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Biological Activities of *Albizia amara*: An Overview

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Abstract *Albizia amara*, commonly known as the white siris tree, is a plant species with a rich history of traditional medicinal use across various cultures. In recent years, scientific interest in the biological activities of *Albizia amara* has surged, leading to a growing body of research aimed at uncovering its pharmacological potential. This overview provides a comprehensive summary of the biological activities associated with *Albizia amara*, including its antioxidant, anti-inflammatory, antimicrobial, antidiabetic, and anticancer properties. Additionally, the review discusses the phytochemical composition of *Albizia amara*, highlighting the presence of bioactive compounds such as flavonoids, alkaloids, and saponins. Furthermore, the potential therapeutic applications of *Albizia amara* in treating various diseases and disorders are explored, along with insights into its mechanisms of action. Finally, future perspectives and research directions in the field of *Albizia amara*'s biological activities are discussed, emphasizing the need for further investigation to unlock its full therapeutic potential and promote its sustainable utilization.

Keywords *Albizia amara*, white siris tree, Antioxidant Activity, Antimicrobial Activity, Anticancer Activity

Introduction

Albizia is a taxonomic group consisting of more than 150 species of trees and shrubs. These plants are primarily characterized by their rapid growth and their preference for subtropical or tropical climates. They belong to the Fabaceae family and the subfamily Mimosoideae. The genus has a pantropical distribution, with occurrences in Asia (India, China, Indonesia, Thailand, and Malaysia), Australia (Queensland and northern New South Wales), Africa, and America. However, it is predominantly found in the tropics of the Old World [1-2].

Albizia trees are highly prized for their aesthetically pleasing feathery leaves and vibrant flowers, frequently bearing a resemblance to pompoms. These trees are widely admired for their elegant appearance and adaptability to many temperatures, making them ideal choices for decorative purposes in various regions of the world. In addition, certain species of Albizia are utilized in traditional medicine for diverse purposes [3].

Albizia trees commonly possess bipinnately complex leaves, which results in a feather-like appearance. The foliage typically exhibits alternate arrangement and can either be deciduous or evergreen, contingent upon the specific species and prevailing climatic conditions. The blooms of Albizia species are frequently conspicuous and attractive, grouped in clusters or spikes. They are available in a range of hues, including as white, pink, yellow, and red. The flowers typically emit a pleasant scent and entice pollinators such as bees and butterflies. Albizia fruits are commonly legume pods that form during the process of flowering. These pods encompass seeds and exhibit

variations in size, shape, and color. Albizia species can be found in several settings, ranging from humid tropical forests to arid savannas. These trees have a high tolerance for many soil types and are commonly found growing along riverbanks, in regions that have been disrupted, and as decorative trees in parks and gardens [4-5].

Several Albizia species are cultivated for their aesthetic attributes, such as their appealing leaves and blooms. These trees serve as shade trees, street trees, and landscape specimens in gardens and urban areas. Certain Albizia species have been employed in traditional medicine to address diverse health conditions. Albizia lebbeck is highly esteemed in Ayurvedic medicine due to its anti-inflammatory, antipyretic, and analgesic qualities. Although Albizia species offer environmental advantages such as providing shade and shelter for wildlife, certain species have become invasive in specific locations beyond their original distribution. The presence of invasive Albizia trees can lead to the displacement of native vegetation, causing significant changes to ecosystems and disturbances to natural processes [6-7].

