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MIRACLE OF NATURE GYMNEMA SYLVESTRE - A REVIEW

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Abstract:

Higher plants are the source of a large number of chemicals with wide range of medicinal, pharmacological and insecticidal properties. In recent years there is a great demand for plant-based products because of the broad biological activities, safety without any toxic side effects and low impact on environment. *Gymnema sylvestre* (Family-Asclepiadaceae) is one of the important medicinal plants of India. *Gymnema* is popularly known as gurmar or Madhunashini for its remarkable property of temporally paralyzing the sensory perception of sweet. The active principle of the drug is widely used in indigenous medicine in the treatment of diabetes mellitus, complex mixture of gymnemic acids found in the leaves. Presently there is a vast market demand for this plant in national and international market. The present review describes the various morphological, medicinal, chemical, pharmacological activities and biotechnological aspects of *Gymnema sylvestre.*

Key Words: *Gymnema Sylvestre*, Antidiabetic, Gymnemic Acid & Antioxidant

Introduction:

Gymnema Sylvestre is a valuable herb belonging to the family-Asclepiadaceae, and widely distributed in India, Malaysia, Srilanka, Australia, Indonesia, Japan, Vietnam, tropical Africa and the southwestern region of the People's Republic of China. The plant is commonly known as Periploca of the woods (English); Gurmar (Hindi); the word "Gymnema" is derived from a Hindu word "Gurmar" meaning "destroyer of sugar" and it is believed that it might neutralize the excess of sugar present in the body in Diabetes mellitus.

Plant Description:

Gymnema sylvestre is a slow growing, perennial, woody climber, distributed throughout the India, in dry forests up to 600 cm height. It is mainly present in the tropical forest of Central and Southern India. It is also found in Banda, konkan, Western Ghats, Deccan extending to the parts of western and northern India. The plant is a large, more or less pubescent, woody climber. The leaves are opposite, usually elliptic or ovate (1.25–2.0 inch x 0.5-1.25 inch). Flowers are small, yellow, in axillary and lateral umbel in cymes; Follicles are terete and lanceolate up to 3 inches in length. The Calyx-lobes are long, ovate, obtuse and pubescent. Corolla is pale yellow campanulate, valvate, corona single, with 5 fleshy scales. Scales adnate to throat of corolla tube between lobes; Anther connective produced into a memberanous tip, pollinia 2, erect, carpels 2, unilocular; locules many ovuled.

Gymnema sylvestre is a potent anti-diabetic plant and used in folk, ayurvedic and homeopathic systems of medicine. It is also used in the treatment of asthma, eye complaints, family planning, snakebite, urinary complaints, stomach problems, piles, chronic cough, breathing troubles, colic pain, cardiopathy, constipation, dyspepsia and hemorrhoids, hepatosplenomegally.

Gymnema preparations modulate taste, particularly suppressing sweet taste sensations, and are used in the treatment of diabetes mellitus and in food additives against obesity and caries. *Gymnema* has become a popular natural product used in the management of blood sugar levels in individuals with diabetes and is believed by some to play a role in reducing serum lipids (Porchezhian & Dobriyal, 2003).

Medicinal Properties of *Gymnema Sylvestre:*

Traditional Uses:

Selvanayagam, Gnanavendhan, Chandhra Shekaran, Balakrishna and Rao.1995. Sushruta describes *Gymnema sylvestre*, as a destroyer of madhumeha (glycosuria) and other urinary disorders. Its property of abolishing the taste of sugar it has been given the name of gurmar meaning sugar destroyer. Hence, it is believed that it might neutralize the excess of sugar present in the body suffering from the Diabetes mellitus. In fact the sweet taste suppressant property of *Gymnema* was revealed to a British officer by the inhabitants of a northern Indian village in the mid-19th century. Traditionally, the leaves are also used as diuretic. Even now, people from some district of Tamil Nadu are in the habit of chewing a few green leaves of *Gymnema*, in the morning, in order to see their urine clear. *Gymnema* leaf extract is also used for the treatment of snake bite.

