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A REVIEW ON *ACACIA ARABICA* - AN INDIAN MEDICINAL PLANT

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ABSTRACT

The use of herbal drugs for the prevention and treatment of various health ailments has been in practice from time immemorial. *Acacia arabica* has been reported to be effective against a variety of disease including diabetes, skin disease and most concerning with cancer. The fresh plants parts of *Acacia arabica* is considered as astringent, demulcent, aphrodisiac, anthelmintic, antimicrobial, antidiarrhoeal, with good nutritional value in Indian traditional medicine system. This article briefly reviews the ethanobotanical as well as medicinal uses of *Acacia arabica* with plant description. This is an attempt to compile and document information on different aspect of A*cacia arabica* and its potential use. More studies are needed before the pharmacological properties of *Acacia arabica* can be utilized in therapy.

INTRODUCTION: *Acacia* is the most significant genus of family: Leguminosae, first of all described by Linnaeus in 1773. 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 [1, 2]. Gamble, (1918) have reported more than 40 species of this genus in India in his 'Flora of Madras Presidency.'

Acacia species are commonly known as 'Babool' in India and ethnomedicinally have long been used for the treatment of skin, sexual, stomach and tooth problems. *Acacia nilotica* (L.) Del. syn. *Acacia arabica* (Lam.) Willd. (Mimosaceae). Commonly known as babul, kikar or Indian gum Arabic tree has been recognized worldwide as a multipurpose tree. It is widely distributed throughout arid and semi-arid zones of the world. *Acacia arabica* has been proved as effective medicine in treatment of malaria; sore throat (aerial part) and toothache (bark) [3-8] have tested the anti-fertility activity of *A. arabica* pods and nuts.

The methanolic extracts of *A. arabica* pods have been claimed against HIV-PR [9, 10]. Currently, one group of researchers has tested the antiplasmodial activity of *A. nilotica* ethyl acetate extract against different chloroquine resistant and sensitive strains of *Plasmodium falciparum* [11]. The fresh plant parts of this species have been reported to be most active against Hepatitis C virus [12]. it is an important multipurpose tree that has been used extensively for the treatment of various diseases, e.g. colds, bronchitis, diarrhoea, dysentery, biliousness, bleeding piles and leucoderma [13].

Description [14, 15, 16, 17, 18, 24]:

Acacia arabica

Scientific name: *Acacia arabica* (L.) Delile

Subordinate taxa: *Acacia nilotica* (*Nilotica* means 'of or from the Nile valley)

Synonyms: *Acacia nilotica (Lam.)* Willd., *Acacia scorpioides* W. Wight*, Mimosa arabica* Lam.*, Mimosa nilotica* L., *Mimosa scorpioides L.* **Family/tribe:** Fabaceae (alt. Leguminosae) subfamily: Mimosoideae tribe: Acacieae also placed in: Mimosaceae.

Common names: Acacia gomifera, acacia de cayenne, acacia à gomme, arabische gummiakazie, babul, babul acacia, black piquant, casha, cassie, egyptian acacia, goma arabica, gommier rouge, gum arabic tree, Indian gum-arabic-tree, gum arabic tree , thorn-mimosa, thorny acacia.

Regional and other name:

Ben: Babla, Babul; **Eng:** Babul, Black Babul, Indian Gum Arabic tree; **Guj:** Babaria, baval, Kaloabaval; **Hind:** Babul, Kikar; **Kan:** Gobbli, Karijali; **Mal:** Karivelan, Karuvelum; **Mar:** Babhul, Vedibabul, Babhula; **Ori:** Bambuda, Baubra; **Punj:** Sak; **Tam:** Kaluvelamaram, Karrivelei, Karuvael, Karuvelam; **Tel:** Nallatumma, Tumma, Tuma.

Morphological description: Perennial shrub or tree, 2.5–10 (–20) m tall, variable in many aspects. Branches spreading, forming a dense flat or rounded crown with dark to black coloured stems; branchlets purple-brown, shortly or densely pubescent, with lenticels. Bark thin, rough, fissured, deep red-brown. Spines (thorns) thin, straight, light-grey in axillary pairs, usually in 3–12 pairs, 5–7.5 cm long in young trees, mature trees commonly without thorns. Leaves bipinnate 30–40 mm long, often with 1–2 petiolar glands and other glands between all or only the uppermost pinnae; pinnae 2–11 (–17) pairs, with 7–25 pairs of leaflets (1.5–7 mm long) per pinnae.

