International Journal of Pharmaceutical Research and Development (IJPRD)
Platform for Pharmaceutical Researches & Ideas
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A REVIEW ON *ACACIA NILOTICA* LINN. AND ITS ETHNOBOTANY, PHYTOCHEMICAL AND PHARMACOLOGICAL PROFILE

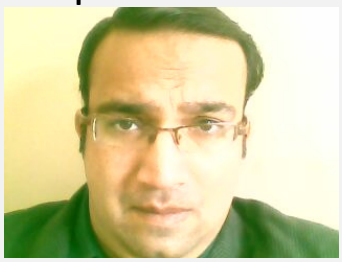
Verma Vikrant*[1],
Singh Umesh Kumar[1], Sharma Anuj Kumar[1] ,Sharma Suparna[1],Singh Brijendra[2], Goyal Prashant[2],Singh Rahul[2]

[1]Department of pharmacy Kharvel Subharti College of Pharmacy Swami Vivekanand Subharti University Meerut
[2] Shreya Life Sceinces

ABSTRACT
Acacia nilotica (Linn.) Willd. Ex Del., is a medicinal tree, belonging to the Leguminosae family and sub-family Mimosaceae, a moderate sized, spiny, evergreen tree found throughout India, known to be rich in phenolics, consisting of condensed tannin and phlobatannin, gallic acid, (+) catechin, (-) epigallocatechin-7-gallate, and has been used for treatment of viral (colds, bronchitis), bacterial (diarrhoea), amoeboid (dysentery),fungal, bleeding piles and leucoderma diseases. The present review summarizes the information concerning the botany, ethnopharmacology, phytochemistry, biological activity and toxicity of the Acacia nilotica Linn.

Keywords *Acacia nilotica (Linn.), medicinal tree, ethnopharmacology , toxicity .*

Correspondence to Author



Verma Vikrant

Department of pharmacy Kharvel Subharti College of Pharmacy Swami Vivekanand Subharti University Meerut

Email: vijeetsingh84@rediffmail.com

INTRODUCTION

Occurrence, Botanical Description And Ethnopharmacology

Acacia nilotica (Linn.) Willd. ex.Del. belonging to the Leguminosae family and sub-family Mimosaceae consists of dried mature stem bark having moderate sized, spiny, evergreen tree found throughout India. *Acacia* is one of about 135 thorny African Acacia species. Variation is considerable with nine subspecies presently recognized, three occurring in the Indian subcontinent and six throughout Africa [1]. The common name of this tree is Babula tree, Indian gum arabic tree.

Widespread Occurance

The species is naturally widespread in the drier areas of Africa, from Senegal to Egypt and down to South Africa, and in Asia from Arabia eastwards to India, Burma and Sri Lanka. It has also been cultivated elsewhere, including Australia, Cape Verde islands, Indonesia, Iran, Iraq, Nepal, Vietnam, and the West Indies. It is indigenous to the plains of Andhra Pradesh and Maharashtra in

India. *Acacia nilotica* occurs from sea level to over 2000 m.

Climate Requirement

It withstands extremes of temperature (-1 to 50^0C), but is frost tender when young. Annual rainfall varies from 250 - 1500 mm. Trees are generally deciduous during the dry season, though riverine species can be almost evergreen [2].

Physical Characterstics

It is a moderate-sized, almost evergreen tree with a short trunk, and a spreading crown. The bark is dark brown to almost black, longitudinally fissured or deeply cracked. Leaves are 2-pinnate and the main rachis has glands. Stipular spines are variable. Leaflets are sub sessile and glabrous. Flowers golden-yellow, fragrant, crowded in long-stalked globose heads, forming auxiliary clusters of 2-5 heads. Pods are stalked, 7.5-15.0 cm in length and contracted between the circular seeds [3-5].

