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Bioactives and Pharmacology of Acacia Nilotica: A Review

Mullaicharam Bhupathyraaj [aω*], Nirmala Halligudi [a], Fatma Abdul Razak Al Sayigh [a] and Marwa Hakkak [b#]

[a] College of Pharmacy, National University of Science and Technology, Muscat, Oman.
[b] Apotex Inc. Muscat, Oman.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

This review article aims to provide details on the primary phytochemicals found in *Acacia* and its numerous pharmacological activities. For those working on the creation of new pharmaceutical products, this review is helpful.

Keywords: Acacia nilotica; bioactives; pharmacology; fabaceae.

ABBREVIATIONS

ADP : Adenosine Triphosphate
CQ-SYBR : Chloroquine Synergy Brands
ATCC : American Type Culture Collection
MDR : Multidrug Resistant

1. INTRODUCTION

A genus of shrubs and trees by the name of *Acacia* is found in the family Fabaceae, subfamily *Mimosoideae* [1]. Many species contain large amounts of condensed tannins and tannins, which are used as pharmaceuticals and preservatives. These species are typically pod-bearing, with sap and leaves. The word for its distinctive thorns in Greek is where this name originates (as, thorn). The generic name comes from the Greek word akakia, which was the name given to the medicinal tree by the early Greek physician and botanist Pedanius Dioscorides (c. 40–90). *A. nilotica* wrote about it in Materia Medica [2].

ω Professor;
 # Medical Representative;
**Corresponding author: Email: mullaicharam@nu.edu.om;*

The genus *Acacia* contains 1300 species. Out of 1300 species, 960 are indigenous to Australia. The remaining species are dispersed throughout the tropical to warm temperate regions of both hemispheres, including southern Asia, Africa, Europe, and America. The Unani medical system refers to the extract of pods or legumes as "Aqaqia" [3]. When it is made from unripe fruit, it is referred to as qurz. The majority of India, Ceylon, Baluchistan, Waziristan, Arabia, Egypt, and tropical Africa are home to this native Egyptian plant [4].

The *Acacia nilotica* also referred to as babul, is a significant tree in India's arid regions. The majority of a plant's parts, including its roots, bark, leaves, flowers, gum, pods, and flowers, are used in various ways [5]. Gallic acid, a powerful and astringent acid found in the tannin in the bark of the babul tree, is used in tanning, dyeing, inks, and pharmaceuticals [6]. It is an evergreen tree that is 10 meters tall. It is a small tree with a slender, terete, and pubescent young branchlet. The bark is dark brown or black with longitudinal fissures. The tree can grow to a maximum height of between 15 and 30 meters, with a girth between 1.2 and 3 meters [7]. The tree's leaves are 2-pinnate, 5–10 cm long, with a downy, frequently gland-adorned main rachis and smooth, 2.5–5 cm–0.6–5 cm long petioles [8].

“The leaflets are opposite and arranged in 10 to 20 pairs. They are sessile, linear-oblong, rigid, greyish green, and about 1/6 inch long” [9]. “The flowers are two-flowered, golden-yellow, fragrant, crowded in long-stalked, globed heads that are 1.5 cm in diameter, forming axillary clusters of 2–5 heads”,[7] pubescent, and have very short teeth. Bracteoles are also present. Corolla 3 mm long; triangular, short lobes [9]. Long funicular seeds are roundish in outline, slightly opened at the hilum, persistently grey and downy, and have a bitter flavor. Gum appears as ovoid tears that protrude from the bark cuts. The tears are lustrous, brittle, and spotted with tiny cracks. The gum's hue ranges from light yellow to black.

