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THERAPEUTIC USES OF *ANDROGRAPHIS PANICULATA* (BURM.F.) NEES AND THEIR OVERVIEW—A REVIEW

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ABSTRACT

Andrographis paniculata **(Burm. f.) Nees (Acanthaceae) (*A. paniculata*, *Chuanxinlian*), native to Taiwan, Mainland China and India, is a medicinal herb with an extremely bitter taste used to treat liver disorders, bowel complaints of children, colic pain, common cold and upper respiratory tract infection. According to Chinese medicine theory, *A. Paniculata* 'cools' and relieves internal heat, inflammation and pain and is used for detoxication. In addition, *A. paniculata* is also used for treating animal diseases, e.g. respiratory infection and diarrhoea, as an alternative to antibiotics. *Andrographis paniculata* is Widely found and cultivated in tropical and subtropical Asia, south-east Asia and India. The species is also reported from different phytogeographical and edaphic zones of China, America, West Indies and Christmas Island in Indian Ocean. Cultivation experiments were reported by different authors. In India the seeds of the species are sown in the months of May – June, flowers during August – November and the whole plant starts maturing during February – March. *A. paniculata* is prominent in 26 Ayurvedic formulations as evidenced from Indian Pharmacopoeia; while, in Traditional Chinese Medicine it is an important "cold property" herb used to release body heat in fever. *A. paniculata* is a diterpenoid lactone having a variety of pharmacological effects specified in ayurveda, unani, sidhha and traditional chinese medicine system. *A. paniculata* herb has been revered for treating infectious diseases and highly regarded as having preventative effects against ailments like liver damage, hyperglycaemia, dysentery, cancer, pulmonary tuberculosis, AIDS, acute and common cold, flu, myocardial infarction, inflammation, blood clotting etc. It has no toxic effects but yet it found unsafe during the pregnancy. Besides a great number of pharmaceutical uses, andrographolide has some side effects like nausea, vomiting, loss of appetite which can only be seen upon overdosing.**

Key Words : ***Andrographis paniculata, Therapeutic, Ayurvedic, Herb and Disease.***

Andrographis paniculata is an annual herbaceous plant in the family Acanthaceae, native to India and Sri Lanka. *Andrographis paniculata* Nees is widely used as an antipyretics, antibacterials and antivirals etc.[9]. In Thai Herbal Pharmacopoeia, the total lactones in the plant were determined by an acid base titration[27]. *Andrographis paniculata* (Burm. f.) Nees (Acanthaceae) (*A. paniculata*, *Chuanxinlian*), native to Taiwan, Mainland China and India, is a medicinal herb with an extremely bitter taste used to treat liver disorders, bowel complaints of children, colic pain, common cold and upper respiratory tract infection [33,40,23]. The aerial part of *A. paniculata* is commonly used in Chinese medicine. According to Chinese medicine theory, *A. Paniculata* 'cools' and relieves internal heat, inflammation and pain and is used for detoxication [20, 12, 26]. In addition, *A. paniculata* is also used for treating animal diseases, e.g. respiratory infection and diarrhoea, as an alternative to antibiotics (47). Modern pharmacological studies indicate that andrographolide protects the liver and gallbladder, and has been found to be slightly more active than Silymann, a known hepatoprotective drug [43] neo-and rographolide shows greater activity against malaria[29] and is hepatoprotective against carbon tetra-chloride[21]. The herb contains diterpenoids, flavonoids and polyphenols as the major bioactive components [38, 52]. Andrographis paniculata (Burm.f.) commonly known as Kalmegh is an important medicinal plant, occurring wild in India, and is used both in Ayurevda and Unani system of medicine (Chadha, 1985).

Taxonomic hierarchy

Kingdom	: Plantae
Division	: Angiospermae
Class	: Dicotyledoneae
Order	: Tubiflorae
Family	: Acanthaceae
Genus	: *Andrographis*

Species : *paniculata* Nees

Morphology and Microscopy of leaves of *A. paniculata* : The leaves of *A. paniculata* are dark in

color, simple, opposite, lanceolate, glabrous, 2–12cm long, 1–3cm wide; The leaves of *A. paniculata* have diacytic stomata at leaf's lower epidermis, glandular and non-glandular trichomes, fairly large cystoliths, columnar palisade cells, collenchymas in midrib beneath epidermis; spongy parenchyma cells; vascular bundles of lignified spiral, scalariform and reticulate xylem vessels in the upper part and lignified phloem in the lower part, small acicular calcium oxalate crystals, a layer of wavy-walled lower epidermis cells, dense collenchyma at the corners of stems, a layer of thick-walled endodermis cells and parenchyma contains chloroplastid (7).