Traditional Uses and Knowledge Acquired During Work

The stem bark of *Acacia nilotica* Linn. for the treatment of tonsillitis.[6] In traditional practice the plant is used for the treatment of tuberculosis, pneumonia, gonorrhea and small pox.[7] Ethnobotanical study reported the plant to be most frequently used for the treatment of sexually transmitted diseases (STDs) [8]. The antimicrobial activity of the plant extract showed that it is active against *S. aures, E. coli* [7]. The methanolic extract of the plant showed significant inhibition of gram-positive and gram-negative bacteria [8] whereas, the ethanolic extract of the plant displayed activity against gram-positive bacteria only [9]. Apart from its antibacterial activity, the plant possesses antifungal activity, and molluscicidal activity against schistosomiasis transmitting snails *Bulinus truncatus* and *Biomphalaria pfeifferi* and cercarcidal and miracicidal activity against *Schistosoma mansoni* [10, 11]. Also, the methanol extracts of the bark and pods of *Acacia nilotica* and aqueous extracts of *pods of A. nilotica* inhibited HIV-1 Protase replicate activity [12]. *Acacia nilotica* has also been reported to possess antiplasmodial activity *in vitro* against *Plasmodium falciparum* 3D7 (chloroquine sensitive) and Ddz (chloroquine resistant and pyrimethamine sensitive) with an IC50 value of less than 5µg/ml. Bioassay guided fractionation of *Acacia nilotica* revealed that the ethylene extract possessed the highest activity (IC_{50} =1.5µg/ml) [13] . *Acacia nilotica* extract had an inhibitory effect on carrageen induced paw edema and yeast- induced pyrexia in rats and produced a significant increase in the hot plate reaction time in mice. Flavonoids, polysaccharides and organic acids may be mainly responsible for its 60 pharmacological activities. [14] Also, a steroid 3β-acetoxy-17β-hydroxy-androst-5-ene isolated from aerial parts of *Acacia nilotica* showed dose-dependent anti-inflammatory activity against TPA-induced mouse ear edema [15].

Phytochemistry

Acacia nilotica Linn. have been reported to contain alkaloids, flavonoids, gum ,fatty acids and tannins. It consists principally of arabin a compound of arabic acid with calcium, varying amounts of the magnesium and potassium salts of the same acid being present. It is believed, also, that small amounts of other salts of these bases occur. (Arabic acid can be obtained by precipitating with alcohol from a solution of acacia acidulated with hydrochloric acid.) The gum also contains 12 to 17 per cent of moisture and a trace of sugar, and yields 2.7 to 4 per cent of ash, consisting almost entirely of calcium, magnesium and potassium carbonates [16-20]. It contains gallic acid, m-digallic acid,(+)-catechin, chlorogenic acid, gallolyated flavan-3,4-diol and robidandiol (7,3',4'5',-tetrahydroxyflavan-3,4-diol) [21]. It also contains 29% oleic, 44.5% linoleic acid) [22]. Seeds of *A. nilotica* contained coronaric acid (*cis*-9,10-epoxyoctadec-*cis*-12-enoic [23-25]. The alkaloids found in acacia include dimethyltryptamine (DMT), 5-methoxy dimethyltryptamine (5-MeO-DMT) and N-methyltryptamine (NMT) [26]. Gum contains galactose,l-arbinose,l-rhamnose and 4-aldobiouronic acids,arabinobioses [27]. Bark contains several polyphenols.Bark from Egypt have higher tannin content (27%)than that from India, It has been reported that various parts of the plant are rich in tannins (ellagic acid, gallic acid, tannic acid), stearic acid, vitamin-C (ascorbic acid),

carotene, crude protein, crude fiber, and selenium.[28-34]Bark consists of octaconsanol,betulin ,β-amyrin and β-sitosterol.[35] Mainly flavonoids are apigenin-6,8-*bis*-C-β-D-glucopyranoside (vicenin).[36] (+)-catechin-5,7-digallate, (+)-Catechin-3-,5-digallate, (+)-Catechin-4-,5-digallate,[37] melacacidin[38], rutin (quercetin 3-*O*-rutinoside)[39-41]12-dimethylbenz(a)anthracene [42].

