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A review of ethnomedicine, phytochemical and pharmacological activities of *Acacia nilotica* (Linn) willd

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ABSTRACT

An impressive abound medicinal plants have been utilized for the treatment of diseases from the time immemorial. The medicinal plants used in traditional medicine still plays an important role in emerging and developing countries since; they are inexpensive, effective and have natural origin. *Acacia arabica* commonly known as babul belongs to the family Fabaceae is widely distributed throughout the tropical and subtropical plains all over India, Sri Lanka, and Sudan, this plant is native to Egypt. Almost all its parts such as root, bark, leaves, flower, gum, pods etc are used in medication. The qualitative phytochemical study of different part of plant extract like leaves and fruits contain tannin; flowers contain stearic acid, kaempferol-3- glucoside, isoquercetin, leucocyanidin; pods contain tannin gum contain Arabic acid combined with calcium, magnesium and potassium. Moreover, polyphenolic compounds have also been reported in pods and bark. In traditional medicine, it is used for bleeding diseases, prolapse, leucorrhoea etc and experimental studies of *A. arabica* showed antihypertensive, antispasmodic, antibacterial, antifungal, antioxidant activity etc. The present review is an attempt to explore and comprehensively highlight the ethnomedicine uses, phytochemical properties and pharmacological uses of *Acacia arabica* reported till date.

Keywords: *Acacia Arabica*; phytochemical study; tannin; Arabic acid; ethnomedicine uses.

1. Introduction

Over three quarters of the world population relies mainly on plants and plant extracts for healthcare. More than 30% of the entire plant species at one time or other was used for medicinal purposes. In India drugs of herbal origin have been used in traditional system of medicine such as Unani, Ayurveda since ancient times. The Ayurveda system of medicine uses about 700 species, Unani 700, Siddha 600, Amchi 600 and modern medicine around 30 species. [1] The plant-based traditional medicine system continuously plays an essential role in health care.

Acacia is a genus of shrubs and trees belonging to the subfamily Mimosoideae [2, 3], of the family Fabaceae or Leguminosae, [4, 5] first described by the Swedish botanist Carl Linnaeus (1773). They are pod-bearing, with sap and leaves typically bearing large amounts of tannins and condensed tannins that historically in many species found use as pharmaceuticals and preservatives. This name derives from the Greek word for its characteristic thorns, ἀκίς (*akis*, thorn). The generic name derives from ἀκακία (*akakia*), the name given by early Greek botanist-physician Pedanius Dioscorides (ca. 40-90) to the medicinal tree *A. nilotica* in his book *Materia Medica*. The species name *nilotica* was given by Linnaeus from this tree's best-known range along the Nile river. The genus *Acacia* previously contained roughly 1300 species, about 960 of them native to Australia, with the remainder spread around the tropical to warm-temperate regions of both hemispheres, including Europe, Africa, southern Asia, and the America. [6] The extract of pods or legumes is known as *Aqagia* in Unani system of medicine. When it is obtained from unripe fruit then called as *Qurz* [7, 8, 9, 10, 11]. It is Native to Egypt, seen throughout the greater part of India, Ceylon, Baluchistan, Waziristan, Arabia, Egypt and tropical Africa [12]. The synonyms are *Acacia arabica* (Lam.) Willd, *Acacia scorpioides* W.Wight, *Mimosa arabica* Lam., *Mimosa nilotica* L., and *Mimosa scorpioides* L [6].

A. nilotica know as babul is the most important tree of the dried parts of India. Almost all its parts are used in medication including root, bark, leaves, flower, gum, pods etc [9, 13].

2. Botanical Description

It is an ever green tree, growing upto 10 meters in height. It is a small tree with dark brown or black longitudinally fissured bark; branch lets slender, terete and pubescent when young [12]. The tree generally attains a height of 15 m and girth of 1.2 m, though trees up to a height of 30 m with a girth of 3 m have also been recorded [8]. The leaves are 2-pinnate, 5-10 cm long; main rachis downy, often furnished with glands; petioles are 2.5-5 cm long; stipular spines very variable, 0.6-5cm long, and smooth [4]. The leaflets are opposite in 10 to 20 pairs crowded, sessile, linear-oblong, obtuse or acute, rigid, greyish green about 1/6 inch long [12]. The flowers are yellow, golden-yellow, fragrant, crowded in long-stalked, globed heads, 1.5 cm in diameter, forming axillary clusters of 2-5 heads, [8] and pubescent; bracteoles 2, calyx campanulate, 1.25 mm long; teeth very short. Corolla 3 mm long; lobes short, triangular [12]. Pod shortly stalked, 3 or 4 inches long by about 3/4 wide, more or less constricted between the 2-6 seeds, flat except over the seeds, smooth, pale membranous, with a strong fibrous marginal rib and fainter transverse reticulating veins. Seeds with a long funicle slightly dilated at the hilum, roundish in outline [12] and persistently grey downy [8]. It is very bitter to taste [13, 14, 15]. 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 [4, 14].