Albizia amara, a member of the Mimoseace family, is commonly referred to as the "oil cake tree." This plant is native to the arid regions of Tamil Nadu, Andhra Pradesh, and Karnataka in India. A. amara is a deciduous tree that is modest to moderate in size, with a smooth, dark green, scaly bark and many branches. It bears a resemblance to the Acacias, although it does not possess thorns. The root system of the plant is superficial and expansive. The leaves exhibit pinnate compound arrangement, consisting of 15-24 pairs of diminutive, elongated leaflets, distributed across 6-15 pairs of pinnate. The flowers are golden, fragrant, and globose, arranged in clusters. They form when the tree is nearly devoid of leaves. The flowers are pedicelled, yellow, fragrant, and arranged in 12-20 globose heads. The fruits are elongated pods, measuring approximately 10-28 × 2-5 cm. They are light brown, covered with fine hairs, and have a thin texture. Each fruit contains 6-8 seeds, which are flattened and measure 8-13 × 7-8 mm. The seeds of A. amara were utilized as an astringent to cure various conditions such as piles, diarrhea, gonorrhea, leprosy, leucoderma, erysipelas, and abscesses. The leaves and petals have been used topically to treat boils, eruptions, and swellings. They are also considered to have emetic properties and are used as a treatment for coughs, ulcers, dandruff, and malaria [8].

Scientific Classification

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Fabales
Family: Fabaceae
Subfamily: Mimosoideae
Genus: Albizia

Phytochemical Constituents of *Albizia amara*

The study of plant chemicals in several species of the Albizia genus resulted in the discovery of various types of secondary compounds, including saponins, terpenes, alkaloids, and flavonoids. The genus Albizia has been found to contain several bioactive compounds, including triterpenoid saponins (such as julibroside J29, julibroside J30, and julibroside J31), novel macrocyclic alkaloids (budmunchiamines A, B, and C), and two flavonol glycosides (quercitrin and isoquercitrin). These compounds have demonstrated various biological activities, including antitumor, antiplatelet aggregation, and bactericidal effects [9-11].

Albizia amara possesses antioxidant activity due to the presence of phytochemicals like flavonoids, phenolic compounds, and tannins. These substances have the ability to remove harmful free radicals and decrease oxidative stress, which helps to safeguard cells from harm and perhaps decrease the likelihood of developing chronic illnesses like cardiovascular disease, cancer, and neurological disorders [12-13].

The antioxidant activity of *Albizia amara* leaves was assessed by examining the extracts as a proportion of their concentration. Multiple biochemical assays were employed to evaluate the antioxidant characteristics of the substance. These included measuring the ability to scavenge 2,2-diphenyl-1-picrylhydrazyl (DPPH) radicals by

observing the decrease in DPPH radical absorption after exposure to radical scavengers, assessing the capacity to scavenge nitric oxide, and determining the reducing power by observing the conversion of a Fe3+/ferricyanide complex to the ferrous form. The robust bioactive qualities of fruits and vegetables are a result of the combined actions of phytochemicals, which can be additive or synergistic. The benefits of a diet rich in fruits and vegetables are linked to the combination of phytochemicals included in these whole foods.

The radical scavenging effects of petroleum ether and methanol extracts were investigated using DPPH, a stable free radical that has a distinct absorption peak at 517nm. The reduction in absorption is considered a quantification of the degree of radical scavenging. The RSA values were quantified as the percentage ratio of the sample.

The absorbance at 517 nm of the DPPH˙ solution diminishes in the absence of extract.

The production of nitric oxide was induced by sodium nitroprusside and quantified using the Greiss reduction method. Sodium nitroprusside in a water-based solution at a pH level seen in the human body naturally produces nitric oxide. This nitric oxide then reacts with oxygen to form nitrate ions, which may be measured using Greiss reagent. Nitric oxide scavengers engage in competition with oxygen, resulting in less nitric oxide synthesis. Plant or plant-derived substances possess the ability to inhibit the production of nitric oxide in the human body.

The ability of a chemical to reduce may be a valuable predictor of its potential antioxidant activity. A greater absorbance value suggests a greater ferric reducing capability. The concentration of the extracts positively correlated with the increasing reduction power, resulting in favorable values for all the extracts. The methanolic extract exhibited superior reducing power. Higher levels of polyphenolics are associated with increased reducing activities, which in turn may indicate a compound's antioxidant potential. The presence of reductones in *Albizia amara* leaf has been found to be responsible for its reducing properties. Reductones have been shown to act as antioxidants by interrupting the free radical chain through the donation of a hydrogen atom. Therefore, the methanolic extract of *Albizia amara* leaf is likely to contain higher levels of reductones and polyphenols compared to the petroleum ether extract.