Cultivation and Distribution

Andrographis paniculata is Widely found and cultivated in tropical and subtropical Asia, south-east Asia and India (11). The species is also reported from different phytogeographical and edaphic zones of China, America, West Indies and Christmas Island in Indian Ocean(25). Cultivation experiments were reported by different authors, namely, (17, 30, 32) amongs others and they were of the opinion that in general *A. paniculata* prefers sunny condition and is raised from seeds. The seedlings raised in nursery beds should be transplanted to field at a distance of 60 cm × 30 cm with 1 to 3 irrigations during the day periods particularly at flowering stage. In India the seeds of the species are sown in the months of May – June, flowers during August – November and the whole plant starts maturing during February – March. Maximum harvest of total diterpene lactones was noted at blooming from the aerial part. *Andrographis paniculata* plant grows

well in all types of soil which explains its wide distribution. It grows in soil types where almost no other plant can be cultivated, particularly 'serpentine soil', which is relatively high in metals such as aluminum, copper and zinc (42). However, soil that is flooded or wet throughout the year may be avoided for its cultivation (22). (49) recommended the use of vermicompost coirpith for the reclamation of soils from industrial sites for the cultivation of A. paniculata in a small scale nursery.

Therapeutic Uses

A. paniculata is prominent in 26 Ayurvedic formulations as evidenced from Indian Pharmacopoeia; while, in Traditional Chinese Medicine it is an important "cold property" herb used to release body heat in fever (8). The species is well explored therapeutically and effectively used as immunostimulant (35) and for asthma, gonorrhea, piles (36), dysentery and dyspepsia (6), blood purification (51), phary-ngitonsillitis(46), fever (1), loss of scalp hair (19), snake bite (18), myocardial ischemia (16), common cold (28), diabetes(53), respiratory tract infections(13), jaundice (48) amongs others. The species also possesses antiulcerogenic (50), antityphoid (5), anti snake venom (44), antiplatelet aggregation (4), anti HIV (10), antimalarial (14), antifertility(3), anti-inflamatory (45) and antihyperglycemic (37) properties. Bioeffectivity of the species against phytopathogens (bacteria-Erwinia

caratovora, Pseudomonas marginales, *P. syringae, P. aeruginosa and Xanthomonas compestris; fungi-Acremonium strictum, Alternaria alternata, Aspergillus flavus, Bipolarise bicolour, Cladosporium herbarum, Curvularia lunata, Fusarium oxysporum, Pencillium expansum, Rhizoctonia solani, Tiarosporella phaseolina and Ustilago maydis*) was noted from methanolic (95%), chloroform (80%) and hexane (65%) extracts (8). Ethanolic extract of the leaves of *A. paniculata* was reported to inhibit growth of Escherichia coli and Staphylococcus aureus(15), while, methanolic extract was effective against Proteus vulgaris (31). Komwatchara (24) and Rassamee-masmaung(39) reported that *A. paniculata* has inhibitory effect against Porphyromonas gingivalis (34). reported significant antimicrobial activity of aqueous extract of the species containing andrographolide and arabinogalactan proteins. Roy et al. (41) also assessed the anti-microbial activity from inhibition zones, minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) values of *A. paniculata* extracts (chloroform and chloroform+HCl) on four gram positive bacteria (*Staphylococcus aureus, Bacillus subtilis, Enterobacter faecalis, S. epidermidis*) as well as five gram-negative bacteria (*Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Salmonella typhimurium, Enterobacter cloacae*) and suggested the utility of the species in development of novel broad spectrum antimicrobial agents.

Infectious disease

Andrographolide is found to be active against pulmonary type of tuberculosis, tuberculous meningitis and acute pyelonephritis. Intra-arterial or retrograde intravenous injections of the herb were reported to be effective in thromboangiitis obliterans, especially of “heat toxic type”. Ten cases of viper bites were reportedly cured in 3-5 days by a compound formula containing *A. paniculata* as the chief constituent. A phase I, dose-escalating clinical trial of and rographolide was conducted on 13 HIV-positive patients and five HIV-negative healthy volunteers. Andrographolide administration significantly improved the CD4+ lymphocyte count from a baseline mean of 405 cells/mm (Bhardwaj A) to 501 cells/mm^3 in HIV-positive patients. There were no statistically significant changes in mean plasma HIV-1 RNA levels. *A. paniculata* has also been used for uncomplicated upper respiratory tract infections (URTIs) (2).