Bioactivity

Acacia nilotica Linn. has been found to possess significant antimicrobial activity, antioxidant, antidiarrhoeal, anticancer and antimutagenic properties, anthelmintic activity, antiplatelet aggregatory activity and vasoconstrictor.

Antibacterial Activity

The methanolic extract of *Acacia nilotica* leaf showed significant activity against *E. coli, S. aureus*. The highest antibacterial activity of 20 mm in *B. subtilis* and least activity recorded in *E. coli* measured 14 mm. Bark extract of *Acacia nilotica Linn.* exhibit highest activity against *B. subtilis* and *S. aureus* (15 mm) and lowest in *P. fluorescens*.

Anthelmintic Activity

In vitro anthelmintic activity of crude methanolic extract (CME) of the plants was determined against *Haemonchus contortus* by the adult motility assay, the egg hatch test and the larval development assay. *In vivo* anthelmintic activity was evaluated in sheep naturally infected with gastrointestinal nematodes by administering increasing doses of crude powder (CP) and CME (1.0–3.0 g/kg). The plants exhibited dose- and time-dependent anthelmintic effects by causing mortality of worms, and inhibiting egg hatching and larval development [45].

Anticancer And Antimutagenic Properties

The chemotherapeutic activity of aqueous extracts of *Acacia nilotica* (Linn.) gum, flower and leaf is due to 7, 12–dimethylbenz(a) anthracene (DMBA) and croton oil induces skin papillomagenesis in male Swiss albino mice. Thus a significant reduction in the tumor burden, tumor incidence, and cumulative number of papillomas was noted, with a marked increase in the latency period as compared to the animals treated with single topical application of DMBA alone and croton oil. Significant reduction in micronuclei number and chromosomal aberrations in the form of chromatid breaks, chromosome breaks, centric rings, dicentrics, acentric fragments and exchange was also apparent [42,46].

Antidiarrhoeal Activity

Methanol extracts of *Acacia nilotica* showed highest inhibition and the activities were reported at the concentration of 50 g/ml Chloroform extracts of *Acacia nilotica,* were found active at the concentration of 100 gm/ml. Aqueous and petroleum ether extracts of *Acacia nilotica* inhibited the pathogen at the concentration of 500 gm/ml [47].

Antioxidant Activity

The extracts of *Acacia nilotica* pod exhibited strong and effective in vitro and in vivo antioxidant potential by chelation to metal ions as well as scavenging free radical. Presence of polyphenols is hold responsible for their overall antioxidant potential. It can also prevent strand break formation in supercoiled plasmid DNA and protein oxidation [48-50].

Antihypertensive And Antispasmodic

A methanol extract of *Acacia nilotica* Linn. pods caused a dose-dependent (3-30 mg/kg) fall in arterial blood pressure. Treatment of animals with atropine abolished the vasodilator response of acetylcholine (ACh), whereas the antihypertensive effect of the plant extract remained unaltered. Phentolamine (an alpha-adrenergic blocker) abolished the vasoconstrictor effect nor epinephrine (NE), whereas pretreatment of the animal , did not modify the NE response. These results indicate that the antihypertensive effect of plant extract is independent of muscarinic receptor stimulation or adrenoceptor blockade. In the in vitro studies, *Acacia nilotica* produced a dose-dependent (0.3-3 mg/ml) inhibitory effect on force and rate of spontaneous contractions in guinea-pig paired atria. Similarly, it inhibited the spontaneous contraction of rabbit jejunum in a concentration-dependent (1-3. mg/ml) manner. *Acacia nilotica* also inhibited K(+)-induced contractions in rabbit jejunum at a similar concentration range, which suggests that the antispasmodic action of *Acacia*

nilotica is mediated through calcium channel blockade, and this may also be responsible for the blood pressure lowering effect of *Acacia nilotica* observed in the *in vivo* studies [51,52,53].

