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A Review on Acacia species of therapeutics importance

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ABSTRACT

Plants are used medicinally in different countries and are a source of many potent and powerful drugs. Various plants of *Acacia* species were claimed to possess traditional medicinal activities .Different parts of plant have different phytochemical constitution and different pharmacological action. Different species of *Acacia* have been reported, but only a few of these find medicinal importance out of which the prominent ones are *Acacia nilotica*, *Acacia polycantha*, *Acacia Leucophala* and *Acacia farnesiana.* In light of this, the present review aims at exploring current scientific findings on the various plants of this specie.The present review mainly covers some of the important medicinal plants belonging to the *Acacia* spp. with special attention towards their various traditional uses, chemical constituents and medicinal properties.

Keywords: *Acacia*, scientific findings, traditional system of medicine.

INTRODUCTION

The genus *Acacia* belongs to family Mimosaceae. *Acacia* Willd is a very large genuscontaining trees, shrubs and climbers. It is indigenous to the Indian Sub-continent as also in Tropical Africa, Burma, Sri Lanka, Saudi,Arabia, Egypt and in West and East Sudan. In India, natural babul forests are generally found in Maharashtra, Gujarat, Andhra Pradesh, Rajasthan, Haryana and Karnataka. However, scattered trees in groups occur naturally and also widely planted in almost all states and Union territories except north-eastern states, Kashmir and Kerala.[1] It is estimated that there are roughly 1380 species of Acacia worldwide, about two-third of them native to Australia and rest of spread around tropical and subtropical regions of the world.

The Ayurveda system of medicine uses about 700 species, Unani 700, Siddha 600 and modern medicine around 30 species [2]. Plants are used medicinally in different countries and are a source of many potent and powerful drugs. Various plants of *Acacia* species were claimed to possess traditional medicinal activities.Different parts of plant have different phytochemical constitution and different pharmacological action.

There are more than 1500 species, worldwide, with around 1200 of these endemic to Australia [3].Many of them have traditionally been use in various disease conditions.

Traditional healers of different regions in India used *Acacia* species for treatment of various ailments [9]. *Acacia* species is one of the richest resources of bioactive flavonoids, alkaloids, phenolics, saponins, polysaccharides, tannins, and terpenoids [10]. Different species of *Acacia* have been reported [3], but only a few of these find medicinal importance out of which the prominent ones are:

1. *Acacia nilotica*
2. *Acacia polycantha*
3. *Acacia Leucophala*
4. *Acacia farnesiana*

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5. *Acacia leucophloea*
6. *Acacia sinuata*
7. *Acacia ferruginea*
8. *Acacia catechu*

The present review mainly covers some of the important medicinal plants belonging to the *Acacia*spp. with special attention towards their various traditional uses, chemical constituents and medicinal properties.

***Acacia nilotica*L.**

Fig. 1: A twig of *A. nilotica*showing flowers

Fig. 2: Pods of *A. nilotica*.

Acacia nilotica is a medium-sized, thorny tree, evergreen tree with a short trunk and having round spreading crown with feathery foliage, found in the whole drier parts of India. *Acacia nilotica* is a single stemmed plant, grows to 15-18 m in height and 2-3 m in diameter. The leaves are fine and densely hairy with 3-6 pairs of pinnate consisting of 10-20 pairs of leaflets that are narrow with parallel margins and are rounded at the apex with a central midrib closely crowded. [4].

The gum exudes from the cuts in the bark in form of ovoid tears. The tears are glossy and marked with minute fissures and are brittle in nature. The colour of the gum varies from pale yellow to black. It is soluble in water [5]. It is known in India as babul, kikar, babur (Hindi). [1]

Traditional uses

Traditionally the bark, leaves, pods and flowers are used against cancer, cold, congestion, cough, diarrhea, dysentery, fever, gall bladder, hemorrhoid, ophthalmia, sclerosis, tuberculosis and small pox, leprosy, bleeding piles, leucoderma and menstrual problems. They have spasmogenic, vasoconstrictor, anti/-hypertensive, -mutagenic, -carcinogenic, -spasmodic, -inflammatory, -oxidant and -platelet aggregatory properties. [6]

The bark of the plant is used as astringent, acrid, cooling, styptic, emollient, anthelmintic, aphrodisiac, diuretic, expectorant, emetic and nutritive, in hemorrhage, wound ulcers, leprosy, leucoderma, skin diseases and seminal weakness. Gum is used as astringent, emollient, liver tonic, antipyretic and antiasthmatic. [7] Pods and tender leaves are given to treat diarrhoea and are also considered very useful in folk medicine to treat diabetes mellitus.[8]