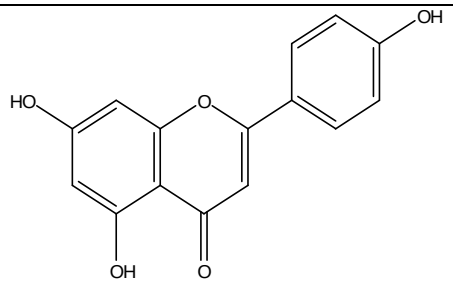
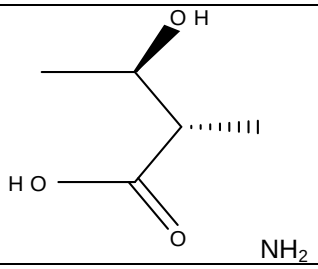
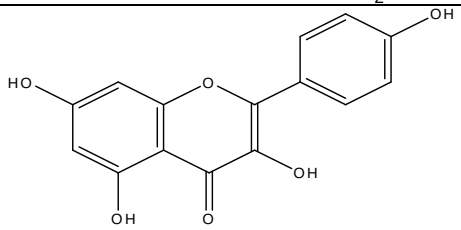
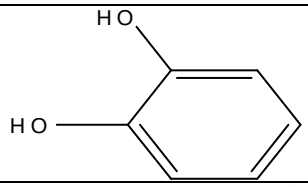
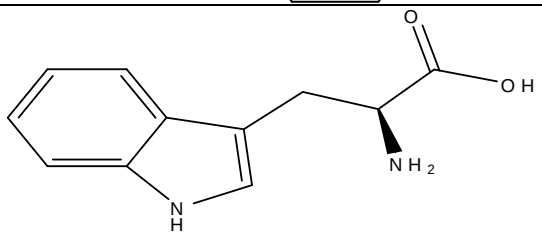
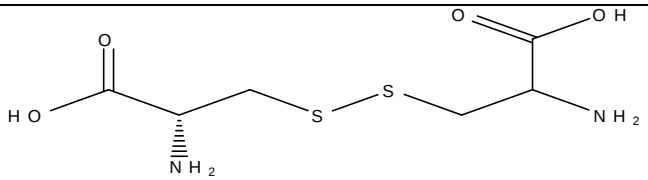
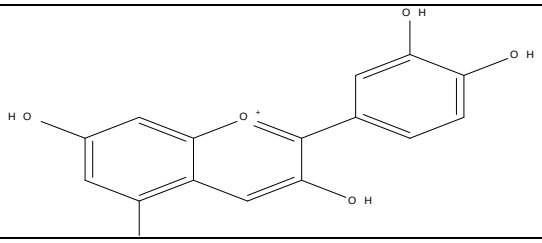
2. BIOACTIVES

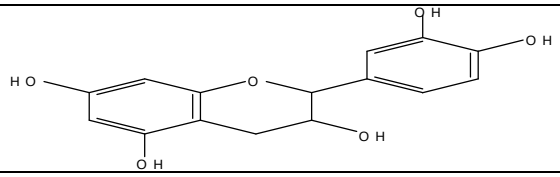
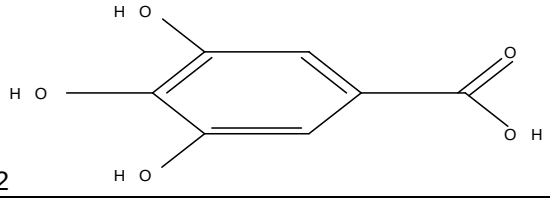
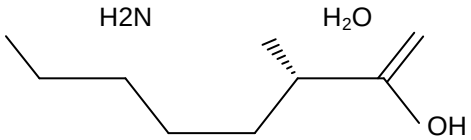
In addition to amines and alkaloids, secondary metabolites also include cyanogenic glycosides, cyclitols, fatty acids, fluoroacetate, gums, nonprotein amino acids, terpenes (including essential oils, diterpenes, phytosterol, and triterpene genins), saponins, hydrolyzable tannins, flavonoids, and condensed tannins. The plant is a richer source of minerals like potassium, phosphorus, magnesium, iron, and manganese [6] as well as amino acids like cysteine, methionine, threonine, lysine, and tryptophan. The secondary metabolites found in *Acacia* species include saponins, hydrolyzable tannins, flavonoids, condensed tannins, alkaloids, cyclitols, fatty acids, fluoroacetate, gums, nonprotein amino acids, terpenes (including essential oils, diterpenes, phytosterols, and triterpene genins), and terpenes.

Fig. 1. Picture of *Acacia nilotica [1]*

The plant is a better source of potassium, phosphorus, magnesium, iron, manganese, cysteine, methionine, threonine, lysine, and tryptophan [10]. The fruit contains mucilage and saponins. Gallic acid, Me-este-n-digallic acid, and condensed tannins can all be found in pods. The leaf contains pigenin, 6-8-bisD-glucoside, rutin, and 8% digestive protein (12.4% crude protein). Deseeded pods (50%) and pods (5.4%) have the highest relative tannin contents, followed by leaves (7.6%), bark (13.5%), and twigs (15.8%). “The bark contains high levels of tannin (12–20%), terpenoids, saponins, glycosides, gallic acid, protocatechuic acid, pyrocatechol, (+)-catechin, and (–) epigallocatechin digallate” [11]. “Its extract has a total phenolic content of 9.2 to 16.5 g/100 g. The root contains octacosanol, betulin, B-amyrin, and B-sitosterol” [12].

