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Phytochemical and Pharmacological Uses of *Acacia Nilotica* - A Review

Rasha Jame[1, 2]

[1]Department of Chemistry, Faculty of Science, Tabuk University, Tabuk, Saudi Arabia

[2]Department of Chemistry, Faculty of Education, Dalanj University, Dalanj, Sudan

Email address:
rjame@ut.edu.sa, rashajame@gmail.com

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Abstract: The present review aims to provide up-to-date a summary of the phytochemical and pharmacological usage of *Acacia nilotica* tree. *Acacia nilotica* is an important multipurpose medicinal plant; it was used for the treatment of various diseases and is widely distributed throughout the tropical and sub-tropical regions. It belongs to a family: Fabaceae; genus: *Acacia* and spices**:** *nilotica*. The different parts of *Acacia nilotica* like roots, leaves, bark, gum, flowers and pods were recognized as a component of traditional medicine in different countries. *Acacia nilotica* is commonly known as 'Algarad' in Sudan and have long been used for the treatment of some diseases from the time immemorial. An exhaustive survey of literature has revealed that the phytochemical of different extracts of acacia were evaluated for phenolic, flavonoids, tannins, alkaloids, fatty acids, anthraquinones, saponins, steroids, triterpenoids protein and polysaccharides. The qualitative phytochemical studies of different part of plant extract showed that, the bark contains terpenoids, tannins, alkaloids, saponins, sterols and glycosides; leaves contain tannins, alkaloids, sterols, saponins, cardiac glycosides and flavonoids; roots contain saponins, flavonoids, terpenes, tannins, sterols, phenols, alkaloids, and anthraquinones; pods contain alkaloids, flavonoids, tannins, saponins, carbohydrate, and sterol; Flowers showed presence of phenolic compound. The pharmacological studies reviewed many significant medicinal usages of the different parts extract of the *Acacia Nilotica* tree as an anti-inflammatory, antioxidant, antidiarrhoeal, antihypertensive and antispasmodic, antibacterial, antifungal, antiplasmodial, analgesic, antipyretic, antiviral, antiplatelet aggregatory and anticancer activities. Through this review I am tried to explore the therapeutic potential of *A. nilotica* and thus may be a promising route for a new, safe, inexpensive, biodegradable and renewable source of natural drugs with high therapeutic index.

Keywords: *Acacia Nilotica*, Phytochemical, Pharmacological Uses

1. Introduction

Plants and plants extract used for medicinal purposes and play an important role in developing countries since; they are inexpensive, effective and have a natural origin. In traditional medicine, *Acacia Nilotica* is widely used. Almost all their parts used in medication including root, bark, leaves, flower, gum, and pods [1]. This plant has anti-microbial, antiplasmodial, anticancer, antimutagenic and antioxidant activity and used for the treatment of against cold, cough, sore throat diarrhea, dysentery, tuberculosis, piles, hepatitis C virus, burns, and scalds. Some common pharmacological uses of different parts of *A. nilotica* listed in table 1.

Acacia first described in 1773 by the Swedish botanist Carl Linnaeus. *Acacia* is a genus of shrubs and trees belonging to the subfamily Mimosoideae of the family Fabaceae or Leguminosae, see review in [2]. It is a complex species with nine subspecies, six are native to the African tropics and the others are native to the Indian subcontinent [3]. *Acacia nilotica* is a tree widely distributed all over India, Sri Lanka, Sudan, Saudi Arabia and Egypt [2, 4-6]. Arabia. *Acacia nilotica* has different English names: like Indian gum arabic, Tomentose Babool, Black piquant, Black babul, Gum arabic, Egyptian mimosa, Egyptian thorn, Prickly Acacia, Nile acacia, Scented thorn and Scented-pod acacia; and different Arabic names: as Ummughilan, Usarequrz (see [6]and references therein) and kaarad [4].