Peduncles clustered at nodes of leafy and leafless branchlets. Flowers prolific, golden yellow, in globulus heads 1.2–1.5 cm in diameter. Pods straight or slightly curved, 5–15 cm long on a pedicel, 0.5–1.2 cm wide, with constrictions between the seeds giving the appearance of a string of pearls, fleshy when young, indehiscent, becoming black and hard at maturity. Seeds deep blackish-brown, smooth, sub-circular, compressed, areole 6–7 mm long, 4.5–5 mm wide. Seed weight ranges from 5,000–16,000 seed/kg. Subsp. *nilotica* is characterized by glabrous pods and twigs, or nearly so, while subsp. kraussiana has strongly constricted white-grey hairy pods. Pods lightly, or not constricted in subsp. adstringens.

Ayurvedic Description [18, 19, 20]:

Sanskrit Name: Babbula;

Synonyms: Barbura, Kinkirata, Yugmakanta, Suksmapatra, Pitapuspa, Malaphala

Properties:

Rasa: Kasaya; **Guna;** Guru, ruksa; **Virya:** Sita; **Vipaka:** Katu

Action

General: Kapahahara, grahi, visaghna

Gum : Grahi, vrsya, sonitasthapana

Fruits : Stambhana, asthisandhanakara

Therapeutic uses:

General: Kasa, amatisara, raktatisara, krmi, kustha, raktapitta

Gum : Raktatisara, meharoga, pradara, bhagna

Flower : Netraroga, prameha

Distribution:

Native to: Africa: Algeria, Angola, Botswana, Egypt, Ethiopia, Gambia, Ghana, Guinea-Bissau, Kenya, Libya, Malawi, Mali, Mozambique, Niger, Nigeria, Senegal, Somalia, South Africa - Transvaal, Sudan, Tanzania, Togo, Uganda, Zambia, Zimbabwe.

Asia: Arabian Peninsula: Oman, Saudi Arabia, Yemen. Western Asia: Iran, Iraq, Israel, Syria. Indian Subcontinent: India, Nepal, Pakistan. *A. nilotica* subsp. *nilotica* is restricted to well-drained seasonally flooded and riverine habitats from Senegal and northern Nigeria, to Sudan, Arabia and India.

Ethnobotanical Studies: The part of the tree finds use in diabetes, skin diseases and leucorrhoea. These are also used as an antidiarrhoeal, antidysenteric, antidiabetic. The stem bark is astringent, demulcent used in diarrhoea, dysentery, diabetes as astringent, antihelmentic, in skin disease, cough and bleeding

piles, gonorrhoea [23] and as an antiasthmatic [24]. The tender twigs are used as toothbrushes while the thorns are used for joints pains [25]. The gum is used in diarrhoea, dysentery and diabetes [26], dry cough in amoebic dysentery, as a tonic, antiasthmatic analgesic and in oral cavity lesions [27]. Pharmacologically, GA has been claimed to act as an anti-oxidant, and to protect against experimental hepatic-, renal- and cardiac toxicities in rats. These reports could not be confirmed by others.

GA has been claimed to alleviate the adverse effects of chronic renal failure in humans. This could not be corroborated experimentally in rats. Reports on the effects of GA on lipid metabolism in humans and rats are at variance, but mostly suggest that GA ingestion can reduce plasma cholesterol concentrations in rats. GA has proabsorptive properties and can be used in diarrhoea. It enhances dental remineralisation, and has some antimicrobial activity, suggesting a possible use in dentistry. GA has been shown to have an adverse effect on electrolyte balance and vitamin D in mice, and to cause hypersensitivity in humans[28].

The flowers are reported to reduce the body temperature [29]. These are also used in earache and as a tonic, antidiarrhoeal, antidysentary. The fruits are found to be useful in diarrhoea, dysentery and diabetes. The pods are use for impotency, urino-genital disorder and in dry cough. The seeds and leaves extracts are used for general body vigour. The leaves are used in diarrhoea [30], dysentery 3,1 in headaches; eczema [32], abscess [33] and opthalmic disorder [24]. The root is used for wound healing and for burning sensation.