Agnihotri et al; 2004, EKKA & Dixit-2007, Srikant et al; 2010 and Nadkarni, 1993 reported that the Jungle Irulas, inhabitants of Nagari hills of the Chittoor District, Bombay and Gujarat from India, Bourgeosis of Bombay and Gujarat have the habit of chewing a few green leaves of G. sylvestre in the morning in order to keep the urine clear and to reduce glycosuria. In Bombay and Madras "Vaid" are known to recommend the

leaves in the treatment of furunculosis and Madhumeha. The Juice obtained from root is used to treat vomiting and in dysentery and the plant paste is applied with milk to treat mouth ulcer.

Kritikar and Basu 2007, Mohsina and Singh; 2014, Selvanayagam et al; 1995; *Gymnema Sylvestre* is used in folk medicine and Ayurvedic system of medicine to treat type 1 and 2 diabetes. It is also helpful for the treatment of urinary complaints, chronic cough, piles, stomach problems, breathing troubles, asthma, eye complaints, cardiopathy, jaundice, constipation and bronchitis. It is also used by trials to treat to neutralize the toxin of snake bite.

Antidiabitic Activity:

Verma et al. (2008), A study was undertaken to evaluate the antidiabetic activity of alcoholic extract of leaf of *Gymnema sylvestre* in streptozotocin induced diabetic rats. Glycoside is isolated from *G. sylvestre* investigated hypoglycemic activity of normal and streptozotocin induced diabetic rats and compared with glibenclamide reference drug. *Gymnema sylvestre* (250 mg/ kg/body weight) decrease blood glucose levels significantly ($p < 0.05$) at 2 and 4 h after the glucose load in glucose tolerance test. The results suggested that the alcoholic extract of *Gymnema sylvestre* possess significant hypoglycemic activity in normal and streptozotocin induced diabetic rats.

Grijesh Kumar Mall, Pankaj Kishor Mishra and Veeru Prakash., The concerned study reveals the experimental investigation of the biological activity of *Gymnema sylvestre* Ex schult (Family: Asclepiadaceae) used as a traditional antidiabetic and hypolipidemic agent in past and present culture. To study the effect of *Gymnema sylvestre* in both normal and alloxan induced diabetic rats. The aqueous leaf extract of *Gymnema sylvestre* at the dose of 400, 600 and 800 mg kg 1 body weight was administered orally once a day to the groups for 30 days. The fasting blood glucose, cholesterol, HDL cholesterol and serum triglyceride content were estimated in both normal and alloxan induced diabetic rats. The fasting blood glucose, cholesterol and serum triglyceride content were found to be significantly reduced ($p<0.05$) in treated rats whereas the extract also showed the potent elevation in the level of serum HDL cholesterol.

Antimicrobial Activity:

Gupta et al 2014 The petroleum benzene, ethanol, and aqueous leaf extract and isolated gymnemic acid from aquous extract of *Gymnema sylvestre* was assayed *in vitro* searching for antimicrobial activity against human pathogenic microorganism *(Escherichia coli, Vibrio cholera, Streptococcus mutans, Staphylococcus aureus Candida albicanse and Aspergillus niger).*The aqueous extract and isolated gymnemic acid of such medicinal plant showed the best zone of inhibition against the organisms. A maximum zone of inhibition was obtained *Staphylococcus aureus* (9.25mm) on gymnemic acid and aqueous extract showed (8.50mm) in comparison to others but aqueous extract present large inhibition of *Escherichia coli* (9.00mm) and *Candida albicanse* (8.76mm). The petroleum benzene extracts that showed minimum zone of inhibition or negative result against microorganisms Of plants extracts in all solvent and gymnemic acid assayed, the *Staphylococcus aureus* had the best performance, sometimes exhibiting higher activity than ciprofloxacin. A tiny amount of data is presented, as the preliminary antimicrobial properties of the medicinal plant, under the urgent necessity of new antibiotics in the market and in the face of the increased resistance of infectious microorganisms to antimicrobials.