Table 1. Bioactives from *Acacia nilotica Linn* [1]

S. No	Name	Structure
1	Apigenin	
2.	Threonine	
3.	Kaempferol	
4.	Pyrocatechol	
5.	Tryptophan	
6.	Cystine	
7.	Cyanidin	

S. No	Name	Structure
8.	Catechin	
9.	Gallic acid	
10.	Lysine	

3. PHARMACOLOGY

3.1 Antioxidant activity

"Acacia species contain polyphenolic compounds, which have potent antioxidant properties and aid in the prevention and treatment of many oxidative stress-related diseases, such as cancer, cardiovascular disease, and neurodegenerative disease. The antioxidant activity of the plant, which is present in the methanolic extract of the plant, is due to kaempferol" [13].

3.2 Antimicrobial Activity

The plant's extract inhibits platelet aggregation caused by platelet agonists like collagen, platelet-activating factor, arachidonic acid, and ADP. The Ca+2-channel-induced platelet aggregation is prevented by it [6].

Four different bacterial species—gram-positive Bacillus subtilis, gram-negative Escherichia coli, gram-positive Staphylococcus albus, gram-negative Streptococcus faecalis, and two fungi—candida Albicans and aspergillus flavus—were all effectively treated by the plant extract [14].

Acacia nilotica species can be seen as promising sources for antibacterial drugs due to the plant's highly active nature. *A. nilotica* methanolic and aqueous extracts have antifungal activity, with percentage inhibitions ranging from 34.27% to 93.35%. *Acacia nilotica's* dried fruits are effective against C. Albicans and are used to treat oral conditions [15]. The plant's methanolic extracts are effective against two animal viruses like the fowlpox and Newcastle disease viruses.

"Campylobacter coli isolated from goats and its susceptibility to the crude ethanolic leaf extract of *Acacia nilotica Linn*. By using the agar diffusion method, researchers found that the ethanolic stem bark extract of the plant had the highest zone of inhibition at a concentration of 70 mg/ml against Streptococcus viridans, Staphylococcus aureus, Escherichia coli, Bacillus subtilis, and Shigella sonnei. The minimum inhibitory concentration of the plant's stem bark extract ranged between 35 and 50 mg/ml, while the minimum bactericid"[16].

"In mice, Plasmodium berghei and Plasmodium falciparum were resistant to the root extracts of *Acacia nilotica*. In vitro antimalarial activity against P. falciparum strains that are CQ sensitive (3D7) and CQ resistant (Dd2 and INDO) in culture using the fluorescence-based SYBR" [12]. "In vitro, *Acacia nilotica* exhibits the highest antiplasmodial activity against the Plasmodium falciparum 3D (chloroquine-sensitive) and Dd2 (pyrimethamine-sensitive and chloroquine-resistant) organisms" [9].

Humans can effectively treat their cough and diarrhea with *acacia nilotica*. For the treatment of severe diarrhea, the plant's powdered bark is combined with a tiny amount of salt. Escherichia coli is active against methanol and chloroform

extract [14]. It lessens intestinal transit of charcoal and the number of unformed feces.

On the isolated guinea-pig ileum, the aqueous seed extract of *Acacia nilotica* exhibits spasmogenic activity. It might be caused by an increase in calcium influx, which causes muscle spasms [17].

At doses of 3 to 30 mg/kg, methanol extract of *Acacia nilotica* pods lowers arterial blood pressure. In guinea-pig paired atria, it has an inhibitory effect on the force and rate of contraction. Vasoconstriction will manifest if an aqueous *Acacia nilotica* extract is administered to guinea pigs. The increase in calcium influx caused by the extract is what causes this reaction. The extract exhibits sustained contractile activity that is dose-dependent Eline [18].

4. CONCLUSION

Most animal studies have shown that the various *Acacia nilotica* extracts have nine different pharmacological activities. To develop the new drug dosage forms, additional in-vivo testing may be helpful.

COMPETING INTERESTS

The authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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