

PHTOCHEMICAL & PHARMACOLOGICAL REVIEW ON ACACIA SPECIES

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ABSTRACT

Acacia species: Acacia is the most significant genus of family Leguminosae, first of all described by Linnaeus in 1869. It is estimated that there are roughly 1589 species of Acacia worldwide, about two-third of them native to Africa and rest of spread around tropical and subtropical regions of the world.^[1] Acacia species are commonly known as 'Babool' in India and ethno medicinally used for the treatment of various types of diseases. The large number of exudates gums obtained from trees of acacia and contain similarly bound sugars (D-galactose, L-arabinose and Deoxy-sugar) and uronic acid salts of Na, K, Ca and Mg.

INTRODUCTION

Acacia, Babul (*Acacia arbica*) *Acacia arbica* belonging to the family Leguminosae is a moderate sized tree that grows up to 22m. It has an umbrella shaped crown and is easily identified by its bright yellow, sweet-scented flower heads, its sweet-smelling gray pods and its paired whitish spines at the base of each leaf. During the hot season the tree is in full leaf and its feathery foliage provides good shade. It is found throughout the dry parts of India.^[2]

Pods: The pods are 8-22 cm long, green or greenish black when mature, indehiscent, and deeply constricted between the seed giving a necklace appearance.

Seeds: The seeds are 9-15 per pod, compressed, ovoid, dark brownish shining with hard taste **Leaves:** The leaves are bipinnate, 2-11 pairs, 1.4- 4.2 cm long, leaves 11-21 pairs, and 3-6mm long (Beniwal et al., 1992).

Stem: Stems are dark to black color, deep longitudinal fissured, grey-pinkish slash, exuding a reddish low quality gum^[22]

Flowers: Flowers are globular heads, 1.4-1.8 cm in diameter of a bright golden yellow color, develop either in axillary pattern on peduncles 2-5 cm long located at the end of branches.^[21]

Bark: The bark a tinge of orange and/or green (young tree), but older trees have dark, rough bark and tend to lose their thorns.

Roots: Root is generally of brownish color in older and whitish in younger regions.

Gum: The gum varies in colour from very yellowish brown to dark reddish brown depending on the quantity of tannins in the sample. The lighter, more highly valued gums are soluble in water and very viscous; the tannins in the darker gum reduce the solubility. The gum has a moisture content of about 15% and is slightly dextrorotary (New, 1984).

Chemical constituents: It contains a high percentage of phenolic constituents consisting of Gallic acid, Protocatechuic and ellagic acids, leucocyanidin, oligomer 3,4,7- trihydroxy flavan 3,4-diol and 3,4,5,7-tetrahydroxy flavan-3-ol and (-) epicatechol. Leaves also contain mucilage and saponins. Also is rich in phenolics consisting of condensed tannins and phlobetannin, gallic acid, protocatechuic acid pyrocatechol, (+) – catechin, (-) epigallocatechin-5, 7-digallate, apigenin, 6-8-bis-D-glucoside, and rutin (Seigler, 2003).

Kingdom	Plantae
Sub-kingdom	Tracheobionta
Division	Spermatophyta
class	Magnoliophyta
Order	Fabales
Family	Fabaceae
Genus	<i>Acacia</i>
Species	<i>Acacia arbica</i>

Review of Literature

Thangavelu L, et al (2018) investigated the hepatoprotective effects and possible mechanism of *Acacia catechu* in acetaminophen (APAP) induced hepatotoxicity using female Wistar rat model. Hepatotoxicity was induced by oral administration of acetaminophen (750 mg/kg body weight) for 24 h. The seed (400 mg/kg body weight) and bark (400 mg/kg body weight) extract's treated groups exhibited hepatoprotective effects and was compared with well-known clinical anti-dote N-acetylcysteine (NAC). When groups treated with acetaminophen, significant increase of liver weight/body weight ratio, liver function enzymes such as alanine aminotransferase (ALT), alkaline phosphatase (ALP) and aspartate aminotransferase

(AST) and decrease of antioxidant enzymes such as glutathione (GSH) and superoxide dismutase (SOD) were observed. The histopathology of APAP treated groups also showed moderate degree of sinusoidal congestion, centrilobular necrosis with polymorph nuclear cells infiltration, marked vacuolations and congestion. However, pretreatment with seed or bark extract groups decreased LPO accumulation, reduced the liver function enzymes and increased antioxidant defense enzymes.