A survey programme was organised in Lucknow and Farrukhabad, two towns of Uttar Pradesh, from March 1987 to July 1987. During the survey, the common folk medicine plants used by women were recorded and Ayurvedic and Unani drug encyclopaedias were consulted for the antireproductive potential of these plants [34]. *Ziziphus nummularia* (Rhamnaceae) and *Acacia nilotica* (Fabaceae) are being used as anthelmintics in ethnoveterinary medicinal system of Pakistan [35]. An infusion made of the bark of acacia nilotica tree or the gum can either be used in decoction or in syrup as an effective medicine for diarrhea. The bark of *Acacia nilotica* (booni) tree is useful in the treatment of eczema. In India, The leaves of booni tree (acacia nilotica) are effective in the treatment of conjunctivitis; *Acacia nilotica* gum allays any irritation of the skin and smoothes the inflamed membranes of the pharynx, alimentary canal and genito urinary organs. In treating tonsillitis, a decoction of the acacia nilotica bark mixed with rock salt can be used as a gargle. In treating leucorrhoea, the decoction of the bark of the *Acacia nilotica* should be used as vaginal douche for the treatment of this disorder.

The fresh pods of *A. nilotica* (booni) tree are effective in treating sexual disorders such as spermatorrhoea, loss of viscidity of semen, frequent night discharges and premature ejaculation. The pods of *Acacia nilotica* are reported helpful in removing catarrhal matter and phlegm from bronchial tubes; African zulu take bark of *Acacia nilotica* for cough treatment [36]. Masai people/tribe believes *Acacia nilotica* is a good aphrodisiac and the root is said to cure importance.

The bark or gum of the plant *Acacia nilotica* is used in West Africa to treat cancers and/or tumours of ear, eye or testicles. It is also used in West Africa to treat indurations of liver and spleen, condylomas and excess flesh. In Senegal, the bark, leaves and young pods are chewed as an antiscorbutic. The bruised leaves are poulticed and used to treat ulcers. In Lebanon, *Acacia nilotica* is infused with orange flower to treat typhoid convalescence. The Chipi and Tonga people / tribes use the root to treat tuberculosis. The Egyptians believe that diabetics may eat unlimited carbohydrates as long as they consume powdered pods of *Acacia nilotica*.

The Italian Africa uses the bark concoction in treating small pox. In Ethiopia, *Acacia nilotica* (booni) is used as a lactogogue (increase milk supply). In Australia, *Acacia nilotica* bark is believed to be an astringent with high tannic acid contents that help to check bleeding, discharge and excess mucus. The extract from this highly astringent herb may block the body's pain triggers. In Ayuvedic medicine, the plant bark or pods are used internally to treat dysentery, chronic diarrhoea and excess mucus [37]. Externally, it helps to stop nose bleeding and good for the treatment of hemorrhoids, skin eruptions, leg sores, mouth ulcers, sore throats and dental infections. In ayurveda, *Acacia nilotica* is considered a remedy for premature ejaculation.

Pharmacological and Biological Studies: *Acacia nilotica* (Linn.) Willd. Ex Delile ssp. **Indica** (Benth.) Breanan syn. *A. arabica* sensu Baker (major part); *A. arabica* auct. Non Willd.; *A. nilotica* (Linn.) Willd. Ex Delile; *A.nilotica* (Linn.) Willd. Ex Delile var. Indica (Benth.) Hill; *A. Arabica* (Lamk.) Willd. var. indica Benth [38].

Antidiabetic: Wadood *et al*., demonstrated that *Acacia arabica seeds* contained a substance(s) which depressed the blood glucose level in normoglycemic but not in alloxan-diabetic rabbits, suggesting that the mechanism of action involved release of insulin from pancreatic beta-cells. The bark in the form of decoction (20 mg/kg) as well as the standard drug talbutamide produced a significant reduction in blood glucose levels in mild alloxonised diabetic rabbits fasted for 18 hr [38]. The *A. nilotica* ssp. Indica fed for one week were found to exhibit hypoglycaemic effect (blood sugar lowered by 25.05%,) in normal rats, but did not show any significant hypoglycaemic effect in alloxanised diabetic rats (blood sugar lowered by 2.14%). The hypoglycaemic effect of the legumes was due to its direct or indirect stimulation of β–cells of islets of langerhans to secrete more insulin [40].

Antimutagenic: The methanolic extract of the bark decreased the UV- induced mutagenicity using the Escherichia coli WP-2 in a dose of 5 mg/plate. This decrease might be due to some enzymatic action which reverted the formation of pyrimidine dimmers [41].

Antiproteolytic: 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 [42].