Vernaculars Name: Unani Tibbi: Aqaqia [9, 15, 16]; English: Indian gum arabic, Black babool [4, 12]; Arabic: Ummughilan [12], Usare qurz [11, 16]; Persian: Kharemughilan [9, 11, 12]; Urdu: Babul, Kikar [9, 12] Hindi: Kikar [8, 11, 12]; Sanskrit: Babbula [12]; Kannada: Jaali, Gobbli [2, 8]; Tamil: Karuvelam [12]; Telugu: Nallatumma [8, 12]; Sinhala: Babbulae [17].

3. Pharmacological actions in traditional and ethno medicine

The pharmacological actions described in the traditional system of medicines are concisely summarized and abound of them are pharmacologically proven on modern scientific parameter.

4. Action mentioned in Unani medicine

Qabiz-Astringent; [13, 18] Muqawwi meda wa kabit-Strengthen the stomach and intestine [11] Habis khoon-Haemostatic; [11, 19] Mujaffif-Desiccant [19]; Radae-Divergent; [10, 20] Mugharri Stimulant; [12, 21] Muqawwi asab-Nervine tonic; [10, 16] Muqawwi badan-General tonic; [10, 16] Mullattif-Demulcent; [10] Muhallil-Anti-inflammatory; [15] Dafiae tashannuj Antispasmodic; [9] Mullayin- Laxative; [21] Muqawwi basr-Eye tonic [15, 21].

5. Medicinal uses mentioned in Unani medicine

The bark skin, leaves, seeds, pods and the gum of *Acacia arabica* are used for medicinal purpose. The plant is used internally as well as externally.

5.1 Extract of pods (Aqaqia): The extract of pods is useful to prevent leucorrhoea and drives back the uterus and anus when they come out [7, 11, 13, 15, 22]. It is also useful in istarkha rehm (laxity of vagina) [7]. It tightens the perineum if used locally [13]. It is also useful to divert the morbid matter coming towards the organ [11]. It prevents haemorrhagic diarrhoea [7]. It prevents infantile diarrhoea if used along with roghan gul (rose oil) [10, 15]. It causes dryness if applied externally on the body [13]. It prevents the foul smelling of sweat, if applied externally on skin along with gulab (rose) [11, 13]. It causes constipation when used orally or as enema [7, 13]. It is useful for intestinal abrasions and

hemorrhagic diarrhoea [7, 11, 13]. It prevents flabbiness of the joints [7]. It can be used externally in inflammation of anus along with aas and gulab [10]. It promotes and strengthens the vision and cure eye diseases [7, 11, 15]. It gives relief in conjunctivitis, erysipelas and also included in medicine meant for pterygium [7, 13, 15]. It blackens the hair and prevents hair falling [7, 11, 13, 15, 19]. It gives clear complexion and useful for fissures caused by cold [7]. It is suitable for persons suffering from diarrhoea and dysentery [15]. It is useful in all bleeding diseases [11, 13, 15]. It reduces the excessive sweating, when used as tila with gulab and aas [10, 11, 13, 16]. It is useful for whitlow (paronychia), fire burns, pimples and hot swellings when applied with white of egg [7, 8, 13, 15, 16]. It is useful for ulcer of mouth and bleeding gums in the form of zaroor (powder) [7]. It is useful in spermatorrhoea and premature ejaculation [18, 19]. It stops bilious diarrhoea [11]. The powdered pods used in impotency and effective in urogenital disorders [23].

5.2 Flowers: It use as a tonic in diarrhoea and dysentery and good cure for insanity. The flowers are reported to reduce body temperature [14]. Powdered form of flowers and bark useful in premature ejaculation and seminorrhoea [18].