Anti Inflammatory Activity

3-beta-Acetoxy-17beta-hydroxy-androst-5-ene was isolated from aerial parts of *Acacia nilotica* (L.) Willd (Mimosaceae). The structure of this compound was established by spectral analysis and single crystal X-ray diffraction analysis. The steroid showed dose-dependent anti-inflammatory activity against TPA-induced mouse ear edema [54].

Immunosuppressive effect

Acacia nilotica Delile (Mimosaceae) stem bark showed immunosuppressive effect *in vivo* [55].

CONCLUSION

Acacia nilotica Linn. is an important source of many therapeutically and pharmacologically active constituents. The plant has been widely studied for its pharmacological activities and finds its position as a versatile plant having a wide spectrum of medicinal activities.

REFERENCES

1. Brenan. Manual on the taxonomy of Acacia species: Present taxonomy of four species of Acacia (*A. albida, A. senegal, , A. tortilis*), FAO, Rome, Italy 1983; 47 .
2. Fagg CW, Greaves A. *Acacia nilotica*. Annotated bibliography No. F42. CAB International, Wallingford, Oxon, UK 1990;77
3. Ahead Cd, Csir, New Delhi.
4. Amos S. *et. al*., Phytother. Res. 1999; 13(8):683-685.
5. Tybirk K. Flowering, pollination, seed production of *Acacia nilotica*, Nordic Journal of Botany 1989; 9 (4):375-381.
6. Ruffo CK. A survey of Medicinal plants in Tabora region, Tanzania In:Proceedings of International Conference on Traditional Medicinal Plants 1991; 101-111.
7. Khan MR, Nkunya MH. Antimicrobial activity of Tanzanian Traditional Medicinal plant, In: Proceedings of International Conference on Traditional Medicinal Plants 1990; 48-63.
8. Kambizi L,Afolayan AJ.An ethnobotanical study of plants used for the treatment of sexually transmitted diseases in Guruve District, Zimbabwe,J.*Ethnopharmacol* 2001; 77(1): 5-9.
9. Khafagi IK. Screening in vitro cultures of some Sinai medicinal plants for their antibiotic activity, *Egyptian Journal of Microbiology* 1999; 34(4).
10. Rizk AM, El-Ghazaly GA. Medicinal and poisnous plants of Qatar, The Scientific and Applied Research Center University of Qatar, Doha 1995.
11. Nazif NM, Soliman AM, Radwan H M . Bioassay guided isolation of molluscicides from certain medicinal plants, *Hamdard Medicus* 2001; 44 (2): 33-37.
12. Hussein G, Miyashiro H, Nakamura N, Hattori M, Kawahata T, Otake T, Kakiuchi N, Shimotohno K. Inhibitory effects of Sudanese plant extracts on HIV-1 replication and HIV-1 protease, *Phytother Res* 1999; 13(1): 31-36.
13. El-Tahir A, Satti GM,Khalid SA . Antiplasmodial activity of selected Sudanese medicinal plants with emphasis on *Acacia nilotica*, *Phytother Res* 1999; 13(6): 474-478.
14. Dafallah A A, Al-Mustafa Z. Investigation of the anti-inflammatory activity of *Acacia nilotica* and *Hibiscus sabdariffa*, *American Journal of Chinese Medicine* 1996; 24(3-4): 263-269.
15. Chaubal R, Mujumdar A M, Puranik VG, Deshpande V H, Deshpande NR. Isolation and x-ray study of an anti-inflammatory active androstene steroid from *Acacia nilotica*, *Planta Medica* 2003; 69(3): 287-288.
16. Anderson DMW. Analysis of six *Acacia* gum exudates of the series Phyllodineae. Phytochemistry 1972; 15: 1751–1754.
17. Anderso DM. Chemotaxonomic aspects of the chemistry of *Acacia* gum exudates. Kew Bull. 1978; 32: 529–536.
18. Anderson DM, Brenan JPM. Chemotaxonomic aspects of the gum exudates from some subspecies of *Acacia tortilis*. Boissiera 1975; 24: 307–309.
19. Anderson DM, Dea ICM. Studies on uronic acid materials. Part XXV. Some unusual forms of the