Antifertility: The aqueous extract of the flowers shoed 11.5 % abortifacient activity in rats. It was further screened for teratological abnormalities in failure cases (where pregnancy was not prevented) in pregnant rats. The foetuses showed gross external morphological and skeletal defects [43]. The extract of the stem bark at 2% concentration revealed semen coagulant activity in a preliminary screening [44].

Nutritional Value: Leaves contain 2.2–2.6% N, 16.9–20.0% NDF, 13.3–14.1% ADF, 7.2–8.7 MJ/kg energy, 10–21% crude fibre and 6–9% condensed tannins. Pod and seed contain 1.6–2.2% N, 10 MJ/kg energy, 12–18% crude fibre and 4–7% condensed tannins. Pods alone contain 2% N, 25% NDF, 17% ADF .In digestibility trials conducted in Zimbabwe, of several species browse species tested, intake of *A. nilotica* was the lowest.

Nutritional value of the refined seed oils is done by rat bioassay and using peanut oil as control. The animals fed on 10 % seed oil diet showed poor growth performance and low feed efficiency ratio. The digestibility of the seed oil was 90 % as compared to 94 % for peanut oil. The seed oil in the diet of rats for 4 wk did not produce any abnormal serum lipids or histopathological findings. The seed oil was apparently non toxic. The deoiled seed cake contains 21.9% protein and balanced amino acids but also contained antinutritional factors, tannins (4.2%) and saponins (2.4 %).

The nutrient and amino acids composition of the detoxified seed meal (PAM) was almost similar to that of unprocessed seed meal except for antinutritional factors. PAM was nutritionally evaluated using rat bioassay produce in a comparative study with cesain as standard. Nutritional indices, biochemical parameters and histopathology findings indicated the possibility of using PAM as supplementary feed for livestock animals [45, 46].

General Pharmacology: The saline extract of the pollen grains stimulated the ileum of guinea pig which was blocked by mepyramine and atropine; the pet. Ether extract stimulated the rats uterus and the heart of pila which was blocked by 2- bromo LSD. The effect of acid treated acetone extract was blocked by mepyramine [47]. A Quaternary base picrate, (mp 242-44^{0}C), isolated from 11 species including the stem bark of the plant was reported to be pharmacologically identical to choline [48]. The 50 % ethanolic extract of the stem bark in a preliminary biological screening exhibited antiprotozoal activity against *Entamoeba histolytica*, CVS effect in dog/cat, antispasmodic activity in guinea

pig ileum and CNS depressant activity as evidence by amphetamine hyperactivity test in mice. The extract was devoid of antibacterial, antifungal, antiviral, hypoglycaemic and anticancer activities. The LD_{50} was found to be 500 mg/kg i.p. in mice [49].

Antimicrobial: The methanol extracts of *C. reflexa* is implicated as an antimicrobial. Plant extracts of *C.reflexa* growing on different sources (*Acacia arabica* and *Zizyphus jujube*) were prepared using aqueous and various organic solvents viz. benzene, acetone, ethanol and methanol. Agar well diffusion technique was used to assess the antimicrobial potential of plant from different sources against gram positive bacteria (*Staphylococcus aureus* & *Staphylococcus epidermidis*), gram-negative bacteria (*Escherichia coli* & *Pseudomonas aeruginosa*) and fungus (*Aspergillus niger*).

The diameter of zone of inhibition was taken as an indicator of antimicrobial effect. The present study showed a strong inhibitory effect of ethanol and methanol extracts of *C. reflexa* (*jujuba* and *arabica*) on most of the gram positive and gram negative bacteria. The aqueous extract of *C. reflexa* (*arabica*) failed to show any antimicrobial activity while *C. reflexa* (*jujuba*) showed very little effect. Thus, *C. reflexa* growing on *Zizyphus jujuba* could be considered as a potential source of natural antimicrobials [50].

In present exploration antimicrobial screening were performed and in this experiments, *A. catechu* and *A. nilotica* exhibited highest activity against three bacterial (*Escherichia coli, Staphylococcus aureus* and *Salmonella typhi*) and two fungal strain (*Candida albicans* and *Aspergillus niger*). Different plant parts (bark and pods) of both species were found to contain various secondary metabolites such as alkaloids, flavanoids, tannins and saponins [51]. In this study it conclude that the antimicrobial activity in plant not by tannins but by another substance(s), because after the heat treatment the activity was seen. Tannins are also thought to be the bactericidal agent in tea [50, 51, 52].

