

Adansonia digitata L A Review of Its Nutritional, Phytochemical, Antioxidant, Antimicrobial and Hepatoprotective Potential

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Abstract—*Adansonia digitata* L., commonly known as baobab, is a multipurpose tree belonging to the family Malvaceae and is widely valued for its nutritional, traditional, and medicinal applications. Different parts of the plant, including the leaves, stem bark, roots, flowers, seeds, and fruit pulp, have been traditionally used as food and remedies for a variety of health conditions. The available evidence summarized in the present review indicates that *A. digitata* contains several classes of bioactive phytochemicals, including alkaloids, saponins, flavonoids, tannins, terpenoids, steroids, and glycosides. The fruit pulp is particularly notable for its vitamin C content, dietary fibre, and antioxidant potential. Experimental investigations have reported antioxidant, antimicrobial, amoebicidal, and hepatoprotective activities associated with different plant parts and extracts. Ethanolic leaf extract demonstrated amoebicidal activity against *Entamoeba histolytica*, while extracts of the leaves and stem bark exhibited antibacterial activity against bacterial isolates including *Escherichia coli* and *Salmonella typhi*. The plant also demonstrated free-radical-scavenging activity in the DPPH assay, although the activity varied according to plant part and extract. In an experimental model of carbon tetrachloride-induced hepatotoxicity, methanolic fruit-pulp extract showed hepatoprotective potential. Collectively, these findings support the potential of *A. digitata* as a source of nutritional and biologically active compounds. However, variations in extraction procedures, plant parts, experimental models, and reported outcomes highlight the need for standardized phytochemical characterization, toxicity assessment, mechanistic investigations, and well-designed controlled studies before therapeutic applications can be established.

Index Terms—*Adansonia digitata*; baobab; phytochemicals; antioxidant activity; antimicrobial activity; amoebicidal activity; hepatoprotection; fruit pulp; medicinal plants; nutritional value.

I. INTRODUCTION

Adansonia digitata L., commonly known as the baobab tree, belongs to the family Malvaceae and is the most widespread species of the genus *Adansonia*. The species has considerable nutritional, cultural, and medicinal importance. Different parts of the plant have traditionally been used as food as well as in folk medicine.

The leaves are nutritionally important and have been described as a source of protein that can complement the amino-acid profile of the diet. Young leaves are commonly consumed as vegetables, while dried leaves may be incorporated into soups throughout the year. Flowers may also be consumed or used as flavouring materials in drinks. The fruit pulp has attracted particular attention because of its nutritional composition and antioxidant properties.

Traditional medicinal applications of *A. digitata* include the management of fever, diarrhoea, malaria, haemoptysis, dysentery, and conditions associated with vitamin C deficiency. Various preparations of the stem bark, root bark, leaves, and fruit pulp have also been used traditionally. The diversity of traditional applications has stimulated investigations into the phytochemical composition and biological activities of the plant.

The available experimental evidence summarized in the source material indicates that *A. digitata* possesses several potentially beneficial biological properties, including antioxidant, antimicrobial, amoebicidal, and hepatoprotective effects. The objective of this review is to organize the available information concerning the nutritional importance, phytochemical constituents, biological activities, and medicinal potential of *A. digitata*, while identifying important areas for further investigation.



II. BOTANICAL AND ETHNOMEDICINAL IMPORTANCE

The baobab is described as a multipurpose tree whose different organs have nutritional and medicinal uses. Leaves are consumed as vegetables or dried for later incorporation into traditional foods. Flowers can be eaten or incorporated into beverages. Bark preparations have been used traditionally for medicinal purposes, and a semi-fluid gum obtained from the bark has been reported as a traditional treatment for sores.

The stem bark has historically received considerable attention in traditional medicine. Bark preparations have been described as decoctions used internally, with their activity associated in part with soluble and insoluble tannins and gummy and albuminous constituents. β -Sitosterol has also been reported from bark and seed oil. Root bark has similarly been used in traditional medicine and has been reported to contain β -sitosterol and glycosides.

The leaves and roots have also been incorporated into traditional remedies, including preparations used as tonics for individuals affected by malaria. These applications provide a basis for investigating the chemical constituents and biological activities of different parts of the plant.