The phosphomolybdenum assay relied on the antioxidant's ability to reduce Mo (VI) to Mo (V), resulting in the development of a green phosphate/Mo (V) complex at an acidic pH. The high absorbance values indicated that the sample exhibited substantial antioxidant activity. In this study, we assessed and compared the overall antioxidant activity of solvent extracts with those of ascorbic acid and the control, which did not include any antioxidant component. The test has proven to be effective in measuring the amount of vitamin E in various parts of plants, such as seeds, leaves, and other plant parts. Due to its simplicity and lack of reliance on other regularly used antioxidant assays, it was determined that the assay could also be used to analyze plant extracts.

Phenolic chemicals can directly contribute to antioxidative activity. Studies have proposed that the consumption of up to 1.0 g of polyphenolic compounds per day from a diet abundant in fruits and vegetables can potentially limit the occurrence of mutations and the development of cancer in people. Furthermore, there have been reports indicating that phenolic chemicals are

Linked to antioxidant action, these compounds serve a crucial role in stabilizing lipid peroxidation. Phenols play a crucial role in plants as they possess hydroxyl groups that enable them to effectively scavenge radicals. *Albizia amara* has also shown a positive correlation between total phenols and antioxidant activity. The situation was.

The methanol and petroleum ether extracts were found to contain 243.37 and 1161.86 µg of gallic acid, respectively. The disparity in phenolic levels between the Methanolic extract and petroleum ether extract was statistically significant [14].

Albizia amara potentially possesses antibacterial properties as a result of the presence of phytochemicals such alkaloids, flavonoids, and saponins. These chemicals have demonstrated the ability to impede the proliferation of bacteria, fungi, and viruses, indicating their promise in the treatment of infections and the prevention of diseases caused by microorganisms [15-16].

A. foliage Amara exhibited substantial antibacterial efficacy. The current study unequivocally established the first antibacterial action of A. Amara exhibits antagonistic activity against several significant plant pathogenic fungus and bacteria. The current study found that the chloroform extract exhibited the best antibacterial activity, followed by the methanol extract. The chloroform extract of A inhibited the growth of all the test microorganisms. Amara has a wide

range of activity across various areas. The current investigation unequivocally demonstrates that chloroform was the most efficient solvent for extracting the antibacterial component from A. Amara. Upon further separation of the chloroform extract, it was possible to isolate and identify the active principle responsible for the antibacterial activity. It was found that the basic fraction exhibited considerable antimicrobial activity. Afterwards, the basic fraction was separated to isolate and identify the active chemicals responsible for antibacterial activity using thin-layer chromatography (TLC). The analysis showed the existence of 2 bands. The findings of this study indicate that band-2 (Rf value 0.52) is an alkaloid component that is responsible for its antibacterial activity [17-18].

Albizia species possess bioactive chemicals that have the potential to have anticancer effects. These substances have the ability to cause the death of cancer cells, prevent the growth and spread of tumors, and trigger programmed cell death in cancer cells. Extracts from *Albizia amara* may offer potential as additional therapy for different forms of cancer.

Based on ethnopharmacological data, the ethanolic extract of A. has been documented. The leaves of the amara plant exhibited antioxidant properties, which can help prevent cancer by stabilizing cells. Six unreported substances, namely 3-Hydroxy-4-methoxymandelic acid, 2H-1-Benzopyran, 3, 5, 6, 8 tetrahydro, βAmyrin trimethylsilyl ether, 3- Hydroxy- 4- methoxymandelic acid Undecane, 2, 8- dimethyl, Octadecanoic acid, and 2-oxo methyl ester, were identified from A. Amara leaves exhibit anticancer properties on Hep-G2 and A431 cell lines. Therefore, A. Amara has the capability to offer an alternative medication for cancer treatment, as it has the power to inhibit the proliferation of cancer cells [19].