5.3 Leaves: The decoction of the leaves used for astringent to the bowels, cure bronchitis, heal fracture, good for eye diseases [14]. Bruised leaves applied to sore eyes in children. Paste of burnt leaves effective ointment in itch [9]. Tender leaves beaten into a pulp are used as a gargle in spongy gums, sore throat and as wash in haemorrhagic ulcers and wound [9].

Leaves extract is an astringent and injected to allay irritation in acute gonorrhoea and leucorrhoea. Further, bruised leaves formed into a poultice and applied to ulcer act as a stimulant and astringent [4]. The tender leaves growing tops rubbed into a paste with sugar and water and given morning and evening act as a demulcent useful in coughs [4]. The tender leaves beaten into a pulp are given in diarrhoea as astringent [12].

5.4 Bark: the bark contains a large quantity of tannin and is a powerful astringent; its decoction is largely used as a gargle and mouth wash in cancerous and syphilitic affections [4].

Infusion of bark (1½ ounces to one pint of water) is given in chronic diarrhoea and diabetes mellitus in doses of 1½ to 2 ounces twice a day. The juice of the bark mixed with milk is dropped into the eye in conjunctivitis [4]. Decoction of bark is largely used as an astringent douch in gonorrhoea, cystitis, vaginitis, leucorrhoea and prolapse of uterus [9].

5.5 Gum: the powdered gum mixed with quinine is useful in fever cases complicated with diarrhoea and dysentery [4]. It stops bleeding and urinary and vaginal discharges, also useful in diabetes [23]. Powdered gum mixed with quinine is useful in fever cases complicated with diarrhoea and dysentery; mixed with white of egg it is applied to burns and scalds [9].

5.6 Fruits: The fruits are prescribed in dysentery and ophthalmia [14].

6. Other Traditional System of Medicine: The African zulu people used bark for cough and also in West Africa, the bark or gum is used to treat cancers/or tumours (of eye, ear or testicles) and indurations of liver and spleen, condylomas and excess flesh [24]. **Lebanon:** The resin is mixed with orange flower infusions for typhoid convalescence [24]. **Tonga:** The root is used to treat tuberculosis [24]. **Egypt:** The Egyptian Nubians believed that

diabetics may eat unlimited carbohydrates as long as they also consume powdered pods [24]. **Italian Africa:** The wood is used to treat smallpox [24]. **Ethiopia:** Certain parts of the tree are used as a lactagogue [24]. **Senegal:** Sap or bark, leaves and young pods are strongly astringent due to tannin and are chewed as an antiscorbutic [24].

Dosage mentioned in Unani literature: Extract of pods (Aqaqia): - 1½ g [19]; 2¾ - 3½ g [13]; 3½ g [13,15]

Substitute: Sandal sufaid (white sandal wood) [10, 13, 15, 16]; Masoor ki daal (gram) [10, 13, 15]; Rasaut (wild turmeric) [13, 15] (Rasaut is the best substitute for Aqaqia [10]); Dammul Akhwain (Dragon blood) [13].

Formulations (Unani medicine): Hab awaz kashk; [9] Hab ral; [9] Hab surkh chashm; [9] Qurs deedan; [9] Qurs ziabitus; [9] Qurs salajit; [9] Qurs sailan; [9] Qurs sailan jadid; [9] Qurs kabid naushadri; [9] Qurs kahruba; [9] Qurs gulnar; [9] Sunun poast mughilan; [9] Majoon bawasir; [9] Lauq sapistan [4].

7. Medicinal uses in ethno medicine

7.1 Leaves: Tender leaves beaten into a pulp are used as a gargle in spongy gums, sore throat and as wash in hemorrhagic ulcers and wound [4, 9, 25]. Bruised tender leaves formed into a poultice and applied to ulcers act as stimulant and astringent [4]. The leaves are tonic to brain and liver [4]. Also promotes and strengthens the vision and cure eye diseases [15, 25]. The leaves are astringent, tonic to the liver and the brain, antipyretic, enriches the blood [16]. The tender leaves infusion used as an astringent and remedy for diarrhoea and dysentery [23].

7.2 Bark: Decoction of bark is largely used as an astringent douche in gonorrhoea, cystitis, vaginitis, leucorrhoea, prolapse of the uterus and piles [4, 9, 12]. The decoction largely used as a gargle and mouth wash [4, 8]. The juice of bark mixed with milk is dropped into the eye for conjunctivitis [4]. The burnt bark and burnt almond shell both pulverized and mixed with salt to make a good tooth-powder [4]. The Italian Africa uses the bark concoction in treating small pox. In Ethiopia, *Acacia nilotica* (booni) is used as a lactagogue (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 [26].