Moreover, histopathology of seed extract treated groups showed normal architecture whereas bark extract treated groups exhibited mild degree of vacuolations in the hepatocytes with minimal sinusoidal congestion concludes that *A. catechu* seed extract to be a more promising agent for protecting liver from APAP induced hepatotoxicity.^[1]

Karthikeyan R, et al (2018) examined the antimicrobial efficacy of a mixed herbal powder extract (MHPE) against cariogenic microorganisms. The results revealed that the anti-adherence and anti-biofilm effect as well as the faster killing activity suggests that MHPE formula has effective antibacterial activity and could be a useful source of anticariogenic agents in near future.^[2]

Sood R, et al (2018) investigated all the extracts of *O. sanctum* (crude extract, terpenoid and polyphenol) and *A. arabica* (crude extract, flavonoid and polyphenol) showed significant virucidal activity, however, crude extract *ocimum* and terpenoid *ocimum* showed highly significant to significant ($p < 0.001-0.01$) decrease in virus genome copy numbers with lowest dose tested. Similarly, therapeutic effect was observed in all three extracts of *O. sanctum* in comparison to the virus control, nevertheless, crude extract *ocimum* and terpenoid *ocimum* maintained this effect for longer period of time (up to 72 h post-incubation). None of the leaves extracts of *A. arabica* had therapeutic effect at 24 and 48 h post-incubation, however, only the crude extract *acacia* and polyphenols *acacia* showed delayed therapeutic effect (72 h post inoculation). Prophylactic potential was observed in polyphenol *acacia* with highly significant antiviral activity compared to virus control ($p < 0.001$).^[3]

Gupta A, et al (2017) examined the extracts of herbs like Babool and Neem which have been used traditionally for oral care. The objective of the current clinical study was to investigate the efficacy of Babool Neem Toothpaste in oral hygiene and dental care. The study was conducted in patients of gingivitis & periodontitis and healthy subjects free from oral diseases. Babool Neem Toothpaste showed significant improvement in all the parameters assessed when compared to baseline. However, the similar results were also observed in Placebo Toothpaste Group. It could be concluded that brushing with Babool Neem Toothpaste produced significant improvement in various parameters viz. gingivitis, dental stains, plaque, halitosis, microbial counts, clinical attachment loss and

global efficacy assessments. The results were statistically significant in comparison to the baseline within the same group and were assessed by investigator to be clinically significant.^[4]

Farzana M, et al (2014) stated that aqueous root extract of *A. nilotica* was analyzed for antiplasmodial activity in mice. Five groups, of five mice in each group were used. Group 1 or control, was administered with 10ml distilled water/kg body weight; groups 2, 3 and 4 were administered with 100, 200, and 400 mg extract/kg body weight, respectively, while group 5 was administered with 5 mg chloroquine/kg body weight. The results of this study showed that the aqueous root extract of *Acacia nilotica* is safe and has anti plasmodial activity.^[5]

Bukhtiar H, et al (2014), investigated that the extract of *Acacia nilotica* (*A. nilotica*) have capacity to blocked platelet aggregation mediated by platelet agonists, arachidonic acid (0.75 μ M), ADP (4.3 μ M), platelet activating factor (800 nM) and collagen (638 nM) in a dose-dependent manner. The findings revealed that the antiplatelet aggregatory activity of the extract of *A. nilotica* is mainly due to blockade of Ca²⁺ channels, although evidence also suggests that the involvement of protein kinase.^[4,9,25]

Amin B, et al (2013) has studied methanol, acetone and water extracts of different parts of *Acacia nilotica*, *Calotropis procera*, *Adhatoda vasica* Nees, *Fagonia arabica* L. and *Casuarina equisetifolia* L. to investigate the anti-bacterial activity against thirty four clinical isolates and two reference strains of *H. pylori*. Minimum inhibitory concentrations (MICs) of the extracts were determined using the agar dilution method and compared with some standard antibiotics like amoxicillin, clarithromycin, tetracycline and metronidazole, used in the triple therapy for *H. pylori* eradication. Methanol and acetone extracts from *Acacia nilotica* and *Calotropis procera* exhibited stronger anti-*H. pylori* activity than metronidazole, almost comparable activity with tetracycline, but were found to be less potent than amoxicillin and clarithromycin.^[7]

Sunil K et al (2013) investigated the petroleum ether, methanolic and water extracts for antidiarrhoeal activity. Only methanolic extract showed significant antidiarrhoeal activity against castor oil and magnesium sulphate induced diarrhoea and barium chloride induced peristalsis using swiss albino rat.^[48,49]

Bhatnagar M, et al (2013) studied the potential of the polymeric component of aqueous extracts of gum acacia (GA) and the seeds of *M. oleifera* (MSP) in wound management. The results revealed that both biopolymers were hemostatic and hasten blood coagulation. They showed shortening of activated partial thromboplastin time and prothrombin time and were non-cytotoxic in nature.^[51]