Chemical constituents

Phytochemistry confirmed that all the tested extracts contain physterols, fixed oils, fats, phenolic compounds, flavanoids and saponins. [11]Phytochemical screening of the stem bark of *A. nilotica*exposed that the plant contain terpenoids, alkaloids, saponins and glycosides. Negative results were recorded for steroids and flavonoids which authenticate the absence of these phytochemicals [12]. This plant recommends a variety of phytochemical such as gallic acid, ellagic acid, isoquercitin, leucocyanadin, kaempferol-7-diglucoside, glucopyranoside, rutin, derivatives of (+)-catechin-5-gallate, apigenin-6,8-bis-C-gluco-pyranoside, m-catechol and their derivatives.

*A. nilotica*contains gallic acid, m-digallic acid, (+)-catechin, chlorogenic acid, gallolyated flavan-3, 4-diol, robidandiol (7, 3, 4, 5-tetrahydroxyflavan-3-4-diol), and rostene steroid, D-pinitol carbohydrate and catechin-5-galloyl ester (Singh et al., 2009a). The bark is prosperous in phenolics viz. condensed tannin and phlobatannin, gallic acid, protocatechuic acid pyrocatechol, (+)-catechin, (-) epigallocatechin-7-gallate, and (-) epigallocatechin-5,7- digallate [13]. The bark is also reported to contain (-) epicatechin, (+) dicatechin, quercetin, gallic acid, (+) leucocyanidingallate, sucrose and (+) catechin-5-gallate [14]. *A.nilotica*is a medicinal plant from which the polyphenolic compounds kaempferol has been reported for the first time]. Another compound umbelliferone has been reported from *A. nilotica*[6].

Medicinal properties

Anti-hypertensive and anti-spasmodic activities

A decrease in arterial blood pressure is reported by use of methanolic extract of *A. nilotica*pods and provides evidence of anti-hypertensive activities independent of muscarinic receptor stimulation. In the *in vitro* studies, *A. nilotica*has inhibitory effect on force and rate of spontaneous contractions in guinea-pig paired atria and rabbit jejunum. *A. nilotica*also inhibits K+ induced contractions in rabbit jejunum advocating the antispasmodic action of *A. nilotica*which is mediated through calcium channel blockade and this may also be responsible for the blood pressure lowering effect of *A. nilotica*, observed in the *in vivo* studies [16].

An aqueous of the seed of *A. nilotica*is also investigated on the isolated guinea-pig ileum which exposed the sustained dose-related contractile activity. A dose-related significant elevation of blood pressure is produced by intravenous administration of the extract [15].

Antibacterial and antifungal activities

The assays of the stem bark extracts confirms the antimicrobial activity against *Streptococcus viridans*, *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis*and *Shigellasonnei*using the agar diffusion method. *A. nilotica*could be a potential source of antimicrobial agents [12].

*A. nilotica*demonstrates highest activity against three bacterial (*E. coli, S. aureus*and *Salmonella typhi*) and two fungal strain (*Candida albicans*and *Aspergillusniger*) [11].

Antibacterial activity of *Acacia nilotica*lysate

The findings revealed that aliquots of 100 µl lysate (equivalent to10 mg of *A. nilotica*lysates)

exhibited> 99 % bactericidal activity against MRSA . At 10 mg/ml concentration, the extract exhibited > 80 % bactericidal activity against all the clinical isolates of *E. coli*, but only 52% against *E.coli* isolated from sewage. *A.nilotica*lysates exhibited > 90 % bactericidal activity against all *K. pneumonia* isolates at a concentration of 10 mg/ml except *K.pneumonia* folly tip isolate against which it showed 42 %.[22]

Antiplasmodial activities

The ethyl acetate extract holds the highest activity on *Plasmodium falciparum*. Phytochemical analysis indicated that the most active phase contained terpenoids and tannins and was devoid of alkaloids and saponins [17]. Crude methanolic root extracts of *A. nilotica*reveals significant activity against chloroquine sensitive strain of *Plasmodium berghei*in mice [18].

Antioxidant activity

Water extract/fractions of *A. nilotica*(L.) in lipid peroxidation assay possess the peroxyl radical scavenging capacity and results prove the anti-oxidant activity of plant.

The bark powder of the plant extracts with different solvents found the scavenging activity using maceration extraction [19]. Another study reveals that *A. nilotica*is easily accessible source of natural antioxidants, which can be used as supplement to aid the therapy of free radical mediated diseases such as cancer, diabetes, inflammation, etc [15]. Furthermore, the high scavenging property of *A. nilotica*may be due to hydroxyl groups existing in the

phenolic compounds that can scavenge the free radicals [9].