7.3 Gum: Gum administered in the form of mucilage in diarrhea, dysentery and diabetes mellitus [4, 8, 9, 12]. Fried in ghee, the gum is useful as a nutritive tonic and aphrodisiac in cases of sexual debility [4, 9]. Powdered gum mixed with the white of an egg is applied on burns and scalds [4]. The gum is expectorant, antipyretic, cure lung troubles. [12] The gum is said to be very useful in diabetes mellitus [14, 27].

7.4 Pods: Decoction is beneficial in urogenital diseases and [8, 27] prevents premature ejaculation. [4] It is an astringent and injected to allay irritation in acute gonorrhoea and leucorrhoea. [4] The pods are use for impotency, urino-genital disorder and in dry cough. The seeds and leaves extracts are used for general body vigour. [28]

The fresh pods of *A. nilotica* (booni) tree are effective in treating sexual disorders such as spermatorrhoea, loss of viscosity 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 [29].

7.5 Fruits: The fruits are found to be useful in diarrhoea, dysentery and diabetes [8].

7.6 Seeds: Extract of seeds found to be general body vigour [28].

7.7 Root: Powder of root is useful in leucorrhoea, [30] useful in wound healing and useful in burning sensation. [31] Various plants parts used in hair-fall, ear-ache, syphilis, cholera, dysentery and leprosy [23].

The tender growing tops rubbed into a paste with sugar and water and given morning and evening act as demulcent, useful in cough [4].

8. Chemical constituents:

Leaves and fruits contain tannin 32% and flowers contain stearic acid, kaempferol-3- glucoside, isoquercetin, leucocyanidin [27, 32]. The bark contains 20% of tannin. There is polyphenolic compounds have been reported and those identified are (+) dicatechin, quercetin, gallic acid [9, 33] and ∞ - amyryn, β-sitosterol. [23, 32] The bark contains sucrose also [2, 32]. Pods of babul also contain tannin, 12-19% in the whole pod and 18-27% after removal of seeds. Several polyphenols are present in pods and those identified are gallic acid, m- digallic acid, (+) catechin, and robidandiol, [4, 33] chlorogenic acid, m-digallic acid, galloylated flavan-3-4-diol [33]. The gum contains 1.8% moisture, galactose, L-arabinose. L-rhamnose and four aldobiouronic acids. It also contains arabinose, 3-O-β-L-arabinopyranosyl, L-arabinose [4, 32, 33]. Further it contains calcium, polysaccharides, magnesium salts, potassium, sugar, moisture, ash and malic acid and oxidative enzymes [9, 32]. Wood contain chlorides [5] Analysis of the seeds gave the following values (dry basis). Moisture 8.83, crude protein 26.5, fat 3.3, N-free extract 62.9, crude fibre 2.7, and total ash 4.7, calcium 673.0, phosphorous 420.0, iron 4.95, niacin 3.17, ascorbic acid 4.51, and thiamine 0.24 mg/100 ml. The essential amino acid composition of the seed protein is histidine 3.7, lysine 4.3, methionine 0.4, cystine 0.49, leucine 8.8, valine 4.2, and threonine 3.39/16 g. The seeds on extraction with petroleum ether yield brownish oil (6.7%). The oil contains; saturated acids 27.4%, oleic 30.5% and linoleic acid 42.1 % [27]. Both contain 32% tannin [34] and fruit also contain gallic acid [23]. Root contains hentriacontane, lapachol, n-hentriacontanol, sitosterol, [30] octacosanol, betulin, β-amyryn [33]. Flower provides stearic acid, kaempferol-3 glucoside, isoquercetin, leucocyanidin [32].

9. Precautions and adverse reactions: The drug sometime causes bloating, intestinal gas, more frequent bowel movement and skin inflammation and intravenous injection of gum arabic may cause kidney and liver damage. Combining herbs with certain drugs may alter their action or produce unwanted side effects. Some it produces obstruction also [35].

10. Ethnopharmacological studies

Several research workers have reported different biological activities of *Acacia arabica* in various *in vitro* and *in vivo* test models. These have been highlighted in detail in following headings.