Albizia species possess bioactive chemicals that have the ability to promote wound healing. These chemicals have the potential to enhance tissue regeneration, collagen synthesis, and angiogenesis, hence speeding up the healing of wounds and injuries. Therefore, extracts from *Albizia amara* may be useful in creating topical formulations for wound treatment [20].

The ethanolic extract of *Albizia amara* leaves contains n–hexadecanoic acid and phytol, which contribute to its possible wound healing properties. Separating the different components could result in potent antioxidant and anti-inflammatory effects. The in vivo wound healing efficacy of the ethanolic extract derived from the A. plant was evaluated. The effect of Amara leaves varied depending on the dosage. The gel formulation consists of 1% carbopol and 15% A. The wound healing activity of the amara leaves extract was much higher than that of the standard control. The histology results revealed the presence of fully developed granulation tissue, indicating the last stage of the wound healing process after 15 days. From now on, the influence of A. Amara's departure for the establishment of an effective system for wound healing was well-documented [21].

The larvicidal activity of *Albizia amara* primarily targets the larval stages of insects, particularly mosquitoes. Albizia species are recognized for their diverse range of bioactive chemicals, such as alkaloids, flavonoids, saponins, and tannins. These compounds have been proven to possess insecticidal and larvicidal activities in numerous studies. Albizia species have been studied for their insecticidal properties against several insect pests, such as mosquitoes. Albizia plants, specifically their leaves, bark, and seeds, contain substances that can be poisonous to mosquito larvae, causing them to die [22].

Albizia amara contains phytochemicals such as flavonoids, alkaloids, and triterpenoids, which may have anti-inflammatory effects. *Albizia amara* extracts have the potential to alleviate inflammation and its associated symptoms by inhibiting inflammatory pathways and reducing the production of pro-inflammatory mediators. This makes them potentially useful in managing inflammatory conditions like arthritis and inflammatory bowel disease [23-24].

Albizia species have long been utilized in traditional medicine for their pain-relieving effects. It is possible that *Albizia amara* also has analgesic characteristics. The extracts of *Albizia amara* include bioactive chemicals that can influence the pathways involved in pain perception. These compounds have the potential to alleviate pain and suffering associated with several illnesses, including headaches, toothaches, and musculoskeletal pain [25].

Albizia amara potentially has immunomodulatory effects via influencing the function of the immune system. *Albizia amara* extracts include phytochemicals that can activate the immune system, improve immunological function, and

regulate inflammatory and allergic responses. These effects may have a positive impact on overall health and well-being [26].

Albizia amara may have antihyperlipidemic and cardioprotective effects due to its antioxidant, anti-inflammatory, and lipid-lowering qualities. *Albizia amara* extracts may provide protection against cardiovascular disorders such as atherosclerosis, hypertension, and coronary artery disease by lowering oxidative stress, inflammation, and cholesterol levels. The botanical name for the plant is *Albizia amara* (Roxb.) Boiv. Bark was employed in traditional Indian medical practices to address cardiovascular ailments. Hyperlipidemia is the primary risk factor for coronary heart disease [27-28].

Albizia amara may demonstrate neuroprotective effects as a result of its antioxidant and anti-inflammatory characteristics. *Albizia amara* extracts have the potential to enhance cognitive performance and safeguard against neurodegenerative disorders like Alzheimer's and Parkinson's disease [29]. This is achieved by scavenging free radicals, decreasing inflammation, and shielding nerve cells from harm.

Antidiabetic Activity: Certain species of Albizia contain bioactive chemicals that have the potential to exhibit antidiabetic activities. These substances can potentially manage blood sugar levels by improving the body's response to insulin, promoting the release of insulin, or preventing the breakdown and absorption of carbohydrates. Extracts from *Albizia amara* may offer potential in the treatment of diabetes [30].