Acetylcholinesterase inhibitory activities

Acetylcholinesterase is a basic aim in the treatment of Alzheimer's disease. It has been found that *A. nilotica*has effect on central nervous system activities due to potent Acetylcholinesterase inhibitory activities. More investigations are required in the treatment of Alzheissmier's [20].

Chemopreventive, cytotoxic and anti-mutagenic activities

It has been reported, that the antimutagenic and cytotoxic activities exhibited by acetone extract may be due to the presence of gallic acid and other polyphenols (Kaur et al., 2005). It is reported that the leaf extract of *A. nilotica*had significant chemopreventive and anti-mutagenic activity than the other parts [9]. The chemopreventive activity of *A. nilotica*gum, flower and leaf aqueous extracts, on 7,12–dimethylbenz(a)anthracene (DMBA) induced skin papillomagenesis in male swiss albino mice has been found.

The chemopreventive and anti-mutagenic activity of the leaf extract of *A. nilotica*was the most significant, followed by the flower extract and then by gum [21].

Acacia farnesiana

***Fig.3: Acacia farnesiana*is**

*Acacia farnesiana*is a medicinal plant that grows throughout tropical parts of Indian subcontinent, particularly in sandy soils of river beds in Northern India and parts of Tamil Nadu.[23]Thorny bush or small tree, 8 m tall; bark light brown, rough; branches glabrous or nearly, purplish to gray, with very small glands; stipules spinescent, usually short, up to 1.8 cm long, rarely longer, never inflated; leaves twice pinnate, with a small gland on petiole and sometimes one on the rachis near top of pinnae; pinnae 2–8 pairs, leaflets 10–12 pairs, minute, 2–7 mm long, 0.75–1.75 mm wide, glabrous, leathery; flowers in axillary pedunculate heads, calyx and corolla glabrous, scented; pod indehiscent, straight or curved, 4–7.5 cm long, about 1.5 cm wide, subterete and turgid, dark brown to blackish, glabrous, finely longitudinally striate, pointed at both ends; seeds chestnut-brown, in 2 rows, embedded in a dry spongy tissue, 7–8 mm long, ca 5.5 mm broad, smooth, elliptic, thick, only slightly compressed; areole 6.5–7 mm long, 4 mm wide [24].It is also known as cassieflower,mimosa bush and sweet acacia.

Traditional uses

A. farnesiana has a great number of uses in traditional medicine. The bark has medicinal properties and is employed to treat cough and as an astringent e.g. to treat bleeding gums. In Java cassie flower is used as an emetic and by women after childbirth. In the Philippines it is applied in decoction to treat prolapsed rectum and as an injection for leucorrhoea. A lotion and a poultice of the tender leaves is applied to ulcers and sores previously washed with the decoction. Roots are chewed for sore throat and in decoction they are employed as a remedy for tuberculosis. The tender leaves are bruised with a little water and swallowed against gonorrhoea and affections of the bladder. The flowers are employed in Martinique as a stimulant and antispasmodic. An ointment made from the flowers is used in Mexico as a remedy for headache and their infusion for dyspepsia. The green fruit is very astringent and in decoction it is employed against dysentery and inflammation of the skin

and mucous membranes. The pulp of the pods is used in France as a purgative.[25]

Chemical constituents

Cassie has been reported to contain anisaldehyde, benzoic acid, benzyl alcohol, butyric acid, coumarin, cresol, cuminaidehyde, decyl aldehyde, eicosane, eugenol, farnesol, geraniol, hydroxyacetophenone, methyleugenol, methyl salicylate, nerolidol, palmitic acid, salicylic acid, and terpineol [24]. The leaves contain lipids, carotenoids, alkaloids, and reducing and non-reducing sugars [26]. El Sissi et al (1973) isolated and identified from pods, seven polyphenols (gallic acid, ellagic acid, m-digallic acid, methyl gallate, kaempferol, atomadendrin, and narigenin). Also they found narigenin-7-glucoside and naringenin-7-rhamnoglucoside (naringin), as well as naringenin, glucose, and gallic acid.[27]

Cassie concrete is a solid waxy, dark yellow or brown mass. On alcoholic extraction it yields 30-35% cassie absolute from concrete. This absolute is a dark yellow to pale brown viscous liquid, clear at about 20°C, but forming waxy flakes when colder. Its odour has a herbaceous-flowery top note, an extremely warm, powdery-spicy, but at the same time floral body and a deep and very tenacious cinnamic-balsamic dry-out. It combines well with a wide range of aroma materials.[25]

