Acasia Species and Their Medicinal Importance: A Review

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***Abstract*- The use of plants for medicinal purposes is widespread in many countries, and they are a source of a variety of powerful drugs. It has been suggested that various plants of the Acacia species may possess traditional medicinal properties. The various parts of the plant have varying phytochemical composition and pharmacological action. Various species of the Acacia genus have been reported, however, only a few of them have been found to be of medicinal significance, the most prominent of which are the *A. nilotica, A. polycantha, A. Leucophala and A. farnesiana*. This review seeks to explore current scientific findings on the various species of this genus. This review focuses primarily on certain medicinal plants that are part of the Acacia species with particular emphasis on their various historical applications, chemical compounds and therapeutic properties.**

Keywords: **Acacia, Traditional uses, Chemical constituents, Medicinal properties.**

INTRODUCTION

The family Mimosaceae includes the genus, *Acacia*. A fairly wide genus called *Acacia* Wild include trees, shrubs, and climbers. The Indian Subcontinent, tropical Africa, Burma, Sri Lanka, Saudi Arabia, Egypt, and West and East Sudan are all home to this native species. In India, the states of Maharashtra, Gujarat, Andhra Pradesh, Rajasthan, Haryana, and Karnataka often have natural babul forests. With the exception of the states in the northeast, Kashmir, and Kerala, dispersed trees in groups exist naturally and are widely planted in practically all of the states and union territories. [1] There are thought to be over 1380 different species of acacia in the globe, about two-thirds of which are indigenous to Australia and the remainder of which are found in tropical and subtropical areas. About 700 species are used in the Ayurvedic system of medicine, 700 in Unani and Siddha, and 30 in contemporary medicine.[2] Different nations employ plants as medicine, and they are the source of a number of strong and dangerous medications. There have been claims made about a number of Acacia species having traditional therapeutic properties. Different plant sections have various phytochemical compositions and pharmacological effects. Over 1500 species have been recorded globally, with over 1200 of them being native to Australia. [3] Many of them have been used for various illness conditions in the past. Traditional healers in many parts of India treated a variety of diseases with Acacia species. [9] One of the most abundant sources of bioactive flavonoids, alkaloids, phenolics, saponins, polysaccharides, tannins, and terpenoids is the acacia species. [10] Numerous Acacia species have been identified. [3] although only a small number of them have medical use; the notable ones are:

1. *Acacia nilotica*
2. *Acacia polycantha*
3. *Acacia Leucophala*
4. *Acacia farnesiana*
5. *Acacia leucophloea*
6. *Acacia sinuata*
7. *Acacia ferruginea*
8. *Acacia catechu*

The major focus of the current review is on a few significant medicinal plants from the *Acacia* spp., with a focus on their different traditional applications, chemical makeup, and therapeutic characteristics.

***Acacia nilotica* L.**

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

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

The medium-sized, thorny *Acacia nilotica* tree grows across the drier regions of India. It has a short trunk, a circular, spreading crown, and feathery leaves. The single-stemmed Acacia nilotica plant may reach heights of 15–18 m and diameters of 2-3 m. The leaves are small and heavily haired, with 3-6 pairs of pinnate and 10–20 pairs of thin, parallel-margin leaflets that are rounded at the tip and have a tightly packed centre midrib. [4] The gum leaks out of the bark's incisions as ovoid rips. The tears are brittle in character, shiny, and speckled with tiny fractures. The gum's hue ranges from light yellow to black. It is water soluble. [5] In India, it is referred to as Babul, Kikar, and Babur (Hindi). [1]

Traditional uses

Traditional uses for the bark, leaves, pods, and flowers include the treatment of cancer, menstrual irregularities, bleeding piles, leprosy, tuberculosis, congestion, cough, diarrhoea, dysentery, fever, gall bladder, haemorrhoids, ophthalmia, and sclerosis. They possess qualities that are spasmogenic, vasoconstrictor, anti/hypertensive, mutagenic, carcinogenic, spasmodic, inflammatory, oxidant, and platelet aggregatory. [6] The plant's bark is used for bleeding, wound ulcers, leprosy, leukoderma, skin illnesses, and seminal weakness. It also has astringent, acrid, cooling, styptic, emollient, anthelmintic, aphrodisiac, diuretic, expectorant, emetic, and nutritional properties. Astringent, emollient, liver tonic, antipyretic, and anti-asthmatic are some uses for gum. [7] Pods and delicate leaves are used in traditional medicine to treat diabetes mellitus in addition to treating diarrhoea. [8]