Albizia species contain certain phytochemicals, including flavonoids and saponins, which have been shown to have protective effects on the liver. *Albizia amara* has the potential to be useful for liver health by potentially protecting the liver from damage caused by toxins, oxidative stress, and inflammation [31].

Albizia species contain phytochemicals, including flavonoids and triterpenoids, which have been shown to have anti-allergic properties. *Albizia amara* has the potential to be effective in managing allergies since it may help reduce allergic reactions by preventing the release of histamine and other substances that cause inflammation [32].

Albizia species, particularly Albizia julibrissin, have historically been employed as natural treatments for anxiety and depression because to their antidepressant and anxiolytic properties. The Albizia species contains bioactive substances that can regulate the levels of neurotransmitters in the brain, specifically serotonin and dopamine. This can result in antidepressant and anxiolytic effects. Extracts from *Albizia amara* may have potential in the treatment of mood disorders [33].

In conclusion, *Albizia amara*, a medicinal plant, has the potential to serve as an excellent source for the production of Gold Nanoparticles (GNPs) that can be used in a wide range of biological applications. The biogenic approach is characterized by its simplicity, cost-effectiveness, and eco-friendliness, making it suitable for scaling up the synthesis of GNPs. The abbreviation "A." is used. Amara gold nanoparticles (GNPs) were analyzed using several physico-chemical methods. The GNPs were produced and coated with secondary metabolites of A. Amara demonstrated notable antioxidant, antibacterial, and anticancer characteristics. There is an urgent need for study to evaluate the effects of green produced nano-formulated medications on multidrug resistant strains and malignancies. Therefore, the current results emphasized the several characteristics of A. Amara-mediated gold nanoparticles (GNPs) have the potential to provide crucial foundational data, and additional research is necessary to explore their therapeutic applications [34].

Prospects for the Future

When considering the future outlook for the biological activities of *Albizia amara*, commonly referred to as the white siris tree, we expect a more thorough investigation into its therapeutic characteristics and its possible applications in other disciplines.

Here is a conjectural summary:

Pharmacological research advancements are expected to reveal more bioactive chemicals in *Albizia amara*, which could lead to the creation of new pharmaceutical medications. These chemicals exhibit strong therapeutic effects, including anti-inflammatory, antibacterial, and anticancer actions.

Albizia amara has the potential to play a significant role in the development of new therapies as our scientific knowledge expands. The extensive range of biological activity exhibited by this substance indicates its potential for treating various maladies, such as infectious diseases, inflammatory disorders, and specific types of cancer.

Albizia amara, due to the growing popularity of natural and plant-based therapies, has the potential to be included into traditional medical systems such as Ayurveda and traditional Chinese medicine. Incorporating this plant into comprehensive treatment procedures could provide safer and more environmentally friendly alternatives to pharmaceutical medications.

Albizia amara has the potential to be used in the nutraceutical and functional food industries, in addition to its use in pharmaceuticals. The plant's extracts or derivatives can be added to dietary supplements or functional meals to enhance health and well-being, potentially providing antioxidant or immune-enhancing advantages.

Biotechnological advancements have the potential to synthesize or alter bioactive molecules derived from *Albizia amara*, resulting in the creation of more powerful and specific medicinal medicines. This may entail the utilization of genetic engineering methods to augment the productivity or effectiveness of targeted substances.

Environmental conservation and sustainable harvesting procedures will be crucial as the demand for *Albizia amara* increases. Conservation efforts may prioritize the preservation of the species' genetic variety while also ensuring that local communities derive sustainable benefits from its exploitation.

Overall, the future outlook for *Albizia amara*'s biological activity appears to be highly positive, offering substantial potential for advancements in healthcare, nutrition, and environmental conservation. However, harnessing this potential will necessitate ongoing scientific investigation, interdisciplinary cooperation, and a dedication to sustainable methodologies.

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