MINI-REVIEW

RECORDS OF PHARMACEUTICAL AND BIOMEDICAL SCIENCES

Acacia nilotica as a potential remedy for obesity

Ola A. Shalaby[a*], Ahmed R. Hassan[a], Eman T. Mehanna[b]

[a]*Department of Medicinal and Aromatic Plants, Desert Research Center, El-Matariya, 11753, Cairo, Egypt;*
[b]*Department of Biochemistry, Faculty of Pharmacy, Suez Canal University, Ismailia, Egypt.*

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*Corresponding Author:

Tel: +201068555351

E-mail address:

olaadel191@yahoo.com

Abstract

Obesity and its associated complications are reaching epidemic proportions worldwide. Obesity is closely linked with the development of serious chronic diseases, mainly type 2 diabetes mellitus, cardiovascular disease, and nonalcoholic fatty liver disease and several malignancies. *Acacia nilotica* is an important ornamental and medicinal plant of tropical and sub-tropical regions that belongs to family Fabaceae of genus Acacia. An exhaustive survey of literature has revealed that tannins, flavonoids, alkaloids, fatty acids and polysaccharides (gums) constitute major classes of phytoconstituents of *A. nilotica*. Previous studies revealed significant anti-inflammatory, antioxidant, antidiarrheal, antihypertensive and antispasmodic, antibacterial, anthelmintic, antiplatelet aggregator and anticancer activities.

Keywords: Obesity; *Acacia nilotica*; chemical constituents.

1. Introduction

The incidence of obesity and overweight has increased globally. Despite varied treatment, mitigation, and prevention efforts, the global prevalence and severity of obesity continue to worsen **(Heindel et al., 2024)**. Insulin resistance, chronic low-grade inflammation, and specific adipokines such as adiponectin, leptin, and resistin have been identified as essential contributors to the development and outcomes of obesity **(Nimptsch et al., 2019)**.

The medical rationale for weight loss is that obesity is a serious, chronic, and progressive disease and is associated with a significant increase in mortality and many health risks including type 2 diabetes mellitus, hypertension, dyslipidemia, and coronary heart disease. The benefits of weight loss include a reduction in the rate of progression from impaired glucose tolerance to diabetes, blood pressure in hypertensive patients, and lipid levels in higher risk patients. Other noncardiac benefits of weight loss include reductions in urinary incontinence, sleep apnea, and depression, as well as improvements in quality of life, physical functioning, and mobility **(Kelly et al., 2013)**.

The use of therapeutic plants and their bioactive constituents in the management and prevention of chronic diseases has gained more attention **(Shang et al., 2019)**. Numerous studies have reported the capability of medicinal plants to manage obesity; examples are lingonberry, ginger, omija fruits, aloe vera and red cabbages **(Abduljawad, 2020)**. *Trigonella foenumgraecum* (Fabaceae) was claimed to have anti-diabetes, antioxidant, and anti-hyperlipidemic activities **(Nagamma et al., 2021)**. Wolfberry, the fruit of *Lycium barbarum* (Solanaceae) had protective effects against high fat diet induced liver oxidative stress injury **(Xiao et al., 2013)**.

Acacia nilotica (*A. nilotica*) is a member of the Fabaceae family with many therapeutic properties. It is widely distributed in tropical and subtropical regions and contains several powerful chemicals that have antioxidant, anti-hypertensive, anti-

inflammatory, antispasmodic, and anti-platelet aggregatory activities **(Kaur et al., 2022)**.

2. *Acacia nilotica*

Acacia is a genus of shrubs and trees belonging to the subfamily Mimosoideae of the family Fabaceae or Leguminosae **(Farzana et al., 2014)**. It is a complex species with nine subspecies, six are native to the African tropics and the others are native to the Indian subcontinent **(Raj et al., 2015)**.

A. nilotica is a tree widely distributed all over India, Sri Lanka, Sudan, Saudi Arabia and Egypt. *A. 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 and kaarad (Kaushal, 2017).

2.1. Pharmacological uses

Different parts of *Acacia nilotica* were investigated for their pharmacological profile.

The use of methanol and aqueous extracts of *A. nilotica* pods exposed antibacterial activity against *Escherichia coli*, *Staphylococcus aureus* and *Salmonella typhi* **(Farzana et al., 2014)**. Moreover, high antibacterial activity against *Staphylococcus aureus*, *Escherichia coli*, *Proteus vulgaris*, *Proteus mirabilis*, *Salmonella Para typhi* B and *Klebsiella pneumonia* was detected by using of the petroleum ether and ethanol extract of *A. nilotica* stem bark. Likewise, the crude ethanolic extracts showed antimicrobial activities against multidrug-resistant (MDR) strains of *Escherichia coli* and *Klebsiella pneumonia* **(Deshpande, 2013)**. Not only Antibacterial activity but also Antifungal activity was also confirmed by using aqueous and methanol extracts of *A. nilotica* pods which exhibited antifungal activity against *Candida albicans* and *Aspergillus niger* and by using the ethanolic extract against MDR strains of Candida **(Farzana et al., 2014)**. Furthermore, the extract of the leaves of the *Acacia* plant showed *in vitro* anti-viral activity against the Turnip mosaic virus **(Khan et al., 2009)**.