gum from *Acacia senegal* Willd. Carbohydrate Res. 1966; 6: 104–110.
20. Kaplan M, Stephen AM. Application of gas–liquid chromatography to the structural investigation of polysaccharides. II. Tetetrahedron 1967; 23: 193–198.
21. Malan E. Derivatives of (+)-catechin-5-gallate from the bark of *Acacia nilotica*. Phytochemistry 1991; 30: 2737–2739.
22. Banerji R, Chowdhury AR, Misra G, Nigam SK. Chemical composition of *Acacia* seeds. J.Am. Oil Chem. Soc. 1988; 65: 1956–1959.
23. Brown AJ, Cherikoff V, Roberts DC. Fatty acid composition of seeds from the Australian *Acacia* species. Lipids 1987; 22:490–494.
24. Gunstone FD, Taylor GM, Cornelius JA, Hammonds TW. New tropical seed oils. II. Component acids of leguminous and other seed oils. J. Sci. Food Agric. 1968 ;19: 706–709.
25. Jamal S, Farooqi JA, Ahmad JS Jr, Mannan A. Chemical investigations of *Acacia* seed oils.J. Sci. Food Agric. 1987; 39: 203–206.
26. Camp, B.J., Norvell, M.J., 1966. The phenylethylamine alkaloids of native range plants. Econ. Bot. 20,274–278
27. Glicksman M, Sand RE. Gum arabic. In: Whistler, Academic Press, New York 1973; 197–263.
28. Basu NM, Ray GK, De NK. On the vitamin-C and carotene of several herbs and flowers used in Ayurvedic system of medicine. *J Indian Chem Soc* 1947; 24: 358-360.
29. Swain T.The tannins. In: Plant Biochemistry (J.Bonner- J.Varner eds.), Acad Press, New York 1965; 552-580.
30. Singh V, Pandey RP. Medicinal plantlore of the tribals ofeastern Rajasthan (India). *J Econ Tax Bot* 1980; 1:137-47.
31. Singletone VL. In: Tannins in Ruminant Feedstuffs, Animal Research and Development 1981; 33: 9-62.
32. Chakraborti N, Mandal L, Banerjee GC . Chemical composition of some common tree leaves. *Indian Vet J* 1988; 65:145-149.
33. Sotohy SA, Sayed AN, Ahmed MM. Effect of tannin-rich plant (*Acacia nilotica*) on some nutritional and bacteriological parameters in goats. *Dtsch Tierarztl Wochenschr* 1997; 104: 432-5.
34. Readel K, Seigler D, Hwang K, Keesy J, Seilheimer S. Tannins from Mimosoid legumes of Texas and Mexico. Econ. Bot.2001; 55:212–222.
35. Imperato F. A new chalcone glucoside and isosalipurposide from *Acacia cyanophylla*. Phytochemistry 1978; 17: 822–823.
36. Malan E. Derivatives of (+)-catechin-5-gallate from the bark of *Acacia nilotica*. Phytochemistry 1991; 30:2737–2739.
37. Gupta SK, Bokadia MH. Flavonoids from the flower of Acacia arabica. *Vijnana Parishad Anusandhan Patrika* 1975; 18: 41-45.
38. Tindale MD, Roux DG. Phytochemical studies on the heartwoods and barks of African and Australian species of *Acacia*. Boissiera 1975; 24: 299–305.
39. Sahai R, Agarwal SK, Rastogi RP. Auriculoside, a new flavan glycoside from *Acacia auriculiformis*.Phytochemistry 1980; 19:1560–1562.
40. Thieme H, Khogali A. Isolierung von Apigenin-6, 8-bis-*C*-β-D-glucopyranosid aus den Blattern von *Acacia farnesiana* (L.), Willd. Pharmazie 1974; 29:352.
41. Thieme H, Khogali A. U¨ ber das Vorkommen von Flavonoiden und Gerbstoffen in den Bla¨ttern einiger afrikanischer *Acacia*-Arten. Pharmazie 1975;30: 736–743.
42. Kumar Ashok, Meena Punar Dutt, Kaushik Pallavi, Anticancer and Antimutagenic Properties of *Acacia nilotica*(Linn.) on 7,12-Dimethylbenz(a)anthracene-induced Skin Papillomagenesis in Swiss Albino Mice *Asian Pacific J Cancer Prev,* 7: 627-632.
43. Mahesh B, Satish S. Antimicrobial Activity of Some Important Medicinal Plant against Plant and Human Pathogens, World Journal of Agricultural Sciences 2008; 4 (S): 839-843.
44. Shah B H, Safdar B, Virani S S, Nawaz Z, Saeed S A, Gilani A H, The Antiplatelet Aggregatory Activity of *Acacia nilotica* is Due to Blockade of