Chemical constituents

According to phytochemistry, all of the examined extracts include physterols, fixed oils, lipids, phenolic compounds, flavonoids, and saponins. [11] A. nilotica's stem bark was subjected to phytochemical analysis, which revealed the presence of terpenoids, alkaloids, saponins, and glycosides in the plant. Steroids and flavonoids produced negative findings, confirming the lack of these phytochemicals. [12] This plant suggests a range of phytochemicals, including gallic acid, ellagic acid, isoquercitin, leucocyanidin, kaempferol-7-diglucoside, glucopyranoside, rutin, derivatives of (+)-catechin-5-gallate, apigenin-6,8-bis-C-glucopyranoside, 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), androstene steroid, D-pinitol carbohydrate and catechin-5-galloyl ester (Singh et al., 2009a). The bark contains a wealth of phenolic compounds, including condensed tannin and phlobatannin, gallic acid, protocatechuic acid, pyrocatechol, (+)-catechin, (-) epigallocatechin-7-gallate, and (-) epigallocatechin-5,7-digallate. [13] Gallic acid, (+) leucocyanidin gallate, quercetin, (+) epicatechin, (+) dicatechin, sucrose, and (+) catechin-5-gallate are also said to be present in the bark. [14] The polyphenolic molecules kaempferol have been described for the first time from the medicinal plant *A. nilotica*. Another umbelliferone-containing substance has been discovered in *A. nilotica*. [6]

Medicinal properties

Anti-hypertensive and anti-spasmodic activities

By using a methanolic extract of *A. nilotica* pods, a reduction in arterial blood pressure has been observed, providing proof of anti-hypertensive effects unrelated to muscarinic receptor activation. In in-vitro experiments, *A. nilotica* had an inhibitory impact on the force and rate of spontaneous contractions in the rabbit jejunum and paired atria of guinea pigs. Additionally, *A. nilotica* suppresses K+ induced contractions in the rabbit jejunum, supporting its antispasmodic activity, which is mediated by calcium channel blocking. This effect may also be the source of *A. nilotica's* ability to reduce blood pressure, as seen in in-vivo investigations. [16] On an isolated guinea-pig ileum, an aqueous extract of the

seed of *A. nilotica* was also studied, revealing persistent dose-related contractile action. Intravenous injection of the extract results in a dose-related, substantial increase in blood pressure. [15]

Antibacterial and antifungal activities

Using the agar diffusion technique, the antibacterial activity of the stem bark extracts against *Streptococcus viridans, Staphylococcus aureus, Escherichia coli, Bacillus subtilis*, and *Shigella sonnei* is confirmed. *A. nilotica* could be a source of antibacterial substances. [12] *A. nilotica* exhibits the strongest activity against two fungal (*Candida albicans and Aspergillus niger*) and three bacterial (*E. coli, S. aureus, and Salmonella typhi*) strains. [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 extract from ethyl acetate had the most effect on *Plasmodium falciparum*. According to phytochemical investigations, the most active phase was free of alkaloids and saponins and included terpenoids and tannins. [17] Mice's chloroquine-sensitive strain of *Plasmodium berghei* is significantly active against crude methanolic root extracts of *A. nilotica.* [18]

Antioxidant activity

In a test for lipid peroxidation, *A. nilotica* (L.) water extracts and fractions have the ability to scavenge peroxyl radicals, and the findings demonstrate the plant's antioxidant activity. Using maceration extraction, the plant's bark powder was extracted using several solvents to detect scavenging activity. [19] According to different research, *A. nilotica* is a readily available source of natural antioxidants that may be used as a supplement to help treat diseases caused by free radicals, such as cancer, diabetes, inflammation, etc. [15] Furthermore, hydroxyl groups found in phenolic compounds, which may scavenge free radicals, may be the cause of A. nilotica's strong scavenging ability. [9]

Acetylcholinesterase inhibitory activities

One of the main goals of Alzheimer's disease therapy is to inhibit acetylcholinesterase. It has been discovered that *A. nilotica's* powerful acetylcholinesterase inhibitory actions have an impact on the functions of the central nervous system. The treatment of Alzheimer's disease needs more research. [20]