III. NUTRITIONAL IMPORTANCE OF ADANSONIA DIGITATA

The fruit pulp of *A. digitata* is an important nutritional component of the plant. The available material characterizes the pulp as having a high vitamin C content and substantial antioxidant capacity. It is also described as containing a high proportion of carbohydrates, relatively low protein, extremely low fat, and high crude fibre.

The high fibre content may have physiological and homoeostatic benefits for the intestine and colon. Consequently, the fruit pulp has been considered a potentially useful dietary supplement.

The leaves also have nutritional relevance. Their protein content can contribute to the overall amino-acid profile of diets in which they are consumed with other staple foods. This is particularly relevant in traditional dietary systems where dried leaves are incorporated into staple meals.

IV. PHYTOCHEMICAL CONSTITUENTS

Phytochemical screening of *A. digitata* leaf and stem-bark extracts has demonstrated the presence of several classes of secondary metabolites. The reported constituents include alkaloids, saponins, flavonoids, steroids, tannins, and terpenoids. Additional screening procedures investigated glycosides, resins, anthraquinones, proteins, and amino acids.

The detection of these phytochemical classes provides a possible chemical basis for some of the biological activities reported for the plant. For example, phenolic-associated constituents such as tannins and flavonoids are relevant to antioxidant investigations, whereas several classes of secondary metabolites may contribute to antimicrobial effects.

However, preliminary phytochemical screening provides qualitative evidence of constituent classes rather than definitive identification or quantification of individual compounds. Therefore,

further chromatographic and spectrometric characterization is necessary to establish the chemical profile of *A. digitata* extracts.

V. ANTIOXIDANT ACTIVITY

Oxidative stress is associated with cellular damage and has been implicated in numerous pathological processes. Because of this, antioxidant properties of medicinal plants have attracted considerable research attention.

The antioxidant potential of *A. digitata* extracts has been assessed using the DPPH radical-scavenging assay and an iron-chelating assay. In the DPPH assay, the extract of *A. digitata* leaves showed relatively low radical-scavenging activity, with a reported value of approximately $13 \pm 0.03\%$ radical-scavenging activity. In comparison, *Cucurbita maxima* seed extract showed moderate activity of approximately $38 \pm 0.02\%$.

The iron-chelating assay did not demonstrate activity for the investigated extracts. These observations indicate that antioxidant activity may vary substantially according to plant part, extraction procedure, and assay system.

The antioxidant properties of the fruit pulp have also been emphasized in the source material, particularly in association with its high vitamin C content. The reported antioxidant capacity provides a possible explanation for some of the protective effects observed in experimental models.

VI. ANTIMICROBIAL ACTIVITY

The antimicrobial potential of *A. digitata* has been investigated using different extracts and experimental methods. Leaf and stem-bark extracts prepared using aqueous, ethanol, and chloroform-based extraction procedures were assessed against bacterial isolates.

The reported bacterial isolates included *Escherichia coli* and *Salmonella typhi*. Preliminary phytochemical screening demonstrated the presence of several bioactive constituent classes in the investigated plant materials.

The antibacterial activity was assessed using agar well or cup-plate diffusion methods. Extract concentrations were tested and inhibition zones were measured after incubation. In another experimental investigation, ethanolic leaf extract was evaluated against standard bacterial strains including *E. coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, and *Staphylococcus aureus*. Fungal organisms including *Candida albicans* and *Aspergillus niger* were also included.

Minimum inhibitory concentration (MIC) was determined using dilution-based methods. The available findings indicate that aqueous, ethanol, and chloroform extracts of *A. digitata* leaves and stem bark were capable of inhibiting the growth of the tested bacterial isolates, with inhibition reported at higher concentrations, including 40 mg/mL.

These findings suggest that *A. digitata* contains compounds with antimicrobial potential. Nevertheless, differences in extraction procedures and experimental conditions make direct comparison between studies difficult.

VII. AMOEBICIDAL ACTIVITY

The source material also reports investigation of the amoebicidal activity of medicinal plant extracts against *Entamoeba histolytica*. Ethanolic *A. digitata* leaf extract was tested using an in-vitro susceptibility assay.