Antibacterial: The antimicrobial activity of the extracts of *Acacia nilotica* was assayed against *Streptococcus viridans*, *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis* and *Shigella sonnei* using the agar diffusion method. The plant extract exhibited antimicrobial activity against all the test microorganisms. *B. subtilis* was the most susceptible to the plant extract while *Candida albicans* was the most resistant. 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. *A. nilotica* could be a potential source of antimicrobial agents [53].

The antibacterial activity of aqueous extract, different solvent extracts and isolated constituents of were evaluated by the cup diffusion method against Aqueous, methanol and ethanol extracts of leaves of *Acacia nilotica* (Family: *Fabaceae*) showed significant antibacterial activity against three phytopathogenic *Xanthomonas* pathovars viz., *Xanthomonas axonopodis* pv. *malvacearum*, *X. a*. pv. *phaseoli* and *X. campestris* pv. *vesicatoria* associated with angular leaf spot of cotton, common blight of bean and bacterial spot of tomato respectively and 14 human pathogenic bacteria. This active fraction fractioned from methanol extract recorded highly significant antibacterial activity *in vitro* (MIC 5, 6 and 7 µg/ml for *Xanthomonas* pathovars and 6-12 µg/ml for human pathogenic bacteria) compared with synthetic antibiotics like Bact-805 and K-cycline for phytopathogenic bacteria and Gentamicin and Streptomycin for human pathogenic bacteria [54].

The alcoholic extract of gum, leaf and fruit are revealed in vitro antibacterial activity against *Staphylococcus auresus* (Zone of inhibition 10-19 mm) using agar diffusion method while it was devoid of any activity against the other bacteria *Basillus subtilis*, *E. coli*, *Proteus vulgaris, Salmonella typhimurium* and Pseudomonas *aeruginosa.* The hexane and aqueous extract were completely devoid of any activity [55]. Air dried and powered alcoholic and water extract of the bark exhibited significant in vitro antibacterial activity against *Streptococcus pyogenes*, *Staphylococcus auresus*, *Escherichia coli, Salmonella typhimurium, Pseudomonas aeruginosa* and *Klebsiella* sp. using the disc method. *Pseudomonas aeruginosa* as found to be resistant to both the extracts, further, both the extracts wee highly inhibitory to gram positive organism in comparison with gram negative organism tested. The entire micro organism showed resistance against the pet. ether extract [56].

Antifungal: The polyphenolic complex of the bark at the concentration of 50% showed maximum growth inhibition (56%) as compare to controls against *Fusarium oxysporum.* The extract at the 10 and 25% dilution showed 24% and 37% inhibition, respectively *in vitro* studies**.** The extract of the flower revealed 65% inhibition against the conidial germination of *alternaris solani* after 10 hr of treatment [57]. The water extract of leaves inhibited the Mycelial growth of the plant pathogenic fungi *Sarocladium oryzae* (37%) and *Fusarium oxisporum* (69%) [58] while the ethanolic extract exhibited 51.13% inhibition of *Rhizoctonia solani* [59].

The pollen suspension stimulated the spore germination of *Helminthosporium oryzae* causing leaf blight of paddy [60]. The deproteinised extract of young leaves of the plant as compared to the extract of pods, flowers, bark and old leaves as less inhibitory to the spore germination of the plant fungi *viz., Alternaria brassicicola, Helminthosporium apattaranae, Pestalotia sp., Penicilum purpurogenum, Asperaginos niger, Trichothesium, Neurospora, Fusarium, Trichoderma* and *Rhizopus species.* There was 100% inhibition of all the fungi in the extract of bark and flowers [61].

The bark and leaf decoction of plant inhibited the polygalacturonase enzyme activity of *Alternaria tenuis* indicating the presence of tannins or phenolic compounds [62]. The acetone extract of the bark inhibited the conidial germination of *Pyricularia oryzae* and coletotrichum falcatum at the concentration of 10 gm/lit and to a lesser extent at a concentration of 1gm/lit it was toxic at the concentration of 0.1g/lit [63].