CONCLUSION

A. paniculata is a diterpenoid lactone having a variety of pharmacological effects specified in ayurveda, unani, sidhha and traditional chinese medicine system. This herb has been revered for treating infectious diseases and highly regarded as having preventative effects against ailments like liver damage, hyperglycaemia, dysentery, cancer, pulmonary tuberculosis, AIDS, acute and common cold, flu, myocardial infarction, inflammation, blood clotting etc. It has no toxic effects but yet it found unsafe during the pregnancy. Besides a great number of pharmaceutical uses, andrographolide has some side effects like nausea, vomiting, loss of appetite which can only be seen upon overdosing. Therefore, research may further be undertaken to develop potent formulations consisting of *A. paniculata* and its isolated molecule, andrographolide by making use of novel herbal drug delivery systems like microparticles.

REFERENCES

1. Ahmad, M. and Asmawi, M. A. study of the hypoglycaemic property of *Andrographis paniculata* Nees. 7th Asian Symposium on Med Plants, Spices and other Natural Prod (ASOMPS VII): Manila; 1992.
2. Akbar S. *Andrographis paniculata*: A review of pharmacological activities and clinical effects. Int J Health Sci; author of book Garlic – *The Stinking Magic Herb. 16(1) :* 66-77. (A)
3. Akbarsha MA, Murugaian P. Aspects of the male reproductive toxicity/male antifertility property of andrographolide in albino rats: effect on the testis and the cauda epididymidal spermatozoa. *Phytother Res* 2000; 14:432-5. http://dx.doi.org/10.1002/1099-1573(200009)14:6<432::AID-PTR622>3.0.CO;2-I
4. Amroyan E, Gabrielian E, Panossian A. Inhibitory effect of andrographolide from *Andrographis paniculata* on PAF-induced platelet aggregation. Phytomed 1999; 6(1):27-31. http://dx.doi.org/10.1016/S0944-7113(99)80031-2
5. Anonymous. The Wealth of India: Raw Materials. Vol. IA, Council of Scientific and Industrial Research, New Delhi; 1985.
6. Bhalla NP, Sahu TR, Mishra GP, Dakwale RN. Traditional plant medicines of Sagar district, Madhya Pradesh, *India. J Econ Tax Bot 1982; 3:* 23-32.
7. Bobbarala V, Katikala PK, Naidu KC, Penumajji S. Antifungal activity of selected plants extracts against phytopathogenic fungi *Aspergillus niger*. *Indian J Sci Technol 2009; 20(4)*: 87-90.