Naidu et al., 2013). To investigate the antibacterial activity and phytochemical screening of the hexane, chloroform and methanol extracts of leaves of *Gymnema sylvestre*. The antibacterial activity was evaluated by agar well diffusion method against four Gram-negative (*Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Proteus vulgaris*) and five Gram-positive bacteria (*Bacillus subtilis*, *Enterococcus faecalis*, *Micrococcus luteus*, *Staphylococcus aureus*, *Streptococcus pneumoniae*). Phytochemical screening was performed according to the Harborne method. Methanol extract showed good antibacterial activity with the high inhibition zones, while chloroform extract exhibited mild to moderate activity and hexane extract was found to be less active. Phytochemical screening revealed the presence of various secondary metabolites like steroids, alkaloids, phenols, flavonoids, coumarins, saponins, tannins and triterpenoids. The results of the present study suggest that leaves of *Gymnema sylvestre* can be used to treating infectious diseases caused by *Escherichia coli* and *Staphylococcus aureus.*

Wani et al., The present study was undertaken to analyze the phytochemical components and for screening the antimicrobial activity of leaf extracts of *Gymnema sylvestre*. The qualitative analysis indicated the presence of alkaloids, phenolic compounds, flavonoids, saponins, cardiac glycosides, whereas sterols and anthraquinone glycosides were found to be absent in the methanolic extracts. Antimicrobial activity of *G. sylvestre* leaf extracts was studied. Aqueous and methanolic leaf extracts were studied against *Escherichia coli*, *Serratia marcescens*, *Staphylococcus aureus* and *Candida albicans* for their antimicrobial efficacy.The result of present investigation clearly indicates the antibacterial and antifungal activity of the plant and ascertains the value of this plant which could be of considerable interest to the development of new drugs.

Antioxidant Activity:

Kalyani Singh, Bandita Deo The *Gymnema sylvestre* R.Br. ethanolic extract showed antioxidant activity by inhibiting DPPH. Significant antioxidant activity of ethanolic leaf extract of *Gymnema Sylvestre*

R.Br. might be due to the presence of tannins, saponins, phenols, flavonoids and alkaloids found in the preliminary phytochemical analysis.

Anti-Obesity Activity:

Pierce, Ninomiya, Imoto, (1999).,*G. sylvestre* helps in weight loss possibly due to its ability to control blood sugar levels. It has been reported that the constituent Gurmarin peptide block the ability to taste sweet or bitter flavors and thus reduces sweet cravings.

Kaushik, et al., A standardized *G.sylvestre* extract in combination with niacin-bound chromium and hydroxycitric acid has been evaluated for anti-obesity activity by monitoring changes in body weight, body mass index (BMI), appetite, serum leptin, lipid profiles and excretion of urinary fat metabolites.This study showed that the combination of *Gymnema sylvestre* extract and hydroxycitric acid, niacin bound chromium can serve as an effective and safe weight loss formula that can facilitate a reduction in excess body weight and BMI while promoting healthy blood lipid levels10. Hexane fraction of *Gymnema sylvestre* used for the treatment of induced obesity in Sprague dawley rats. A significant (P>0.001) reduce in increased body weight, temperature due to obesity was observed after 45 day of treatment. The extract also improved the triglyceride, LDL, HDL, Cholesterol level. Observed data was found significreduction in obese rat treated with *Gymnema* extract.

Antiviral Activity:

Joseph et al.,(1968) Gymnemic acids A to D isolated from the aqueous extract of leaves of *Gymnema sylvestre* were tested againsy in vitro influenza virus. Viral growth cycle was studied in control and treated cultures. The yield of viral hem agglutinin and infectivity was measured. Gymnemic acid-A and B showed demonstrable inhibition of growth of viral infected cells while Gymnemic acid C and D was none investigated for their anti-viral activity.

Anti-Inflammatory Activity

Malik et al., (2008), Anti-inflammatory activity of aqueous extract of *G. sylvestre* was carried out using carrageenin-induced paw oedema and cotton pellet models in rats at 200, 300 and 500mg/kg.The activity was compared with the standard drug phenyl butazone. Aqueous extract decrease the paw oedema by 48.5% at 300mg/kg b.wt, whereas the standard drug by 57.6% within hrs. The aqueous extract at 200mg/kg and 300mg/kg produced significant reduction in granuloma weight also and the results were comparable to that of the standard drug phenyl butazone.

Free Radical Scavenging Activity:

Ohmori et al., (2005), Aqueous extract of G. sylvestre was screened for its free radical scavenging properties by DPPH and LDL oxidation method. It is found to be 32.1µl of aqueous extract is required to produce 50% of scavenging of the DPPH radicals.