Antidiarrhoeal: Five medicinal plants [*Acacia nilotica*, *Acanthospermun hispidum*, *Gmelina arborea*, *Parkia biglobosa* and *Vitex doniana*] used in diarrhoeal treatment in Kaduna State, Nigeria, were investigated. This study was carried out on perfused isolated rabbit jejunum and castor oil-induced diarrhoea in mice. The aqueous methanol extracts (0.5, 1.0, 2.0 and 3.0 mg/ml) were generally found to cause a dose-dependent response in the isolated rabbit jejunum, though this was not uniform in all the plants. *Gmelina arborea* and *Vitex doniana* showed concentration dependent relaxation at low doses (0.5, 1.0 mg/ml), but showed no significant relaxation at higher doses (2.0, 3.0 mg/ml). Other extracts showed biphasic effects. For example, *Acacia nilotica* at 3.0 mg/ml caused initial relaxation quickly followed by contraction. In the castor oil-induced diarrhoeal, 100% protections were shown by extracts of *Acacia nilotica* and *Parkia biglobosa* (100, 200 mg/kg) while *Vitex doniana* showed a dose-dependent effect [64].

Antiviral: The crude extract of the leaves of the plant showed *in vitro* antiviral activity against the *Turnip mosaic* virus. There was a decrease in lesions numbers on the hosts *Chenopodium amaranticolor* (93.77 %) and *C. album* (80.2 %). There was also decrease in lesions when the extract was on the host leaves. The bark extract inhibited the potato virus [65, 66].

Nematicidal: The aqueous leaf extract of the plant as also of *A. senegal* showed nematicidal activity against *Meloidogyne incogenita* as it inhibited its hatching [67].

Antioxidant: In the fractionation of methanol extract, a fraction, AN-2, was isolated, which was identified by spectroscopic techniques, namely NMR and mass spectroscopy to be a coumarin derivative, i.e. umbelliferone. The antioxidative activities, including the DPPH, deoxyribose (site and non-site specific), chelating power, reducing power and lipid peroxidation assays, were studied in vitro and performed. It was found that the antioxidative effect of umbelliferone was dose dependent up to 100µg/ml and then levelled off with no further increase in activity. This is the first report of the isolation and antioxidant potential of umbelliferone from *A. Nilotica* [68].

Here, the two extraction methods were evaluates on free radical scavenging activity. Extraction is done on same plant, i.e. Acacia nilotica Results indicated that the sequential extraction method was effective in concentrating the active principles in the ethanol extract as compared to the maceration method in DPPH assay.

Our results indicate that ethanol extract rich in phenolic and flavonoid contents had potent antioxidant activity and were significant in comparison with all the positive controls used in this study. The possible antioxidant mechanism of the ethanol extract can be due to its hydrogen or electron donating and direct free radical scavenging properties [69].

The bark powder of the plant *Acacia nilotica* (L.) Willd. Ex Del was extracted with different solvents of increasing and decreasing polarity by maceration extraction method and then the water extract was further partitioned with ethyl acetate and water. The scavenging activity in lipid peroxidation assay and results were compared with standard antioxidant (butylated hydroxytoluene). The activity of extract was found to increase on fractionating the extract. The antioxidative activities, including the 1'-1' diphenylpicryl-hydrazyl (DPPH) radical-scavenging effects, hydroxyl radical scavenging potential, chelating ability, reducing power and lipid peroxidation inhibition in rat tissue homogenate were studied *in vitro*.

It was found that the antioxidative effect provided by extract/fractions was strongly concentration dependent and increased on fractionating the extract into water and ethyl acetate fractions. From a comparison of the antioxidant potential and IC50 values for different antioxidative reactions, it seemed that extract/fractions were more effective in scavenging DPPH and hydroxyl radicals than reducing; chelating heavy metals and lipid peroxidation inhibitory potential [70]. A polyphenolic compound has been isolated from methanol extract of *Acacia nilotica* Willd. Ex. Del. which has been identified as kaempferol (AN-5) by NMR and mass spectroscopy.

The antioxidant potential of the AN-5 was demonstrated in several in vitro assays: measuring the proton radical scavenging activity (DPPH scavenging assay), hydroxyl radical scavenging activity (deoxyribose degradation assay), metal chelating activity, reducing power and inhibition of lipid peroxidation. It was found that the effect of the compound AN-5 was strongly dose dependent up to the concentrations 1–50 µg/ml in DPPH assay and 1–100 µg/ml in deoxyribose degradation assay but did not show further change above the highest concentrations [71].

Barks extracts of four different trees (*Azadirachta indica, Terminalia arjuna, Acacia nilotica,* and *Eugenia jambolana* Lam.) in three different solvents 80% methanol, 80% ethanol, and 80% acetone (solvent:water, 80:20 v/v) were evaluated for their antioxidant activity.