Hegazy GA, et al (2013) investigated the role of *Acacia arabica* extract as a hypoglycemic, antihyperlipidemic, and antioxidant agent in streptozotocin-induced diabetic rats. The results found that **Acacia Arabica** extract has good potential for hypoglycemic, hypolipidemic, and antioxidant properties, therefore, it can be further investigated for its efficacy in the treatment of diabetes in humans.^[9,11]

Rahiman P, et al (2012) to screen the antimicrobial activity of *Acacia nilotica* and was found to give the most potent antimicrobial extract Noticeably no antimicrobial activity was found in methanolic bark extract of *Acacia nilotica* against the tested bacteria.^[37]

Dhabhai K, et al (2012) examined the antioxidant activity of ethyl acetate soluble fraction of *A. arabica* bark by in vitro lipid peroxidation model was carried out by tertiary butyl hydroperoxide induced lipid peroxidation and the most active fraction were identified by TLC and in vivo experiment in most active fraction were carried out with 50, 100 and 150 mg/kg oral dose in carbon tetra chloride induced hepatotoxicity in rats and it is hypothesized that flash chromatographic fraction of ethyl acetate extract exhibited maximum activity with in vitro lipid peroxidation and 150 mg/kg dose of carbon tetra chloride shows marked liver protection in in vitro model.¹⁰ The extracts, produced by 80% methanol, from leaf, bark and seed of three medicinal plants namely neem (*Azadirachta indica* A. Juss), kiker (*Acacia nilotica* L.) and jaman (*Eugenia jambolana* L.), were assessed for their antioxidant activity. The results showed that among the different parts of the investigated plants, neem leaf extract possessed highest activity to scavenge DPPH (71.54%) followed by kiker leaf and jaman leaf with contribution at 66.54% and 54.27%, respectively.⁴⁴ *Acacia* species are rich source of polyphenolic compounds, known to have strong antioxidant properties that help in prevention and therapy of various oxidative stress related diseases including cardiovascular, neurodegenerative and cancer.^[9,56]

In a study by Bansal and goel (2012), different extracts [ethanolic, 50% hydroethanolic (50:50), 70% hydroethanolic (70:30) and aqueous] of young seedless pods were examined in pylorus ligation induced gastric ulcers in rats. Various parameters like, volume of gastric acid secretion, pH, free acidity, total acidity, ulcer index, mucin content and antioxidant studies were determined and were compared between extract treated, standard and vehicle control following ulcer induction. The most active extract was also evaluated in swimming stress induced and NSAID induced gastric ulceration. Results showed significant antiulcer activity in pyloric ligation induced ulceration. Even more the 70% hydroethanolic extract showed better protection as compared to 50% hydroethanolic extract. Further 70 % hydroethanolic extract also showed significant mucoprotection.^[15]

Sakthivel KM, et al (2012) studied the effect of *A.*

nilotica extract against Dalton's ascitic lymphoma (DAL) induced solid and ascitic tumors in BALB/c mice. Experimental animals received *A. nilotica* extract (10 mg/kg.bw) intraperitoneally for 10 and 14 consecutive days before induction of solid and ascitic tumors, respectively. Treatment with *A. nilotica* extract significantly decreased the development of tumor.^[18]

Shazia B, et al (2011) has investigated the antimicrobial activity against medicinally important bacterial strains, such as *Pseudomonas aurogenosa*. The anti-microbial activity was determined in extracts using agar well diffusion method. Result showed anti-bacterial activity against *Staphylococcus aureus*, *Pseudomonas vulgaris*, *Escherichia coli* and anti-fungal activity against *Streptococcus cereviceae*.^[39]

Malviya S, et al (2011) examined the plant extract and result revealed that potent antibiotic activity against four bacterial species: gram positive; *Bacillus subtilis*, *Staphylococcus albus*, *Streptococcus faecalis*; gram negative, *Escherichia coli* and two fungal species: *Candida albicans* and *Aspergillus flavus* examine by using paper disc diffusion method.^[9]

Parmar B, et al (2010) examined *Acacia arabica* for preliminary phytochemical analysis and characterization by various instrumental techniques. Methanolic extracts of *Acacia arabica* seeds was very good antibacterial activity and also minimum inhibitory concentration of different virus using HEL cell cultures HeLa cell cultures Vero cell cultures but Minimum inhibitory concentration (MIC) of Herpes simplex - 1 and 2, vaccinia virus, vesicular stomatitis and Herpes simplex-1 (TK ACVI) were observed very good antiviral activity of *Acacia arabica* seeds DMSO extracts.^[26]