Medicinal properties

Anti-Inflammatory / Cytotoxicity:

Study yielded four new diterpenes–acasiane B, farnesirane A, farnesirane B with three known diterpenes and eight flavonoids. Some of the compounds exhibited cytotoxicity to human cancer cell lines while some showed moderate antiinflamatory activity.[28]

Vibrio cholera inhibition:

Study of 32 medicinal plants showed the ethanolic extracts of A farnesiana and Artemisia ludoviciana effectively inhibited bacterial growth of Cholera vibrio strains, effects on enterotoxin production and adhesion were also studied.[29]

Antihyperglycemic Activity:

Study evaluated an active fraction from an aqueous extract for anti-hyperglycemic activity in alloxan-induced diabetic rats. Results showed promising anti-diabetic activity. The active fraction was devoid of conspicuous toxic symptoms. [30] Study evaluated extracts of Acacia farnesiana for anti-hyperglycemic activity. A water extract significantly lowered the blood glucose level. Activity was found in the soluble fraction. Results suggest a direct stimulatory effect of the active fraction on glucose uptake without involvement of insulin, which may be the major mechanism.[31]

Antiulcer / Adsorbent:

Study evaluated the ulcer healing activity of Acacia farnersiana methanol leaf extract against ulcer induced model in rats. Results showed the methanol extract significant reduced the ulcer index compared to control Ranitidine.[32]

Bronchodilator / Anti-Inflammatory:

Study reports the smooth muscle relaxant and anti-inflammatory effect of a glycosidal fraction obtained from unripe pods of Acacia farnesiana. Results showed a direct relaxant effect on bronchial muscles and inhibition of carrageenan and formaldehyde induced inflammation.[33]

Antioxidant / Protection Against Oxidative Induced Damage:

The antioxidant protection of acacia pods extracts (Acacia shaffneri and Acacia farnesiana) suggest the possible transference of antioxidant components and protective effects to animal products (milk, meal, and by-products) from Acacia pods with this vegetation is included in the diet. [34]

Antibacterial / Antioxidant / Anti-Inflammatory:

In a study of ethanolic extracts of five plants viz., Acacia farnesiana, S. alata, S. grandiflora, S. cumini, and T. divaricata, all tested extracts showed antioxidant and antibacterial activity. All extracts exerted anti-inflammatory activity as evidenced by reduction of interleukin (IL)-6

secretion and/or tumor necrosis factor (TNF)-a production.[35]

Acacia polycantha

***Figure 4: Acacia polyacantha*is**

*Acacia polyacantha*is of the fabaceae family a group of plants called campylacantha.[36]. It is commonly called "Karo" by the Hausa speaking communities in Northern N igeria.The tree often grows in the moist, subtropical bushveld of Africa,usually in alluvial soils near rivers. It is widespread in tropical Africa, occurring from Gambia to Ethiopia and southwards to Kenya and Zimbabwe [37]. The white-stem thorn is a large, erect tree that grows to an average height of 10-15 m, exceptionally large trees may reach a height of 25 m. The stem of younger trees appears yellowish with papery bark and persisting prickles. As it gets older, the bark gets smoother and whitish grey, with bark flakes sometimes present. Young branches are covered in silvery hairs and the whole tree is covered in dark brown to black hooked thorns in pairs. The leaves are twice compound with 14- 35 pairs of pinnae and 20-60 leaflets per pinna. Leaves are fairly large and arranged singly along the shoots. The upper surface of the leaves is darker than the underside, and mostly with hairs on the margins and on the leaf stalk. The flowers that appear from September to December are light yellow to cream.[38]

Traditional uses

Generally healing (root-bark) Medicines: pain-killers (root-bark) Medicines: arthritis, rheumatism, etc. (gum) Medicines: naso-pharyngeal affections (bark) Medicines: stomach troubles (gum) Medicines: antemetics (bark) Medicines: diarrhoea, dysentery (gum) Medicines: genital stimulants/depressants (root-bark) Medicines: venereal diseases (bark) Medicines: dropsy, swellings, oedema, gout (root-bark) Medicines: tumours, cancers (foliage) Medicines: antidotes (venomous stings, bites, etc.) (heart-wood, bark) Phytochemistry: tannins, astringents (root)

Chemical constituents

Sitosterol; Alkaloid diaboline; Anthocyanins; Catechic tannins; Flavonoids; Galactose; Mannose; Mucilages; Oleanolic acid; Reducing compounds; Saponins; Sterols; Stigmasterol; Terpenes.[39]

Medicinal properties

Candidiasis; Diabetes mellitus; Diarrhoea; Dysentery; Gonorrhea; Leprosy; Malaria; Pneumonia; Sore throat; Sterility in woman; Thirst; Toothache; Trypanosomiasis; Ulcer; Uro-genital diseases.