10.1 Antihypertensive activity: Gilani *et al.* (1999) determined

that a methanol extract of *Acacia nilotica* pods possess decrease in arterial blood pressure at dose (3-30 mg/kg). It also produces an inhibitory effect on force rate concentration through calcium channel blockage in guinea-pig and rabbit [30]. Amos S et al (1999) reported that aqueous extract of seeds of *Acacia nilotica* shows spasmogenic activity on the isolated guinea-pig ileum. The mechanism behind it may be increase in calcium influx that results in muscle spasm [36].

10.2 Antimutagenic activity: Arora S *et al.* (2003) concluded that acetone extract of *Acacia nilotica* exhibited antimutagenic activity against direct acting mutagens of NPD, sodium azide, and the S9-dependent mutagen 2-aminofluorene (2AF). This mutagenic activity is determined by employing the plate incorporation. Ames Salmonella histidine reversion assay by using different strains of Salmonella typhimurium [37].

10.3 Antibacterial activity: Mohan Lal Saini *et al.* (2008) examined antimicrobial activity of *Acacia* species and *A. nilotica* in comparative study, which exhibited highest activity against *Escherichia coli*, *Staphylococcus aureus* and *Salmonella typhi* (bacteria); *Candida albicans* and *Aspergillus niger* (Fungus) in methanolic extract [38].

Deshpande SN (2013) has been conducted study on ethanol and petroleum ether extract of stem bark of *Acacia nilotica*; showed highest antibacterial activity against *Staphylococcus aureus*, *Escherichia coli*, *Proteus vulgaris*, *Proteus mirabilis*, *Salmonella paratyphi B*, *Klebsiella pneumonia*. The results shows both the extracts exhibited inhibitory action on the pathogens above mentioned. But; ethanol extract showed greater activity as compared to corresponding petroleum ether extract [39].

Chandel B.S *et al.* (1992) screened an air dried and powdered alcoholic and water extract of the bark *in vitro* study. This exhibited significant antibacterial activity against *Streptococcus pyogenes*, *Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhimurium*, *Pseudomonas aeruginosa* and *Klebsiella sp.* By using the disc method but *Pseudomonas aeruginosa* as found to be resistant to both the extracts, further, both the extracts were highly inhibitory to gram positive organism in comparison with gram negative organism tested. The entire micro-organism showed resistance against the pet. ether extract [40].

Banso A (2009) showed the antibacterial activity of the extracts of *Acacia nilotica* assay against *Streptococcus viridians*, *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis* and *Shigella sonnei* using the agar diffusion method. This study shows antibacterial activity against all the above said organisms, but *Bacillus subtilis* most susceptible to the plant extract [41].

10.4 Antifungal activity: Mahesh B *et al.* (2008) have concluded that antifungal activity of methanolic extracts and aqueous extract of *Acacia nilotica* with percentage inhibition ranging from 34.27±1.45 to 93.35±1.99 [42].

10.5 Antiviral activity: Singh R *et al.* (1972) evaluated 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%) [43].

10.6 Antimicrobial activity: Methanolic and aqueous extracts of

Terminalia chebula, *Mimusops elengi*, *Achyranthes aspera*, *Acacia catechu*, *Acacia arabica* and *Glycyrrhiza glabra* was tested for their antibacterial activity against six dental infection microorganisms such as *Staphylococcus aureus*, *Staphylococcus mutans*, *Staphylococcus salivarius*, *Staphylococcus sanguis*, *Lactobacillus acidophilus* and *Candida albicans*. These phytochemical analyses of these plants showed synergistic antimicrobial effect [44].

Khan R (2009) has explored the antimicrobial activities of the crude ethanolic extracts of five plants against multidrug resistant (MDR) strains of *Escherichia coli*, *Klebsiella pneumoniae* and *Candida albicans* and ATCC strains of *Streptococcus mutans*, and different stains of microorganism and *A. nilotica* has minimum Inhibitory Concentration range 9.75-313 µg/ml [45]. Mashram N *et al.* (2009) has observed the anti-microbial activity of *Acacia nilotica*, against *S. aureus*, *B. subtilis* and *E. coli*. The leaf and bark extracts showed zone of inhibition between 7.5-16 and 8-15.5 mm respectively and most active against *E. Coli* [46].

10.7 Antidiabetic (Hypoglycemic effect) activity: Wadood A *et al.* (1989) evaluated 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 [47].