Table 1. *Some common pharmacological uses of different parts of Acacia nilotica.*

Part used	pharmacological uses	References
Roots	Leucorrhoea wound healing, burning sensation; anti-malaria; analgesic and antipyretic	[7-9]
Leaves	Antioxidant; antiviral; for general body vigour; applied to sore eyes in children, Paste of burnt leaves effective ointment for the itch, used as a gargle in spongy gums, sore throat and as a wash in haemorrhagic ulcers and wound; anticancer and antimutagenic; diarrhea; antibacterial	[1, 2, 10-15]
Gum	Gum mixed with quinine is useful in fever cases complicated with diarrhoea and dysentery; gum with white of egg it is applied to burns and scalds; anticancer and anti-mutagenic	[1, 12]
Bark	Inhibitory effects against hepatitis C virus (HCV) protease; HIV-1 replication and HIV-1 protease; used as an astringent douch in gonorrhoea, cystitis, vaginitis, leucorrhoea, and prolapse of uterus and piles; antibacterial	[1, 15-21]
Seeds	Antiplasmodial, anti-bacterial and diarrhoea	[22, 23]
Pods (Fruit)	Inhibitory effects against HIV-1 PR (protease), anti-hypertensive, anti-spasmodic, anti-diarrheal, astringent, HIV-1 induced cythopathogenicity, antiplatelet aggregatory activity; antioxidant, decreases the arterial blood pressure; antituberculosis; antibacterial	[7, 15-17, 24, 25]
Flowers	Diarrhoea and dysentery, premature ejaculation; anticancer, anti-mutagenic	[12, 26]

2. Pharmacological Uses

By using of different chemical solvent for extracting, the different parts of *Acacia nilotica* investigated for their pharmacological profile.

2.1. Antiplasmodial, Antibacterial, Antifungal and Antiviral Activity

Alli L. et al. [8] identified the safer and antiplasmodial activity of the aqueous root extract of *Acacia nilotica* against Plasmodium berghei berghei in mice in 2011. Using of methanol and aqueous extract of *Acacia nilotica* pods exposed antibacterial activity against *Escherichia coli, Staphylococcus aureus and Salmonella* typhi, see review in [2]. Moreover, high antibacterial activity against *Staphylococcus aureus, Escherichia coli, Proteus vulgaris, Proteus mirabilis, Salmonella paratyphi B, Klebsiella pneumonia* detected by Deshpande SN [19] by using of the petroleum ether and ethanol extract of stem bark. Likewise, the crude ethanolic extracts showed antimicrobial activities againts multidrug-resistant (MDR) strains of *Escherichia coli* and *Klebsiella pneumoniae* [27]. An acetyl acetate bark extract showed antibacterial activity against gram-positive bacteria *Bacillus subtilis* and *Staphylococcus aureus* with minimum inhibitory concentration values of 4 and 8 µg/mL, respectively; and showed weak activity with minimum inhibitory concentration values (16 and 33 µg/mL) against *Klebsiella pneumonia* and *Escherichia coli* respectively [21]. Antifungal activity was confirmed by using of an aqueous and methanol extract of *Acacia nilotica* pods, which exposed antifungal activity against *Candida albicans, and Aspergillus niger,* see review in [2]. In the same way, Khan R. [27] exposed antifungal activity of ethanolic extracts against multidrug-resistant (MDR) strains of *Candida.* The extract of the leaves of the Acacia plant showed in vitro antiviral activity against the Turnip mosaic virus [11].

2.2. Antioxidant Activity

Kalaivani T. et al. [28] detected an active antioxidant compound (ethyl gallate) from the leaves ethanol extract of *Acacia nilotica* Wild. Ex. Del. Other antioxidant activities of *Acacia nilotica* detected from leaves ethanol extract [10] and from 80% EtOH pods extract [29]. The antioxidants kaempferol was isolated from the methanol extract of *Acacia nilotica* Willd. Ex. Del by Rajbir S. et al. [30]; moreover, the antioxidant Umbelliferone was isolated from the methanol extract of the bark and leaves of *Acacia nilotica* (L.) Willd. Ex. Del [31]. And Z. Osman et al. [32] described antioxidant activity of the water extract of the bark.