Antioxidant activity (AA) was determined by measuring reducing power, inhibition of peroxidation using linoleic acid system and 2, 2'-diphenyl-1-picrylhydrazyl radical (DPPH) scavenging activity. Significant ($P < 0.05$) differences were observed in the total phenolics, total flavonids, inhibition of linoleic acid oxidation and DPPH scavenging activity of different bark extracts. All the bark extracts exhibited wide range of total phenolic, 7.8–16.5 gallic acid equivalents and total flavonoid contents, 1.59–4.93 catechin equivalents. Reducing power at 10 mg/ml extract concentration ranged from 1.34 to 1.87.

Different bark extracts inhibited oxidation of linoleic acid by 44–90% while DPPH radical scavenging activity ranged from 49% to 87%. Extraction efficacy of components with antioxidative properties was lowering in the following order: ethanol > methanol > acetone. *A. nilotica* bark had the highest amounts of total phenolics, ranging from 9.2 to 16.5 g/100 g, while the highest Antoxident Activity as measurement by inhibition of linoleic acid oxidation is offered by bark from *E. jambolana* Lam. The same tree showed the highest DPPH scavenging activity and reducing power [72].

Abortifacient Activity: Aqueous or 90 % ethanol extracts of the plants of interest were studied in rats orally dosed for 10 days after insemination with special reference to effects on foetal development. Leaf extracts of *Moringa oleifern* 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 [73].

Combined Studies: The isolation process from an ethyl acetate bark extract of *Acacia nilotica* subsp. Kraussiana, was carried out using bioassay-guided fractionation. The isolated compound was tested for antibacterial activity using the micro-dilution assay; anti-inflammatory activity using the COX-1 and COX-2 assays and investigated for inhibitory effect against acetylcholinesterase using the microplate assay. A new bioactive compound was isolated and identified as a cassane diterpene, niloticane. Niloticane showed antibacterial activity against Gram-positive bacteria *Bacillus subtilis* and *Staphylococcus aureus* with MIC values of 4 and 8µg/ml, respectively.

With Gram-negative bacteria, niloticane showed weak activity. MIC values obtained were 16 and 33µg/ml against *Klebsiella pneumonia* and *Escherichia coli*, respectively. In the cyclooxygenase test, niloticane possessed activity with IC50 values of 28 and 210µM against COX-1 and COX-2, respectively. IC50 values observed with indomethacin (positive control) were 3.6µM for COX-1 and 189µm for COX-2. In the acetylcholinesterase test, niloticane showed anti-cholinesterase activity with an IC50 value of 4µM. IC50 values obtained by the galanthamine (positive control) was 2.0µm.

The results obtained support the traditional uses of the bark of Acacia nilotica subsp. Kraussiana in African traditional medicine for the treatment of some ailments that relate to microbial diseases, inflammation and central nervous system disorders [74].

The present study was undertaken to evaluate antimutagenic and cytotoxic effects of different extracts/fractions of *Acacia nilotica* prepared by maceration method. The potency order of different extracts was more or less similar in Ames assay as well as in cytotoxic assay. Considering the maximum potential of acetone extract in both the assays, the studies were initiated to fractionate this extract. Two pure fractions, namely AN-1 and AN-2, were obtained from acetone extract, of which AN-2 was found to be of gallic acid and AN-1 fraction is still to be identified. In conclusion, the antimutagenic and cytotoxic activities exhibited by acetone extract may partially be ascribed to the presence of gallic acid and other polyphenols [75].

The seed growing on the cattle dunk inhibited *in vitro* microbial growth of *E. coli* MLS-16, *S.typhimurium, Pseudomonas cichorii, Pseudomonas aeruginosa, Mycobacterium smegnatis, Aspergillus awamori* and *Fusarium moniliforme.* No activity was observed against *Bacillus subtilis, Xanthomonas campestries, E. coli* and *Trichoderma viridae* [76].

In vitro antibacterial and antifungal activities of some metal arabates (mercury, silver and copper) prepared from Arabic acid of gum acacia showed antimicrobial activity against *E. coli, B. subtilis, B. anthracis, B. pumilus, S. typhosa, Staphylococcus aureus, Micrococcus pyogenes, Proteus vulgaris* and A*spergilus niger*, *A. Flavus, Trichophyton equingia, Fusarium oxysporum* and *Cryptococcus neoformans* Both the activities were less as compared to the standard drugs penicillin and salicylic acid, respectively [77]. The fatty oil and unsaponifiable matter of the seeds possessed antibacterial activity against *Escherichia coli, Bacillus anthracis, Bac. Subtilis, Corynebacterium pyogenes, Pseudomonas aeruginosa* and *Staphylococcus aureus* and antifungal activity against *Fusarium solani*, *F. Moniliforme, Helminthosporium oryzae, H. turcicum, Alternaria helianthi* and *Colletotrichum capsici*. The fatty oil and the unsaponifiable matter were less active as compared to penicillin and streptomycin (antimicrobial) and salicylic acid and resorcinol (antifungal) as standards [78].