10.8 Antioxidant activity: Agrawal S (2010) explored methanolic extract of plant have anti-oxidant activity which was found to be 9.88 µg/ml [48]. Sultana B (2007) explained that different extracts of bark of *Acacia nilotica* linn exhibited inhibition of oxidation of linoleic acid 44–90% while DPPH radical scavenging activity ranged from 49% to 87% [49].

Singh R (2010) studied 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 100 µg/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* [50].

10.9 Antidiarrhoeal: Agunua A., *et al.* (2005) described that medicinal plants [*Acacia nilotica*, *Acanthospermum 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.^[51]

10.10 Abortifacient and Anti infertility activity: Nath D (1992) reported that 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 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.^[52] The extract of the stem bark of *Acacia nilotica* at 2% concentration revealed semen coagulant activity in a preliminary screening.^[53]

10.11 Antiplasmodial activity: Aqueous root extract of *A. nilotica* was analyzed for antiplasmodial activity in mice. Acute toxicity of the extract was studied using Organization for Economic Cooperation and Development (OECD) guideline 423. Suppressive activity, curative and prophylactic effect was studied in chloroquine-sensitive *Plasmodium berghei* NK 65 infected 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 doses were administered orally. All doses of the extract produced significant, dose dependent, chemo suppressive activity against the parasite in the suppressive, curative and prophylactic tests. This is comparable to the group treated with chloroquine. The extract also prolonged the mean survival time of treated mice compared to the untreated group. The oral median lethal dose (LD₅₀) of the extract in mice was 5000 mg/kg body weight. The results of this study showed that the aqueous root extract of *Acacia nilotica* is safe and has anti plasmodial activity^[54].

10.12 Hyperglycaemic, Lipid Profile and Platelet aggregation activity: Asad *et al.* (2011) has been expressed that, aqueous methanol extract of *Acacia nilotica* leaves was investigated in streptocin, induced diabetic rats. The results shoes significant differences ($p < 0.05$) were noticed in blood glucose, serum insulin, platelet aggregation and triglyceride levels in diabetic rats treated with AN extract and glyburide as compared to diabetic controlled rats. A significant difference ($p < 0.05$) in β -thromboglobulin and LDL levels was also noticed in rats treated with glyburide than the diabetic controlled rats. The levels of fasting blood glucose, β thromboglobulin and platelet aggregation were significantly reduced ($p < 0.05$) in diabetic rats treated with glyburide than AN extract treated rats^[55].

10.13 Galactagogue activity: Eline M.B *et al* (2004) said that aqueous extract of *Acacia nilotica* ssp can stimulate milk production in lactating women. The activity performed to determine the effect of an aqueous extract of *Acacia nilotica* on milk production in rats. The milk production is improved by 59% in first hour in rat^[56].

10.14 Catalytic activity: Majumdar *et al.* (2013) investigated that the leaf extract of *Acacia niolotica* is synthesized of gold nanoparticles in water room temperature, which has been used an efficient catalyst for the reduction od 4-nitrophenol to 4 aminophenol^[57].

11. Clinical Studies

Single blind, plain controlled randomized study was conducted to evaluate the efficacy of *Aqaqia* (*Acacia arabica*) in improving Woman's Quality of Life in *Nutue Rehm* (Uterine Prolapse) with well validated Prolapse-Quality of Life (P-QOL) Questionnaire. Thirty subjects diagnosed with uterine prolapsed were selected and randomly divided into two groups: Group I – test group (*Acacia arabica* powder orally as well as pessary with pelvic floor muscle exercise) I, Group II-control group (Vitamin B complex with pelvic floor muscle exercise). Clinical evaluation was undertaken using the P-QOL questionnaire. The test group shows a significant improvement in quality of life in uterine prolapse patient as compared to a control group^[58].

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 – gum tone 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. Gum tone 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, gum tone gel was not associated with any discolouration of teeth or unpleasant taste^[59].

12. Conclusion

Acacia arabica has been in use since ancient times to treat wide range of diseases in traditional system medicine. Experimental studies have proven its antidiabetic, antihypertensive, antispasmodic, antibacterial, antifungal activity, antiplaque, antioxidant, antiplasmodic, antiviral activity, catalytic and galactagogue. The scientific studies have proven the claims of traditional system of medicine. Further more detail clinical researches are needed to explore its medicinal value in order to establish it as a standard drug.

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