8. Bunyapraphatsara, N. and Chokecharoenporn, V. 1997. Native herbs Prachachon Co. Ltd. Bangkok, Thailand
9. Calabrese C, Berman SH, Babish JG, Ma X, Shinto L, *et al.* A phase I trial of andrographolide in HIV positive patients and normal volunteers. *Phytother Res*. 2000; 14:333-8. http://dx.doi.org/10.1002/1099-1573(200008)14:5<333::AID-PTR584>3.0.CO;2-D
10. Chang HM, But PPH, eds. Pharmacology and Applications of Chinese Materia Medica. Vol. 1. Singapore, World Scientific 1986:918-928.
11. Chao WW, Kuo YH, Li WC, Lin BF: The production of nitric oxide and prostaglandin E2 in peritoneal macrophages is inhibited by *Andrographis paniculata*, *Angelica sinensis* and *Morus alba* ethyl acetate fractions**.** *J Ethnopharmacol* 2009, 122:68-75.
12. Coon JT, Ernst E. *Andrographis paniculata* in the treatment of upper respiratory tract infections: a systematic review of safety and efficacy. *Planta Med* 2004; *70(4):* 293-8. http://dx.doi.org/10.1055/s-2004-818938 PMid:15095142
13. Dua VK, Ojha VP, Roy R. Anti-malarial activity of some xanthones isolated from the roots of *Andrographis paniculata*. *J Ethnopharmacol* 2000; 95(2-3):247-51. http://dx.doi.org/ 10.1016/j.jep.2004.07.008
14. George M, Pandalai KM. Investigations on plant antibiotics part IV. further search for antibiotic substances in Indian medicinal plants. *Indian J Med Res 1949; 37:* 169-81.
15. Guo Z, Zhao H, Zheng X. An experimental study of the mechanism of *Andrographis paniculata* nees (APN) in alleviating the Ca^{2+}- overloading in the process of myocardial ischemic reperfusion. *J Tongji Med Univ.* 1995; 15:205-8. http://dx.doi.org/10.1007/BF02887945 PMid:8731924
16. Gupta V, Srivastava VK. Evaluation studies on Kalmegh (*Andrographis paniculata* Nees). *Ind J Pl Genet Resour* 1995; 8:141-3.
17. Gupta V, Srivastava VK. Kalmegh- from ethnobotanical realm to modern medication. *IV Int Cong Ethnobiol,* NBRI, Lucknow; 1994.
18. Home C, Roy L, Roy A. Management of khalitya (*Alopecia areata*) by Ayurvedic approach. Int Sem on Traditional Medicine: Calcutta; 1992. p. 124.
19. Huang CJ, Wu MC: Differential effects of foods traditionally regarded as 'heating' and 'cooling' on prostaglandin E_2 production by a macrophage cell line**.** *J Biomed Sci* 2002, 9:596-606.
20. Kapil, A., Koul, I.B., Banerjee, S.K., Gupta, B.D., 1993. Antihepatotoxic effects of major diterpenoids constituents of *Andrographis paniculata. Biochem. Pharmacol. 46,* 182–185.
21. Kasetklangklung. *Andrographis paniculata*, Thai medicinal plant. *J Transfer Tech Agri* 1996; 2(14):6-17.
22. Kligler B, Ulbricht C, Basch E, Kirkwood CD, Abrams TR, Miranda M, Singh Khalsa KP, Giles M, Boon H, Woods J: *Andrographis paniculata* for the treatment of upper respiratory infection: a systematic review by the natural standard research collaboration**.** *Explore* 2006, 2(1):25-29.
23. Komwatchara T. The development of *Andrographis paniculata* extract gel for microbial inhibition in adult periodontitis. *M.Sc. Thesis, Graduate School, Mahidol University.* Bangkok: Thailand; 1996.
24. Lattoo SK, Khan S, Dhar AK, Choudhary DK, Gupta KK *et al. Genetic and mechanism of induced male sterility in Andrographis paniculata (Burm. f.) Nees and its significance. Curr Sci 2006; 9(4):515-9.*
25. Mandal SC, Dhara AK, Maiti BC: Studies on Psychopharmacological Activity of *Andrographis paniculata* Extract**.** *Phytother Res* 2001, 15:253-256.
26. Medical Sciences Department "Fa-Tha-Lai". 1995. Thai Herbal Pharmacopoeia vol. I, Prachachon Co. Ltd. Bangkok, Thailand.
27. Melchior J, Palm S, Wikman G. Controlled clinical study of standardized *Andrographis paniculata* extract in common cold-a pilot trial. Phytomed 1996; 34:315-8. http://dx.doi.org/ 10.1016/S0944-7113(97)80002-5
28. Misra, P., Pal, N.L., Guru, P.Y., Katiyar, J.C., Srivastava, V., Tandon, J.S., 1992. Antimalarial activity of *Andrographis paniculata* (Kalmegh) against plasmodium berghei NK 65 in Mastomys natatensis. *Int. J. Pharmacogenomics 30,* 263–274.
29. Muniramappa RP, Farooqi AA, Gowda HGR, Maricapu S. Influence of macronutrients on yield and active principle content in Kalmegh. *J Med Arom Plant Sci 1997; 19:* 1039-42.
30. Nakanishi K. Phytochemical surveyof Malaysian plants: Preliminary chemical and pharmacological screening. Chem Pharmaceut Bull 1965; 13:882-90. http://dx.doi.org/ 10.1248/cpb.13.882
31. Nandi RP. Increase in productivity regime of some well known medicinal and aromatic plants used in Ayurvedic system of medicines. *Adv Plant Sci*. 1992; 5:274-82.
32. Negi AS, Kumar JK, Luqman S, Sbanker K, Gupta MM, Kbanuja SPS: Recent advances in plant hepatoprotectives: a chemical and biological profile of some important leads**.** *Med Res Rev* 2008, 28(5):821.
33. Prajjal K, Singha S, Roy, Dey S. Antimicrobial activity of *Andrographis paniculata*, *Fitoterapia* 2003; 74(7-8):692-4. http://dx.doi.org/10.1016/S0367-326X(03)00159-X
34. Puri A, Saxena R, Saxena RP, Saxena KC, Srivastava V, *et al.* Immunostimulant agents from *Andrographis paniculata*. *J Nat Prod 1993; 56:* 995-9. http://dx.doi.org/10.1021/np50097a002 PMid:8377022
35. Rao MR. Flowering Plants of Travancore. Bishen Singh Mahendra Pal Singh: The University of California; 1914. p. 307-8.
36. Rao NK. Anti hyperglycemic and renal protective activities of *Andrographis paniculata* roots chloroform extract. *Iranian J Pharmacol Ther 2006; 5(1):* 47-50.