Immunomodulatory Activity:

Jitender et al.,(2009)., *Gymnema sylvestre* aqueous leaf extract was tried for its immunomodulatory activity by determining neutrophil locomotion, chemotaxis test, phagocytosis of killed Candida albicans and nitroblue tetrazolium tests. The aqueous extract of leaves significantly increased thephagocytic function and chemo tactic movement at 25µg/ml. Also intracellular reduction of nitroblue tetrazolium dye to formazan was increased indicating killing property of neutrophils at 50µg/ml concentration. All these results showed Immunomodulatory activity of *Gymnema sylvestre.*

Anticancer Activity:

Srikanth et al., (2010).,Successive extracts of *Gymnema sylvestre* with chloroform, Ethyl acetate and 95% alcohol were evaluated against MCF 7 (epithelial cells of human breast cancer) and A 549 (epithelial cells of human lung cancer) by MTT assay. All the three extracts exhibited IC 50 value concentration dependently and at 50 and 100µg/ml exhibit IC 50 value similar to that of standard drug etoposide.

Snake Venom Neutralizing Effect:

Walter.et al., (2000)., *Gymnema sylvestre* was tested for antidote property against snake venom and found to be effective. The activity of the plant was believed to be due to gymnemgenin.

Wound Healing Activity:

Kiranmai et al., (2011).,Carbopol gels was prepared using hydroalcohoic extracts of *Gymnema sylvestre* and Tagetes erecta Linn. The prepared gel was evaluated for wound healing activity by excision wound model and burn wound models in albino mice. The study was compared with the standard metrogyl. Significant increase in percentage wound contraction was observed in groups treated with both extracts and were comparable to that of the standard.

Antiarthritic Activity:

David Beverly and Sudarsanam.(2013)., Aqueous and petroleum ether extracts of *Gymnema sylvestre* was evaluated for its antiarthritic activity in Freund‟s adjuvant induced arthritic rat and was found to be effective. The antiarthritic activity of the plant was believed to be due to rich source of saponins, triterpenoids and steroids.

Treatment of Dental Caries:

Akhtar and Bhakuni; 2004, Parimala Devi and Ramasubramaniaraja; 2010, Dental caries can be defined as infection of tooth, occurring due to various kinds of gram-positive cariogenic bacteria like *S. aureus*, *S. mitis*, and *S. mutans*, and fungus-like *Candida albicans* which attaches to the tooth surface through release of extracellular polysaccharides from sucrose and metabolize sugar to organic acid mainly lactic acid resulting in demineralization of the tooth enamel. The chloroform, petroleum ether, and methanolic leaf extracts of *G. sylvestre* at various concentrations of 25, 50, and 100 mg/mL were tested against microbial dental infections and found to be significantly effective against these cariogenic bacteria particularly the methanolic extract which showed highest activity at minimum concentration. The good potential of the hydroalcoholic extract of the plant leads to the development and manufacture of gurmar tooth powdered marketed as "Gurmar Herbal tooth paste" and "Gurmar Herbal Tooth powder." These herbal formulations offer new prospects in the treatment of dental caries once clinically approved by the scientific community.

Ethnobotanical Uses:

Kirtikar and Basu; 1975, Anis et al; 2000, Sastry; 1994, traditionally, the leaves of *G. sylvestre* were used for the treatment of diabetes and other disorders, while the flowers and bark are given in diseases related to phlegm. The ancient literature on Indian medicine, *Sushruta*, describes gurmar as a destroyer of madhumeha (glycosuria) and other urinary disorders. The extract of *G. sylvestre* is reported to be a bitter acrid, anti-inflammatory, anodyne, digestive, liver tonic, emetic, diuretic, thermogenic, stomachic, stimulant, anthelmintics, laxative, cardiotonic, expectorant, antipyretic, and uterine tonic. The plant also exhibits medicinal importance in the treatment of jaundice, constipation, cardiopathy, asthma, bronchitis, amenorrhoea, conjunctivitis, renal and vesical calculi, dyspepsia, leucoderma, and Parkinsonism. Reports in the ancient literature suggested that the plant has multiple medicinal applications, namely, antihelminthic, antipyretic, astringent, an alexipharmic, anodyne, cardiotonic, digestive, diuretic, cough dyspepsia, hemorrhoids, hepatosplenomegaly, laxative, stimulant, stomachic, uterine tonic, intermittent fever, jaundice, and leucoderma. The root bark is useful as an emetic, expectorant, and analgesic for bodyache and root juice in the treatment of snakebite. The plant extract is also useful in the treatment of piles, colic pain, dropsy, phlegm, eye troubles, cardiac, and respiratory diseases.