Medicinal Formulation [79, 80, 81, 82, 83, 84]: The prospective, randomized, placebo and positively controlled clinical trial was designed to evaluate the short-term clinical effects of a commercially available gel containing Acacia arabica in the reduction of plaque and gingival inflammation in subjects with gingivitis. Ninety subjects diagnosed with chronic generalized gingivitis were selected and randomly divided into three groups: Group I – placebo gel, Group II – gumtone gel and Group III – 1% chlorhexidine gel. Clinical evaluation was undertaken using the gingival index of Loe and Silness and the plaque index at baseline, 2 weeks, 4 weeks and 6 weeks. A subjective evaluation was undertaken by questionnaire. Gumtone gel showed significant clinical improvement in gingival and plaque index scores as compared to a placebo gel. This improvement was comparable to 1% chlorhexidine gel. Unlike chlorhexidine gel, gumtone gel was not associated with any discolouration of teeth or unpleasant taste [79].

Auromere's Ayurvedic Formula, Brand: Auromere Ayurvedic, Item Number: 327045-172138: Combines the natural tooth-whitening fibre PEELU with the astringent and invigorating properties of NEEM and 21 other barks, roots, plants and flowers that have been esteemed for centuries by Ayurvedic Specialists for their separate and combined efficacy in maintaining superior hygiene. Regular use gently and naturally cleans and polishes teeth to their whitest, invigorates and soothes sensitive gums, and purifies the mouth and breath. Ingredients: Fine Chalk (a gentle cleanser), Glycerin (from vegetable oil), Water, Sodium Lauryl

Sulphate (indian coconut oil), Silica, Carageenan (seaweed), Peelu (*salvadora persica*), Neem (*azadirachta*), Indian Licorice Root, Pomegranate Rind, Common Jujube, Rose Apple, Clove, Persian Walnut, Barleria Prinoitis Bark (vajradanti), Indian Almond, Bedda Nut, Asian Oak, Prickly Ash, *Zanthoxylum alatum* (tejbal), Sappan Wood, Catechu, Bengal Madder, *Acacia arabica* Bark (babul), Sarsaparilla, Cinnamon, Medlar Bark, Mayweed, Bishop's Weed (flower extract), silica, sodium lauryl sulphate (from Indian coconut oil), carageenan (from seaweed), cellulose gum (from plants), Peppermint Oil, Spearmint Oil, Eucalyptus Oil, Cinnamon Bark Oil, Menthol, Thymol, Anethole .

Glyconutrient Powder, Brand: Now Foods, Item Number: 355483-186295: Cellular Immune Support, Supports Intercellular Communication Provides 8 Essential Sugars With Glyconutrient Blend and ImmunEnhancer. Glyconutrient Blend is a proprietary blend of ingredients that supplies eight immune supporting glyconutrients (sugars) from whole coffee fruit and other natural substances. Glyconutrients are essential components of cell signaling molecules that are involved in a multitude of intercellular communication functions and play an especially important role in immune response. ImmunEnhancer™ is a polysaccharide from Larch called Arabinogalactan. Scientific studies have shown that Arabinogalactan can support a healthy immune system through its effects on NK Cells. A strong responsive immune system is the foundation of good health.

Acacia Fiber Organic Powder, Brand: Now Foods, Item Number: 415723-206319: Intestinal Health, Pure Powder, Highly Soluble, Mixes Instantly, Gentle fiber, A Dietary Supplement , Vegetarian Product, GMP Quality Assured. NOW Organic *Acacia* fiber Powder is a natural, pure, soluble dietary fiber produced from the gum of the *Acacia* tree. Scientific studies have shown that as part of the diet, soluble fiber can help to encourage intestinal regularity. *Acacia* Powder is also known to be an excellent prebiotic, as it supports healthy gut flora. Because it actually slows fermentation and decreases gas and bloating, *Acacia* Powder is well tolerated. Now Organic *Acacia* fiber Powder can be used daily and contains no GI irritants or stimulants.

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