Pods: Decoction beneficial in uro-genital diseases

Leaves: Infusion of tender leaves used as an astringent and remedy for diarrhoea and dysentery

Bark: Decoction used as a gargle in sore throat and toothache; dry powder applied externally in ulcers.[39]

Acacia leucocephala

Figure 5: Acacia leucocephala

Leucaenaleucocephala is a medium sized fast growing tree belongs to the family Fabaceae.

The specific name 'leucocephala' comes from 'leu' meaning white and 'cephala', meaning head, referring to the flowers.[40] It is commonly known as White Lead tree, White Popinac, Jumbay and Wild Tamarind. In India, it is popularly known as kubabul or subabul [41]. It has also been described as a "conflict tree" because it has been promoted for its forage production and naturally spreads like a weed. It grows up to 20m height. Leaves are looking like that of tamarind having white flowers tinged with yellow, and having long flattened pods. Seeds are dark brown with hard shining seed coat. The tree has multifarious uses like firewood, timber, greens, fodder, green manure, provide shade, controls soil erosion [42-45]. Leave are double pinnate compound main leaf stalk is about 10-18cm long with 4 to 8 pair of side stalk bearing the delicated leaflets. There are 10 to 17 pairs sessile leaflet, each about 1 to 2cm long and 3mm wide the leaflets are oblong linear.[46]

Traditional uses

Leaves-

In Burma, a paste made from leaves, is applied to poisonous bites and stings.

In Malaysia, the young leaves are pounded with rice and thin paste applied around the neck to treat cough. It is also rubbed to whole body to treat measles.

Leaf ash mix with coconut oil is applied on the body to treat scurf.

Leaves used as a herbal bath to cleanse the body.

Seeds-

In Indonesia, the seeds are used to expel intestinal worms and as a remedy for diabetes.

In Philippines, the roasted seeds help to increase menstrual flow.

Shoots-

Shoots boiled with alum and the water used to clean the affected part of shingles.

Chemical constituents

*Leucaenaleucocephala*leaves and seeds contain lipids, crude protein and carbohydrates. The seeds contain tannin and oxalic acid [47, 48]. The kernel contains oil content of about 17-20 %[16]. The leaves and seeds also contain a toxic and non-protein substance known as mimosine the details are given in table-1 and 2

Table 1: The chemical constituents of *L.leucocephala*leaves and seeds [49-51]

Sr. No.	Chemical costituents	Leaves	Seeds
1	Crude proteins(%)	25.9	46
2	Carbohydrates(%)	40	45
3	Tannins(%)	4	1.2
4	Mimosin(%)	7.19	10
5	Total Ash(%)	11	3.79
6	Total N(%)	4.2	-
7	Crude Proteins(%)	25.9	8.4
8	Calcium(%)	2.36	4.4
9	Phosphorus(%)	0.23	0.189
10	b-carotene(mg/kg)	536.0	-
11	Gross energy (kJ/g)	20.1	-
12	Tannin (mg/g)	10.15	-

Table 2: The chemical constituents of L.leucocephala seeds [52]

Sr. No.	Chemical constituents	Seeds
1	K	137.3
2	N	338.0
3	Mg	44.6
4	Ca	44.4
5	Na	12.6
6	Mn	52.6
7	Fe	642.4
8	Cu	55.0
9	Zn	125.1
10	Fatty Acid(%)	15
11	Saponification Value	108.74
12	Iodine Value	4.90
13	Acid Value	1.08

Medicinal properties

The seeds of leucocephala have great medicinal properties and are used to control stomachache, as contraception and abortifacient. The seed gum used as a binder in tablet formulation [53,54]. Sulfated glycosylated form of polysaccharides from the seeds was reported to possess significant cancer chemo-preventive and anti-proliferative activities [55]. The extracts of the seeds has reported as anthelmintic, antidiabetic and has a broad spectrum antibacterial activity [56-58]. Recently, the seed oil was used in engineering as a novel bio-device useful in biomembrane modeling in lipophilicity determination of drugs and xenobiotics [59]. The plant is reported to be a worm repellent.

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