Chemo preventive, cytotoxic and anti-mutagenic activities

It has been suggested that gallic acid and other polyphenols may be responsible for the antimutagenic and cytotoxic properties of acetone extract (Kaur et al., 2005). According to reports, *A. nilotica's* leaf extract exhibited more chemopreventive and anti-mutagenic efficacy than the other components [9]. A. nilotica gum, flower, and leaf aqueous extracts have been discovered to have chemopreventive action against 7,12-dimethylbenz(a)anthracene (DMBA)-induced skin papillomagenesis in male Swiss albino mice. The leaf extract of *A. nilotica* had the greatest chemopreventive and anti-mutagenic effects, followed by the floral extract and gum. [21]

Acacia farnesiana

Fig. 3. A twig of *Acacia farnesianais* flower

Fig. 4. Pods of *Acacia farnesiana*

Acacia fennesiana is a plant species that is native to the tropical regions of the Indian subcontinent. It is mainly found in the sandy soils of river basins in Northern India and Tamil Nadu. [23] This type of shrub is characterized by its light brown bark, which is rough in texture. The branches of the shrub are glabrous, almost purplish-gray in color, and contain very small glands. The stipules are spinescent and typically measure 1.8 centimetres in length, rarely longer than that,

and are never inflated. The leaves are two-pinnate and contain a small gland located on the petiole, as well as one on the ribiculum near the top of the pinnae. The pinnae are composed of two to eight pairs, while the leaflets are composed of ten to twelve pairs. This species of flowering plant is characterized by its cylindrical or curved pod, which is indehiscent and subterete in appearance. The flowers are glabrous and scented, and measure 4 to 7.5 cm in length and approximately 1.5 cm in width. The seeds are chestnut-brown and are divided into two rows, which are embedded in a dry sponge-like tissue. The seeds are 7 to 8 mm in length and 5 to 5.5 mm in width, and are smooth and elliptical in shape. They are thick and only slightly compressed. The areoles are 6.5 to 7 mm in length and 4 mm wide. [24] It is also referred to as Cassie Flower, Mimosa Bush and Sweet Acacia.

Traditional uses

A. farnesiana is a species of plant with a wide range of traditional medicinal uses. The bark of this species has a range of medicinal properties, including those associated with the treatment of cough and the use of its astringent properties, such as that of bleeding gums. In Java cassia flower is employed as a medicinal emetic in after the childbirth in women, and in the Philippines, it is used as a decoction for the treatment of prolapsed rectums and an injection for the treatment of leucorrhea. The tender leaves are used in the application of a lotion and poultice to ulcers or sores that have been washed with decoction prior to application. Additionally, roots are chewed to treat sore throats, and decoction is used as a treatment for tuberculosis. Tender leaves are also bruised with a small amount of water and swallowed to treat gonorrhea and bladder infections. In Martinique, the flowers are utilized for both stimulatory and anti-spasmodic purposes. Additionally, an ointment derived from the flowers is utilized in Mexico as a treatment for headaches, and their infusion is used to treat dyspepsia. The green fruit of the plant is highly astringent and is used in decoction to combat dysentery, skin and mucous membrane inflammation. Additionally, the pulp of the pod is used as a purgative agent in France. [25]

Chemical constituents

Cassie has been found to contain a variety of substances, including anisaldehyde and benzoic acid, benzyl alcohol, butyric acid, coumarin, cresol, cuminaidehyde, decyl aldehydes, eicosan, eugenols, farnesols, geraniol, hydroxyacetophenone, methyleugenol, methylsalicylate, nerolidols, palmitic acids, salicylic acids and terpineols.[24] The leaves of the plant are composed of a variety of lipids, carotenoids, alkaloids, reducing and non-reducing sugars.[26] Seven polyphenols were isolated from pods and identified by El Sissi et Al (1973). These polyphenols are Gallil Acid, Ellagic Acid, M-Digallic Acid, M-Methyl Gallate, Kaempferol, Atomadendrin and Narigenin. The analysis also revealed the presence of the narigenin-7-glucoside and naringenin-7-rhamnoglucoside (naringin) as well as the metabolite naringenin, glucose, and gallic acid. [27] Cassia concrete is a viscous, solid, dark-yellow or brown substance. When distilled with alcohol, it can produce up to 35% cassia absolute from concrete. The viscous liquid of this absolute is dark yellow to light brown in color and is transparent at temperatures of 20°C or higher, but crystallizes into waxy flakes at lower temperatures. The aroma of this product is characterized by a floral-herbaceous top note, a very warm, spicy, yet floral base, and a deep, persistent dry-out of cinnamic and balsamic. It is well-suited to a variety of aroma profiles. [25]