Alli et al. (2014) described the antipyretic and analgesic activity of an aqueous extract of *A. nilotica* root at doses of 200 and 400 mg/Kg body weight of the tested rats. In addition, an aqueous extract of *A. nilotica* seeds has shown activity against castor oil induced diarrhea **(Akintunde et al., 2015)**. Furthermore, an antihypertensive activity was detected by using of methanol extract of *A. nilotica* pods which managed to decrease the blood pressure at doses of 3-30 mg/kg **(Farzana et al., 2014)**.

Kalaivani et al. (2011) detected an active antioxidant compound (ethyl gallate) in the ethanol extract of *A. nilotica* leaves. The antioxidant kaempferol was isolated from the methanol extract of *A. nilotica* by **Singh et al. (2008)**. Additionally, **Osman et al. (2014)** described antioxidant activity of the aqueous extract of the bark. Moreover, **Arora et al. (2003)** concluded that acetone extract of the bark powder of *A. nilotica* exhibited antimutagenic activity against direct- acting mutagens (4-nitro-ophenylenediamine and sodium azide) and indirect-acting mutagens (2-aminofluorene) in tester strains of *Salmonella typhimurium*.

Recently, *A. nilotica* stem bark extract ameliorated obesity, hyperlipidemia, and insulin resistance in a rat model of high fat diet-induced obesity **(Khalaf et al., 2023)**. also, the methanol extract of *A. nilotica* leaves exhibited hypoglycaemic and anti-platelet aggregation activity in diabetic rats comparable with that of glyburide **(Asad et al., 2011)**. The powdered seeds of *Acacia* exhibited a significant hypoglycemic effect in normal rabbits, while the effect in alloxanised diabetic rabbits was not significant **(Jame, 2018)**.

2.2. Chemical constituents

2.2.1. Bark

Phytochemical analysis of ethanol and petroleum ether extracts of the stem bark **(Fig. 1)** of *A. nilotica* revealed that the plant contains terpenoids, tannins, alkaloids, saponins, and glycosides **(Jame, 2018)**. The carbohydrates and anthraquinone were detected in the ethanol extract by **Deshpande (2013)**, while the results described by **Okoro et al. (2014)** revealed that the ethanolic extracts of *A. nilotica* possess sterols and tannins; but no alkaloids, saponins or glycosides.

2.2.2. Leaves

Phytochemical screening of ethanolic extracts discovered that the leaves of *A. nilotica* contain tannins, alkaloids, sterols; and no glycosides, saponins, resins or flavonoids were detected

Fig. 1: Bark of *Acacia nilotica*

(Okoro et al., 2014). However, **Das et al. (2016)** reported the presence of alkaloids, saponins, cardiac glycosides, tannins, and flavonoids.

2.2.3. Roots

Okoro et al. (2014) showed that the ethanolic extract of the roots of *A. nilotica* contains sterols and tannins; and the aqueous extract contains tannins, saponins, flavonoids, terpenes, sterols, phenols, alkaloids and anthraquinones **(Alli et al., 2014)**.

2.2.4. Pods

Eltegani et al. (2017) used a different solvent to test the presence of alkaloids, flavonoid, saponins, tannin, cardiac glycoside, sterol and carbohydrate in *A. nilotica* pods **(Fig. 2)**. 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 in ethanol and petroleum ether extracts; while no saponins or carbohydrate were detected by using of petroleum ether. In addition, **Oladosu et al. (2007)** detected alkaloids, saponins, tannins and carbohydrate by using an aqueous methanol extract.

Fig. 2: *Acacia nilotica* pods and seeds

2.2.5. Flowers

The results of phytochemical screening of the flower **(Fig. 3)** extract of *A. nilotica* showed the presence of alkaloid, flavonoid, glycosides, tannin, terpenoids, saponin and steroids **(Bhat et al., 2023)**.

Fig. 3: *Acacia nilotica* flowers

2.3. The Relationship between the Chemical Constituents and the Biological Activity

Numerous plants, which are rich in alkaloids, tannins and glycosides, shown antimicrobial activity against several microorganisms **(Farzana et al., 2104)**. The antimicrobial activity is attributed to the presence of alkaloids, cardiac glycosides, tannins, saponins, flavonoids and anthraquinones **(Jame, 2018)**.

Osman et al. (2014) noticed that plants that contain tannins could be excellent sources of natural antioxidants. **Sadiq et al. (2015)** concluded that the antibacterial and antioxidant activities of medicinal plants might be due to the presence of high total phenolic content, proteins and/or flavonoids. Moreover, due to their antioxidant potential, the plant extracts containing phenolic compounds possess anticarcinogenic, antimutagenic and anti-inflammatory effects **(Huang et al., 2009)**.

3. Conclusion

Acacia nilotica is an imperative plant with many medicinal uses. It was demonstrated that *A. nilotica* has potent anti-obesity, antioxidant, and anti-inflammatory effects in diet-induced obesity in rats.

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