2.3. Cytotoxic and Hemolytic Activity

Kalaivani T. et al. [28] determined that the ethanol leaves extract of *Acacia nilotica* do not exert any hemolytic activity against rat and human, and non-toxic.

2.4. Hyperglycaemic, Lipid Profile, and Platelet Aggregation Activity

The methanol extract of the leaves exhibited hypoglycaemic and anti-platelet aggregation activity in diabetic rats as that of glyburide [33].

2.5. Antidiarrhoeal

An aqueous extract of *Acacia nilotica* seeds shown activity against castor oil induced diarrhoeal [23].

2.6. Galactagogue Activity

Galactagogue activity of *Acacia nilotica* recognized in the leaves aqueous extract of *Acacia nilotica* ssp *adansonii* when tested in the rat; the extract found to stimulate the synthesis and release of prolactin [34].

2.7. Antimutagenic Activity

Arora S. et al. [35] concluded that acetone extract of the bark powder of *Acacia nilotica* exhibited antimutagenic activity against direct-acting mutagens (4-nitro-o-phenylenediamine (NPD) and sodium azide (NaN_3)) and indirect-acting mutagens (2-aminofluorene (2-AF)) in tester strains of *Salmonella typhimurium*.

2.8. Abortifacient and anti-Infertility Activity

Nath et al. [36] studied the abortifacient activity of an aqueous or 90 % ethanol extracts of the flowers of *Acacia Arabica*, and they concluded that the flowers appeared to lack teratologic potential at the tested doses (175 mg/kg). For anti-infertility, extract of the stem bark at 2% concentration revealed semen coagulant activity in a preliminary screening, see review in [2].

2.9. Antidiabetic (Hypoglycemic Effect) and Antihypertensive Activity

The powdered seeds of *Acacia arabica* used to test antidiabetic activity (hypoglycemic effect). The seeds exhibit a significant hypoglycemic effect in normal rabbits, while the effect in alloxanised diabetic rabbits was not significant [37]. The antihypertensive activity (decreases the blood pressure at dose 3-30 mg/kg) detected by using of methanol extract of *Acacia nilotica* pods [7].

2.10. Analgesic and Antipyretic Activity

Lukman A. et al. [9] exposed the antipyretic and analgesic activity of an aqueous extract of *Acacia nilotica* root at 200 and 400 mg/Kg body weight of the tested rats.

Another very useful usage of *Acacia nilotica* investigated by Majumdar et al. [38], they described that the ethanol leaf extract of *Acacia nilotica* has catalytic activity, which used in the synthesis of gold nanoparticles.

3. General Techniques Involved in Phytochemical Analysis

Commonly the different preliminary qualitative methods are used to identify the chemical constituents of the plant. To identify the presence of alkaloids: we can use Mayer's test, Hager's test and Wagner's test. Phenolic compounds and tannins: Ferric chloride, Gelatin test, alkaline reagent test, Magnesium and Hydrochloric acid reduction, and lead acetate tests. Amino acids: Ninhydrin test. Carbohydrates: Molish's test and Benedict's test. Fixed oils and fats: spot test and saponification test. Glycosides: Legal test and Borntrager's test. Phytosterols: Libermann-Burchard's test. Proteins: Millon's test and Biuret test. Saponins: Foam test. Test for gum and Mucilages, Test for volatile oil. Terpenoids: Salkowski's test. Flavonoids: Shinoda and alkaline reagent tests. Cardiac glycosides: Killer kiliani test. Anthraquinones: Borntrager's test [19, 39]

Likewise qualitative and quantitative analysis of phytochemicals can be applied using of Gas Chromatography Mass Spectroscopy (GCMS), Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC), High Performance Thin Layer Chromatography (HPTLC), and Optimum Performance Laminar Chromatography (OPLC) [39].