Medicinal properties

Anti-Inflammatory / Cytotoxicity

The results of the study resulted in the identification of four new Diterpenes (Acasiane B, Farnesirane A and Farnesirane B), three of which are known Diterpenes, as well as 8 flavonoids. Some compounds were found to be cytotoxic to human tumour cell lines, while others demonstrated mild anti-inflammatory properties. [28]

Vibrio cholera inhibition:

A research project examining 32 medicinal plants was conducted which revealed that ethanol extracts from A farnesianus and Artemisia ladoviciana had a positive effect on the inhibition of bacterial growth of the Cholera vibrio strains, as well as on the production of enterotoxins and adhesion. [29]

Antihyperglycemic Activity:

A study was conducted to assess the antihyperglycemic activity of an active fraction of aqueous extract in diabetic rats induced by alloxan. The results indicated promising antidiabetic activity. [30] A study was conducted to assess the antihyperglycemic activity of extracts of Acacia farnesiana. A water extract was found to significantly reduce blood glucose levels. The soluble fraction of the extract was found to be active. The results indicate that the active fraction of the extract directly stimulates glucose uptake without the involvement of insulin, suggesting that this may be the primary mechanism of action. [31]

Antiulcer / Adsorbent:

This research conducted a comparative analysis of the ulcer healing efficacy of Acacia farnesiana methanol extract in a rat ulcer induced model. The results indicated that the extract significantly decreased the ulcer index in comparison to the control Ranitidine. [32]

Bronchodilator / Anti-Inflammatory:
The results of a study suggest that the glycosidal fraction of unripe pods derived from the Acacia genus farnesiana has the potential to provide both a muscle relaxant and an anti-inflammatory effect. The glycosidal fraction was found to have a direct relaxation effect on the bronchial muscles, as well as inhibiting the inflames caused by carrageenan, as well as formaldehyde. [33]
Antioxidant:
The antioxidant properties and protective effects of Acacia pods extracts from two of the most common vegetation types in the diet are suggested. These extracts contain antioxidant components and may be transmitted to animal products such as milk, food, and animal by-products. [34]
Antibacterial / Antioxidant / Anti-Inflammatory:
In a research project, five plants were evaluated for their antibacterial and antioxidant properties. All of the tested extracts were ethanolic, meaning that they contain the active ingredients of the plant. The plants in question were Acacia farnesiana, S. alata, S. grandiflora, S. cumini, and T. divaricata, all of which demonstrated antibacterial and antioxidant activity. All extracts demonstrated anti-inflammatory properties, resulting in a decrease in (IL)-6 and/or (TNF)-a secretion. [35]

Acacia polycantha

Fig. 5. *Acacia polycantha*

The plant *Acacia polyacantha* belongs to the Fabaceae family, a group of genera that includes Campylacantha. [36] The tree is commonly referred to as "Karo" by Hausa-speaking communities in Northern Nigeria. It is native to subtropical Africa, where it is found in moist, alluvial soils close to rivers. Its distribution extends from the Gambia to Ethiopia, and its range extends south to Kenya and Zimbabwe. [37] The White-stem Thristor is a large, upright tree that typically grows to a maximum of 10-15 meters in height. Exceedingly large trees may reach up to 25 meters in height. The stem of young trees is yellowish in colour, with papery skin and persistent prickles. As the tree ages, the bark becomes smoother and whiter, with occasional bark flakes. The young branches are adorned with silvery hairs, and the entire tree is adorned with paired dark brown to black thorns. The leaves are composed of a double compound structure, consisting of 14-35 pairs of Pinnae, with 20-60 Leaflets per Pinna. The leaves are characterized by their large size and are arranged in a single layer along the stems of the plant. The upper part of the leaf is generally darker than the lower part, and is often adorned with hairs along the margins and leaf stalk. The flowers typically bloom between the months of September and December, and are characterized by a light shade of yellow to cream. [38]

Traditional uses

Parts of the Plant	**Uses of the Parts**
(Root Bark) Medicines:	Pain- Killer, Arthritis, Rheumatism, Venereal Diseases, Tumours, cancers.
(Gum) Medicines:	Naso-pharyngeal affections, Antemetics, Genital Stimulants/ Depressants.
(Bark) Medicines:	Stomach troubles, Diarrhoea, Dysentery, Dropsy, Swelling, Oedema, Gout.
(Foliage) Medicines:	Antidotes (Venomous Stings, bites)
(Heart- Wood) Phytochemistry:	Tannins, Astringents (root).