Calcium Influx through Membrane Calcium Channels, Gen. Pharmac. 1997; 29(2): 251-255.
45. Bachaya H A, Iqbal Z, Khan M N, Sindhu Jabbar ZA. Anthelmintic activity of *Ziziphus nummularia* (bark) and *Acacia nilotica* (fruit) against *Trichostrongylid nematodes* of sheep, Journal of Ethnopharmacology 2009;123 : 325–329.
46. Kaur K, Arora S, Hawthorne M. A correlative study on antimutagenic and chemopreventive activity of *Acacia auriculifor* A. Cunn. and *Acacia nilotica* (L.) Willd. Ex Del.*Drug Chem Toxicol* 2002; 25: 39-64.
47. Patel JD, Patel D K , Shrivastava A, Kumar V, , Screening of plant extracts used in traditional antidiarrhoeal medicines against pathogenic *escherichia coli,* Scientific World 2008 ; 6,(6).
48. Singh B N , Singh BR , Singh RL, Prakash D, Sarma BK, Singh HB . Antioxidant and anti-quorum sensing activities of green pod of Acacia nilotica L., Food and Chemical Toxicology 2009; 47: 778–786.
49. Kalaivani T, Mathew Lazar. Free radical scavenging activity from leaves of *Acacia nilotica* (L.) Wild. ex Delile,an Indian medicinal tree, Food and Chemical Toxicology 2010;48 :298–305.
50. Singh R, Singh B, Singh S , Kumar N, Kumar S , Arora S. Umbelliferone – An antioxidant isolated from Acacia nilotica (L.) Willd. Ex. Del., Food Chemistry 2009.
51. Gilani A H , Shaheen F , Zaman M , Janbaz K H , Shah B H, Akhtar M S . Studies on antihypertensive and antispasmodic activities of methanol extract of *Acacia nilotica* pods, Phytother Res. 1999; 13 (8):665-669.
52. Gilani AH, Phytother, Res. 1999, Vol. 3(8), pp. 665-669.
53. Rohini Chaubal , Pushpa V, Geeta D, Hebbalkar Larvicidal Activity of *Acacia nilotica* Extracts and Isolation of D-Pinitol - A Bioactive Carbohydrate, Chemistry & Biodiversity 2005;2 (5),: 684 – 688.
54. Chaubal R, Mujumdar AM, Puranik VG, Deshpande VH, Deshpande NR.; Isolation and X-ray study of an anti-inflammatory active androstene steroid from *Acacia nilotica*, Planta Med. 2003;69(3):287-288.
55. Aderbauer B, Clausen P H. "In vitro and in vivo trypanocidal effect of lipophilic extracts of medicinal plants from Mali and Burkina Faso." J Ethnopharmacol 2008; 119(2): 225-231.

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