Biotechnological Approches:

Bishyee and Chatterjee, 1994). The plant cell and tissue culture has been successfully exploited for micropropagation of several important medicinal plants. In *Gymnema*, much work has done on establishing the reliable protocols for plant regeneration and large-scale multiplication *in vitro*. Cost efficient mass multiplication method for *Gymnema sylvestre* is reported using hydroponic system with 1/10 strength of MS salts with different concentrations of Indole butyric acid (IBA). Among all, MS with 0.5 mg/L of IBA produced highest rooting (66%) with 96 % survival. This protocol will serve as an alternative to the existing *in vitro* and clonal multiplication protocols.

Conclusions:

Gymnema sylvestre (Family-Asclepiadaceae) commonly known as gurmar or sugar destroyer, is seen in various parts of India. The woody climber is used for various diseases and disorders in traditional medicines such as glycosuria, urinary complaints, chronic cough, piles, stomach problems, breathing troubles, asthma, eye complaints, cardiopathy, jaundice, constipation and bronchitis. The current updated review on the plant highlights its botanical, pharmacognostical, phytochemical and pharmacological aspects of the climber. This updated review on the plant will be much more helpful for all those researchers who are all carrying out their investigations and research on this climber.

References:

1. Agnihotri A K, Khatoon S, Agarwal M, Rawat A S, Mehrotra S and Pushpangadan. Pharmacognostical evaluation of Gymnema sylves R. Br. Nat prod sci, 2004; 10(4):168-72.
2. Bishayee A and Chatterjee M. Hypolipidemic and antiatherosclerotic effects of Gymnema sylvestre leaf extract in albino rats fed on high fat diet. Phyt Res, 1994; 8(2): 118-20.
3. B. S. Sastry, Gymnema sylvestre, Bhav Prakash Nighantu, Chaukhambha, Varanasi, India, 1994.
4. B. Parimala Devi and R. Ramasubramaniaraja, "Pharmacognostical and antimicrobial screening of Gymnema sylvestre R.Br, and evaluation of Gurmar herbal tooth paste and powder, composed of Gymnema sylvestre R.Br, extracts in dental caries," International Journal of Pharma and Bio Sciences, vol. 1, no. 3, pp. 1–16, 2010
5. Chopra R N, Nayar S L and Chopra I C. Glossary of Indian Medicinal Plants; Supplement. Council of Scientific and Industrial Research, New Delhi, 1992; 319-22.
6. David Beverly C and Sudarsanam G. Antimicrobial activity of Gymnema sylvestre (Asclepiadaceae). Journal of Acute Disease, 2013; 2(3): 222-225.
7. Ekka N R and Dixit V K. Ethno-pharmacognostical studies of medicinal plants of Jashpur district (Chhattisgarh). International journal of Green Pharmacy, 2007; 1(1); 2-4.