Chemical constituents
Sitosterol, alkaloid diabolin, Anthocyanins, Catechic Tannins, Flavonoids, Galactose, Mannose, Mucilages, Oleanolic Acid, Reducing Compounds, Saponins, Sterols, Stigmasterol, Terpenes. [39]

Medicinal properties
Diabetes mellitus, diarrhea, dysentery, gonorrhea, leprosy, malaria, pneumonia, sore throat, sterility in women, thirst, toothache, trypanosomiasis, ulcer, and urogenital diseases. The use of Decoction (Pods) has been found to be beneficial in the treatment of urogenital diseases. Leaves are an infusion of tender leaves that are used astringents and treatment for diarrhea or dysentery. Decoction (Bark) is used as a cleansing agent for sore throats and toothaches; dry powder is applied externally for ulcers. [39]

Acacia leucocephala

Fig. 6. *Acacia leucocephala*

The genus *Leucaena leucocephala* is native to the Fabaceae family, and is characterized by its medium size and rapid growth rate. The specific name Leucaena is derived from the words "leu" meaning white and "cephala" meaning head, both of which refer to the flowers of the tree. [40] The White Lead tree is also referred to as White Popinac tree, Jumbay tree or Wild Tamarind tree. In India, where it is commonly referred to as kubabul tree or subabul tree. [41] This tree has been classified as a conflict tree due to its propagation forage production. It is naturally propagated as a weed and can reach a height of up to 20 meters. Its leaves resemble tamarind leaves, while its flowers are white with a tinge of yellow, and the pods are long and flattened. The seeds are dark brown in color with a hard-shining seed coat. This tree is widely used for a variety of purposes, such as firewood and timber, as well as foraging, green matter, fodder, shade, and soil erosion control. [42- 45] The main leaf stalk of this species is approximately 10-18cm in length, with 4 to 8 pairs of side stalks bearing the delicate leaflets. The leaves are composed of 10 to 17 pairs of sessile leaflets, each measuring 1 to 2cm in length and 3mm in width, with oblong linear leaflets. [46]

Traditional uses

Leaves-
In Malaysia, young leaves are ground with rice and applied as a thin paste to the neck in order to treat coughs. Additionally, it is rubbed to the entire body in order to treat measles. A combination of leaf ash and coconut oil is applied to the body to address the issue of scurf. Additionally, leaves are utilized as a form of herbal bath to purify the body. In Myanmar, a leaf-based paste is employed to reduce the effects of venomous stings and bites.

Seeds-
The seeds of various cultures in Indonesia and the Philippines have been utilized for various purposes, such as the removal of intestinal worms and the treatment of diabetes. Additionally, the roasted seeds have been found to be beneficial in increasing menstrual flow.

Shoots-
The process involves the boiling of shoots of alum and the purification of the affected portion of shingles with water.

Chemical constituents
The leaves and seeds of *Leucaene leucocephala* contain a variety of lipids, crude proteins, and carbohydrates. Additionally, the seeds contain tannins and oxalic acids. [47, 48] The oil content of the kernel is estimated to be between 17-20%. [16] Mimosine is a toxic, non-protein compound found in the leaves and seeds of the plant. Detailed information regarding this compound is provided in Tables 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 leucocephala seeds possess remarkable medicinal benefits and are employed to alleviate abdominal discomfort, as a form of contraception and as an abortifacient. Additionally, the seed gum used in the formulation of the tablets serves as a binding agent. [53,54] Polysaccharides extracted from seeds in the form of sulfate glycosylated compounds have been demonstrated to possess considerable cancer chemotherapeutic and anti-proliferative properties. [55] Extracts from the seeds have been reported to possess anthelmintic, anti-diabetic and broad-spectrum antibacterial properties. [56- 58] The seed oil has recently been utilized in the field of engineering as a new bio-device that can be used in the modeling of bio membranes and lipophilicity determinations of drugs and xenobiotics. [59]

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