37. Rao YK, Vimalamma G, Rao CV, Tzeng Y: Flavonoids and andrographolides from *Andrographis paniculata*. *Phytochemistry* 2004, 65:2317-2321.
38. Rassameemasmaung S. Subgingival administration of *Andrographis paniculata* gel as an adjunct in the treatment of adult periodontitis. M.Sc. Thesis, Graduate School, Mahidol University. Bangkok:
39. Roxas M, Jurenka J: Colds and influenza: A review of diagnosis and conventional, botanical and nutritional considerations. *Altern Med Rev* 2007, 12:25-48.
40. Roy S, Rao K, Bhuvaneswari C, Giri A, Mangamoori LN. Phytochemical analysis of *Andrographis paniculata* extract and its antimicrobial activity. *World J Microbiol Biotechnol* 2010; 26:85–91. http://dx.doi.org/10.1007/s11274-009-0146-8
41. Samantaray S, Rout GR, Das P. Heavy metal and nutrient concentration in soil and plants growing on a metalliferous chromite minespoil. *Enviro Tech 2001; 22:*1147-54. http://dx.doi.org/10.1080/09593332208618204.
42. Saraswat, B., Visen, P., Patanik, G.K., Dhawan, B.N., 1995. Effect of andrographolide against galaetosamine-induced hepatotoxicity. *Fitoterapia* 66, 415–420.
43. Selvanayagam ZE, Gnanavendhan SG, Chandrasekharan P, Balakrishna K, Rao RB. Plants with antisnakevenom activity – a review on pharmacological and clinical studies. Fitoterapia 1994; 65:99-111.
44. Shen YC, Chen CF, Chiou WF. Andrographolide prevents oxygen radical production by human neutrophils: possible mechanism(s) involved in its anti-inflammatory effect. *Br J Pharmacol* 2002; 135(2) : 399-406. http://dx.doi.org/ 10.1038/sj.bjp.0704493 PMid:11815375 PMCid : 1573154
45. Thamlikitkul V, Dechatiwongse T, Theerapong S. Efficacy of *Andrographis paniculata,* Nees for pharyngotonsillitis in adults. *J Med Assoc Thai* 1991; 74(10):437-42. PMid:1797953
46. Tipakorn N, 2002. Effects of Andrographis paniculata (Burm.F.) Nees on performance, mortality and coccidiosis in broiler chickens. *Ph.D. thesis. Institute of Animal Physiology and Animal Nutrition,* Georg-August-Universitat, Gottingen.
47. Tomar GS, Tiwari SK, Chaturvedi GN. Treatment of jaundice (Kamla) with *Andrographis paniculata* Nees (Kalmegh). *Proc Asian Conf on Traditional Asian Med:* Bombay; 1983.
48. Vijaya D, Padmadevi SN, Vasandha S, Meerabhai RS, Chellapandi P. Effect of vermicomposted coirpith on the growth of *Andrographis paniculata*. *J Org Syst* 2008; 3(2):51-6.
49. Viswanathan SP, Kulanthaivel SK, Nazimudeen T, Vinayakam C, Gopalakrishnan *et al*. The effect of apigenin 7,4'-di-O-methyl ether, a flavon from *Andrographis paniculata* on experimentally induced ulcers. *Ind J Pharm Sci.* 1981; 43:159-61.
50. Vohora SB. What is purification of blood? Hamdard 1985; 28:72-84.
51. Xu C, Chou GX, Wang ZT 2010: A new diterpene from the leaves of *Andrographis paniculata* Nees. *Fitoterapia*.
52. Zhang XF, Tan BK. Antihyperglycaemic and anti-oxidant properties of *Andrographis paniculata* in normal and diabetic rats. *Clin Exp Pharmacol Physiol* 2000; 27:358-63. http://dx.doi.org/ 10.1046/j.1440-1681.2000.03253.x PMid:10831236
53. Zhou Z. Cultivation of *Andrographis paniculata*. Chung Yao Tung Pao 1987; 12:15-8. PMid:3446398