Moreover, the spectroscopy detecting methods like UV, IR, MS, ^{13}C- NMR and ^{1}H- NMR frequently used in the study of phytochemicals [39].

4. Phytochemical (Chemical Constituents)

4.1. Bark

Phytochemical analysis of ethanol and petroleum ether extract of the stem bark of *Acacia nilotica* exposed that the plant contains terpenoids, tannins, alkaloids, saponins, and glycosides. [19, 20]; and the carbohydrates and anthraquinone were detected in ethanol extract by Deshpande S. N. [19]; while the results described by Okoro S. O. et al. [40] revealed that, the ethanolic extracts of *Acacia nilotica* possess sterols and tannins; no alkaloids, saponins or glycosides.

4.2. Leaves

Phytochemical screening of ethanolic extracts discovered that the leaves of *Acacia nilotica* contain tannins, alkaloids, sterols; and no glycosides, saponins, resins or flavonoids were detected [40]. And Mrityunjoy Das et al. [13] exposed the presence of alkaloids, saponins, cardiac glycosides, tannins, and flavonoids.

4.3. Roots

A screening study of the ethanolic extracts of the roots of *Acacia nilotica* by Okoro S. O. et al. [40] showed the presence of sterols and tannins; and the aqueous extract contains tannins, saponins, flavonoids, terpenes, sterols, phenols, alkaloids and anthraquinones [8]; and Lukman A. et al. [9] determine the presence of saponins, flavonoids, terpenes, tannins, phenols, alkaloids, and anthraquinones.

4.4. Pods

Sabah E. et al. [41] they used a different solvent to test the presence of alkaloids, flavonoid, saponins, tannin, cardiac glycoside, sterol and carbohydrate. They used ethanol, water; and petroleum ether extracts. water and ethanol showed positive results of alkaloids, flavonoids, tannins, saponins and carbohydrate; and sterol was detected by ethanol and petroleum ether extracts; and no saponins or carbohydrate were detected by using of petroleum ether. In addition, Oladosu P. et al. [25] detected alkaloids, saponins, tannins, and carbohydrate by using an aqueous methanol extract.

4.5. Flowers

Flowers showed the presence of catechin (phenolic compound) [42].

5. The Relationship Between the Chemical Constituents and the Biological Activity

Numerous plants, which are rich in alkaloids, tannins and glycosides, shown antimicrobial activity against a number of microorganisms [19, 20]. Otherwise Chandra Shekar et al. [14] concluded that the antimicrobial activity due to the presence of alkaloids, cardiac glycosides, tannins besides saponins, flavonoids and anthraquinones. Z. Osman et al., [32] noticed that the plant contains tannins could be an excellent source of the natural antioxidant. Muhammad Bilal Sadiq et al. [15] concluded that the antibacterial and antioxidant activities might be due to the presence of high total phenolic content, proteins and/or flavonoids. The antioxidant and anticancer potential could be due to the presence of phenolic compounds [10]. Moreover, to antioxidant activity, the plant extract containing phenolic compounds possess anticarcinogenic, or antimutagenic and anti-inflammatory effects [43]. Alli L. et al., [8] proposed that the antiplasmodial effect might therefore be due to the

phytochemical components (alkaloids, flavonoids and terpenes), the oxidant generation potential, or a combination of these mechanisms. Extracts containing tannins (polyphenolic compounds) showed antiviral activity against HIV-1 replication and HIV-1 Protease [16].

6. Conclusion

Acacia nilotica has been in use since ancient times to treat a wide range of diseases in traditional treatment. Experimental studies confirmed its antibacterial, antifungal, antioxidant, antidiabetic, antihypertensive, antispasmodic, antiviral, antiplasmodial analgesic, antipyretic and galactagogue activities. Different scientific studies established the claims of the traditional system of medicine. Extra details and clinical researches is need to explore its medicinal value in order to establish it as a standard drug.

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