Rajendran A, et al (2010), Fresh flowers of *Acacia arabica* willd were extracted with 80% alcohol and the concentrated extract was fractionated in the usual way. The ethyl acetate fraction was found to contain isoquercetin. The structure was characterized by UV, NMR, Paper Chromatographic and Chemical studies. The yellow pigment was found to contain promising results with respect to acute and chronic anti-inflammatory studies. It also showed considerable percentage protection of bacteriostatic effect on *Bacillus subtilis*, a gram positive organism.^[32]

Sharma AK, et al (2010) to screen the hot aqueous extract of *A. nilotica* revealed both proliferative and inhibitory effects on the rat splenocytes and IL-10 release depending on the dose.^[5]

Patil RN, et al (2010), investigated the antidiabetic effects of hydroalcoholic extracts of *Acacia arabica* in diabetic rats. The Alloxan monohydrate was used to induce the diabetes in normal rats. The tolbutamide 80 mg/kg p.o. was used the standard antidiabetic throughout the study and the results indicated that 250 and 500

mg/kg body weight of all hydroalcoholic test extracts reversed the altered glucose, cholesterol, triglycerides, LDL and HDL levels in diabetic rats significantly and in dose dependent manner.^[45]

Banso A, et al (2009) has studied the antimicrobial activity of ethanolic extracts of the stem bark against *Streptococcus viridans*, *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis* using the agar diffusion method and found the minimum inhibitory concentration of the stem bark extract of the plant ranged between 35 and 50 mg/ml while the minimum bactericidal concentration ranged between 35 and 60 mg/ml.^[34]

Hassan R, et al (2009) has tested antimicrobial activity of ethanolic extract of *Acacia arabica* in vitro against seven bacterial species and two fungal species by well-diffusion method and micro dilution methods. The result of this study revealed that ethanolic extracts of these plants were effective on bacterial strains.^[18]

Yousif M. et al (2009) has observed that lethal doses of plant that caused 100% mortality (LC100) of the adult *B. truncatus* snails were 112.50 ppm (55). Ayoub, S. M. (1982). *Acacia nilotica* have demonstrated the highest Molluscicidal Properties due to tannin activity (18-23%).^[19]

Hussein A, et al (1985) exhibited highest activity using acetone, alcohol and aqueous extracts of the fruits and stem bark of these species are reported against the two snail species which host schistosomes in the Sudan i.e. *B. truncatus* and *B. pfeifferi*.^[20]

Mahesh G, et al (2008) studied methanol leaf and bark extracts of *Acacia nilotica* showed significant antibacterial activity against *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas fluorescens*.^[38]

Mohan S, et al (2008) examined comparative antimicrobial studies of *Acacia* species and *A. nilotica* exhibited highest activity against three bacterial strains *Escherichia coli*, *Staphylococcus aureus* and *Salmonella typhi*.^[42]

Mohan S, et al (2008) has investigated comparative antimicrobial studies of *Acacia* species and *A. nilotica* exhibited highest activity against two fungal strains *Candida albicans* and *Aspergillus niger*.^[43]^[8]

Meena P, et al (2006) reported the chemopreventive activity of *Acacia nilotica* (Linn.) gum, flower and leaf aqueous extracts, on 7,12-dimethylbenz(a)anthracene (DMBA) induced skin papillomagenesis in male Swiss albino mice. A significant reduction in the values of tumor burden, tumor incidence and cumulative number of papillomas was observed in mice treated by oral gavage with the *Acacia nilotica* gum, flower and leaf extracts as compared with the control group.^[8]

Rajvaidhya S, et al (2005), Inhibition of total proteolytic (caseinolytic), tryptic (by hydrolysis of benzoyl arginine p-nitroanilide) and chymotryptic (by hydrolysis of acetyl tyrosine ethyl ester) activities by ten species of legume seeds on human and bovine pancreatic proteases were studied. *Acacia* seeds extracts displayed more pronounced action on human trypsin and chymotrypsin, it was more effective in inhibiting the total proteolytic activity of the bovine system.^[2]

Gilani A H, et al (1995), A methanol extract of *Acacia nilotica* pods (AN) 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 α -adrenergic blocker) abolished the vasoconstrictor effect of norepinephrine (NE), whereas pretreatment of the animal with AN, 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.^[57]

Nath R, et al (1992) studied aqueous or 90 % ethanol extracts of the plants of interest in rats orally dosed for 10 days after insemination with special reference to see the effect on foetal development. Leaf extracts of *Moringa oleifera* and *Adhatoda vasica* were 100% abortive at doses equivalent to 175 mg/kg of starting dry material. Only the flowers of *Acacia arabica* and *Hibiscus rosa-sinensis* appeared to lack teratologic potential at the doses tested.^[22]

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