8. Grijesh Kumar Mall, Pankaj Kishor Mishra and Veeru Prakash Antidiabetic and Hypolipidemic Activity of Gymnema sylvestre in Alloxan Induced Diabetic Rats Global Journal of Biotechnology & Biochemistry 4 (1): 37-42, 2009 ISSN 2078-466X
9. G. Kishor Naidu, K. Chandra Sekhar Naidu and B. Sujatha In Vitro Antibacterial Activity and Phytochemical Analysis of Leaves of Gymnema sylvestre Retz. R. Br. International Journal of PharmTech Research CODEN (USA): IJPRIF ISSN : 0974-4304 Vol.5, No.3, pp 1315-1320, July-Sept 2013
10. Jitender K M, Manvi F V, Nanjwade B K, Alagawadi K R and Sanjiv S. Immuno - modulatory activity of Gymnema sylvestre leaves extract on in vitro human neutrophils. J.Pharmacy Res, 2009; 2(8): 1284-1286.
11. Joseph ES, Gopal SR, Hugh MM, Smith RV, Massab HF and Cochran KW. Isolation and anti-viral activity of the Gymnemic acids. Specialia, Experientia, 1968; 15(3): 302-303.
12. Kiranmai M, Kazim SM and Ibrahim M. Combined wound healing activity of Gymnema sylvestre and Tagetes erecta Linn. Int. J. Pharmaceu. Appl, 2011; 2(2):135-140
13. Kalyani Singh, Bandita Deo Journal of Medicinal Plants Studies 2014; 2(4): 19-23
14. K. R. Kirtikar and B. D. Basu, Indian Medicinal Plants, vol. 3, Periodicals Experts, Delhi, India, 1975.
15. M. Surendra Kumar., N. Astalakshmi., Arshida. PT., Deepthi. K., Nidhin Devassia. M., Shafna. PM and G. Babu. World Journal of Pharmacy and Pharmaceutical Sciences, SJIF Impact Factor 5.210 .Volume 4, Issue 10, 430-448. Review Article ISSN 2278 – 4357.
16. Minal Wani, Faizan Ali Sarvar, Juhi Agrawal, Jyoti Deshpande,Siji Mathew, Madhukar Khetmalas Qualitative Phytochemical Analysis and antimicrobial activity studies of Gymnema sylvestre R. Br. Acta Biologica Indica 2012, 1(1):121-124
17. Malik JK, Manvi FV, Alagawadi KR and Noolvi M. Evaluation of anti-inflammatory activity of Gymnema sylvestre leaves extract in rats. Int J Green Pharm, 2008; 2(2):114-15.
18. M. Anis, M. P. Sharma, and M. Iqbal, "Herbal ethnomedicine of the Gwalior forest division in Madhya Pradesh, India," Pharmaceutical Biology, vol. 38, no. 4, pp. 241–253, 2000.
19. M. S. Akhtar and V. Bhakuni, "Streptococcus pneumoniae hyaluronate lyase: an overview," Current Science, vol. 86, no. 2, pp. 285–295, 2004
20. Nimisha verma, V.K. Shakya and R.C. Saxena Pest Control and Ayurvedic Drug Research Laboratory S.S.L. Jain P.G. College, Vidisha-464 001, India.
21. Ohmori R, Iwamoto T, Tago M, Takeo T, Unno T and Itakura H. Antioxidant activity of various teas against free radicals and LDL oxidation. Lipids, 2005; 40(8): 849-53.
22. Pratibha Gupta1 and Pratibha Singh Antimicrobial activity of Gymnemic acid on pathogens-Gymnema sylvestre R.Br international journal of current microbiology and applied science ISSN: 19-7706 Volume 3 Number 5 (2014) pp. 40-45
23. P. Marsh and M. Martin, Oral Microbiology, vol. 3, Chapman and Hall, London, UK, 1992.
24. Srikanth AV, Sayeeda M, Lakshmi NM, Ravikumar P and Madhava RB. Anticancer activity of Gymnema sylvestre R.Br. Int. J. Pharmaceu. Sci. Nanotech, 2010; 3(1):87-899.
25. Walter BM, Maria CDN, Bettina MRP and Nuno AP. Plant natural products active against snake-bite-the molecular approach. Phytochemistry, 2000; 55: 627-642.
26. Kritikar K and Basu B. Indian medicinal plants. Dehradun: International book distributors, 1998; 1625.
27. Mohsina Syedy and Krishnendra Singh Nama international journal of pure & applied bioscience (6): 318-325 (2014) ISSN: 2320 – 7051
28. Mohsina Syedy and Krishnendra Singh Nama. Gymnema sylvestre: A miracle fruit for Diabetes cure. International Journal of pure and applied bioscience, 2014; 2(6): 318-325.
29. Nadkarni KM. Indian Materia Medica. Popular prakashan, Bombay, 1993; 596-599.
30. Selvanayagam ZE, Gnanavendhan SG, Chandhra Shekaran P, Balakrishna K and Rao RB. Plants with antisnake venom activity- a review on pharmacological and clinical studies. Fitoterapia, 1995; 65: 99-11.
31. Subramaniyan Vijayakumar and Srinivasan Prabhu. Gymnema sylvestre – A Key for Diabetes Management – A Review. Pharmacology & Toxicology Research, 2014; 1(1):1-10.
32. Vaidyaratnam P. Indian Medicinal Plants. Orient Longman Publisher, Madras, 1995; 107-9.