₃₈ N ₂ O ₉	144-150	-88
7	Raunescine	C ₃₁ H ₃₆ N ₂ O ₈	160-170	-74
8	Isoraunescine	C ₃₁ H ₃₆ N ₂ O ₈	152-156	-164
9	Renoxidine	C ₃₃ H ₄₀ N ₂ O ₁₀	238-241	-100
10	Isoreserpiline	C ₂₃ H ₂₈ N ₂ O ₃	211-212	-82
11	Reserpine	C ₃₂ H ₄₀ N ₂ O ₉	264-265	-11
12	ψ -reserpine	C ₃₂ H ₃₈ N ₂ O ₉	257-258	-65
13	Reserpinine	C ₂₂ H ₂₆ N ₂ O ₁	243-244	-131
14	Isoreserpinine	C ₂₂ H ₂₆ N ₂ O ₁	225-226	-18
15	Serpentine	C ₂₁ H ₂₀ N ₂ O ₃	158	+292
16	Serpentinine	C ₄₂ H ₄₄ N ₄ O ₆	265-266	+117
17	Tetraphylline	C ₂₂ H ₂₆ N ₂ O ₁	220-223	-78
18	Tetraphyllicine	C ₂₀ H ₂₄ N ₂ O	320-322	+61
19	Yohimbine	C ₂₁ H ₂₆ N ₂ O ₃	234-236	+101
20	α -yohimbine	C ₂₁ H ₂₆ N ₂ O ₃	238-239	-12
21	β -yohimbine	C ₂₁ H ₂₆ N ₂ O ₃	246-249	-54
22	ψ - yohimbine	C ₂₁ H ₂₆ N ₂ O ₃	268	+27

REFERENCES

- 1) Srivastav SK, Agrawal AK et al IN 0658DEL2009, WO/2012/113180, 2010.
- 2) Indian Medicinal Plants Growers' Consortium, [http://www.impgc.com/images/PlantPictures/Rauwolfia a tetraphylla. jpg](http://www.impgc.com/images/PlantPictures/Rauwolfia%20tetraphylla.jpg).
- 3) Documents and resources for small business and professionals <http://www.docstoc.com/docs/129718212/An-ethnobotanical-survey-of-endemic>.
- 4) Anonymous. The wealth of India: A Dictionary of Indian Raw Materials and Industrial Products, Publications and Information Directorate. New Delhi: CSIR; 2005; 8(Ph-Re); 376- 391.
- 5) Alagesaboopathi, C., "An investigation on the antibacterial activity of *Rauwolfia tetraphylla* dry fruit extracts" *Ethanobotanical Leaflets*, 2009,13: 644-650.
- 6) Abubacker, M.N. and Vasantha, S. "Antibacterial activity of ethanolic leaf extract of *Rauwolfia tetraphylla* and its bioactive compound reserpine" *Drug Invention Today*, 2011, 3(3): 16-17.
- 7) Shariff, N., Sudarshana, M.S. et al "Antimicrobial activity of *Rauwolfia tetraphylla* and *Physalis minima* leaf and callus extracts" *Afr. J. Biotechnol*, 2006, 5(10): 946-950.
- 8) Suresh, K., Saravana, B. et al "Studies on in vitro antimicrobial activity of ethanol extract of *Rauwolfia tetraphylla*" *Ethanobotanical Leaflets*, 2008, 12: 586-590.
- 9) Ganga, B.R., Umamaheswara, P.R. et al "Evaluation of in-vitro antibacterial activity and anti-inflammatory activity for different extracts of *Rauwolfia tetraphylla* L. Root bark" *Asian Pac J Trop Biomed*, 2012, 2(10): 818-821.
- 10) Goutam, B., Mandal, L.C. et al "A new labdane diterpene from *Rauwolfia tetraphylla*" *Journal of Chemical Research*, 2011, 35(3): 678-680.
- 11) Shikha, G., Vinayak, K.K. et al "Bioactive guided isolation of antipsychotic constituent from the leaves of *Rauwolfia tetraphylla* L" *Fitoterapia*, 2012, 83: 1092-1099.
- 12) Vadakkemuriyil, D. N., Rajaram, P. and Ragupathi, G., "Studies on methanolic extract of *Rauwolfia* species from Southern Western Ghats of India- In vitro antioxidant properties, Characterisation of nutrients and phytochemicals" *Industrial Crops and Products*, 2012, 39: 17-25.
- 13) Gangarao, B., Umamaheswara, R. et al., Evaluation of *in-vitro* antibacterial activity and anti-inflammatory activity for different extracts of *Rauwolfia tetraphylla* L. root bark, *Asian Pac J Trop Biomed*, 2012, 2(10): 818-821.
- 14) Anonymous. The wealth of India: A Dictionary of Indian Raw Materials and Industrial Products, Publications and Information Directorate. New Delhi: CSIR; 2003; 166.
- 15) Parrota, J.A., Healing plants of Peninsular India, New York, USA: CABI Publishers, 2001, 120.
- 16) Villar, R., Calleja, J.M. et al Screening of 17 Guatemalan medicinal plants for platelet antiaggregant activity, *Phytother Res*, 1997, 11: 441-445.

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