The ethanolic leaf extract demonstrated 100% inhibition after 96 hours at concentrations of 500 and 250 ppm. Under the same experimental conditions, metronidazole, which was used as the reference control, produced approximately 80% mortality.

These findings provide preliminary evidence that *A. digitata* leaf extract may possess amoebicidal activity. However, the results are derived from an in-vitro experimental model and should not be interpreted as evidence of clinical efficacy. Additional investigations are required to identify the active compounds, determine their mechanism of action, establish dose-response relationships, and evaluate safety.

VIII. HEPATOPROTECTIVE POTENTIAL

The liver is particularly susceptible to chemical and oxidative injury. The hepatoprotective properties of *A. digitata* fruit pulp have been investigated using an experimental model of carbon tetrachloride (CCl₄)-induced hepatotoxicity in rats.

In the reported experimental design, rats were divided into normal-control, negative-control, standard-control, and treatment groups. Hepatotoxicity was induced using CCl₄. Silymarin was used as a standard treatment, while methanolic *A. digitata* extract was administered at doses of 100 and 200 mg/kg/day. Treatment was continued for 21 days, with CCl₄ administered at 72-hour intervals.

The reported findings indicate that oral administration of *A. digitata* fruit-pulp methanolic extract exhibited hepatoprotective properties in the CCl₄-induced model. The protective effect was suggested to be associated with the antioxidant capacity of the extract.

These observations are promising but remain preclinical. The available material itself recommends further evaluation of efficacy and safety using well-designed controlled studies.

IX. RELATIONSHIP BETWEEN PHYTOCHEMICALS AND BIOLOGICAL ACTIVITY

The biological effects reported for *A. digitata* may be associated with the presence of multiple classes of secondary metabolites and nutritional constituents. The detection of flavonoids, tannins, terpenoids, alkaloids, saponins, and steroids suggests that the plant contains a chemically diverse mixture of bioactive constituents.

The antioxidant potential may be related to antioxidant-associated constituents and the high vitamin C content of the fruit pulp. Antimicrobial activity may similarly result from interactions among several secondary metabolites rather than a single compound.

The hepatoprotective effects observed experimentally may also be related to the antioxidant capacity of the fruit-pulp extract. However, the source material does not establish specific molecular mechanisms or identify individual compounds responsible for these activities. Such relationships should therefore be regarded as potential explanations requiring experimental confirmation.

X. LIMITATIONS OF THE AVAILABLE EVIDENCE

Although the reported findings indicate considerable biological potential, several limitations should be considered.

First, different studies have investigated different plant parts, including leaves, stem bark, and fruit pulp. Biological activity cannot therefore be generalized uniformly to the entire plant.

Second, extraction procedures differed substantially among investigations, including aqueous, ethanol, methanol, and chloroform extraction. Differences in solvent polarity, extraction duration, temperature, and concentration can influence the chemical composition and biological activity of the resulting extracts.

Third, several investigations used preliminary phytochemical screening rather than quantitative chemical characterization. Consequently, the exact concentrations and identities of many potentially active compounds remain unclear.

Fourth, several reported biological activities were demonstrated in vitro or in animal models. Such results provide preliminary evidence but cannot by themselves establish efficacy or safety in humans.

Finally, the available source material contains references in abbreviated or incomplete form. Comprehensive bibliographic verification will therefore be necessary before submission to an SCI-indexed journal.

XI. FUTURE RESEARCH PERSPECTIVES

Future investigations should focus on systematic chemical characterization of *A. digitata* extracts and isolation of the compounds responsible for the observed biological activities. Standardized extraction procedures should be established to facilitate comparison between studies.

Quantitative determination of phenolics, flavonoids, vitamin C, and other relevant constituents would strengthen the relationship between chemical composition and biological activity. Mechanistic studies should also be conducted to clarify how individual extracts or compounds produce antioxidant, antimicrobial, amoebicidal, and hepatoprotective effects.

Toxicological studies are particularly important before therapeutic applications can be considered. The hepatoprotective findings reported in animal models should be investigated using standardized biochemical, histopathological, and molecular endpoints.

Finally, well-designed controlled studies are required to determine whether the promising preclinical findings can translate into meaningful health benefits in humans.

XII. CONCLUSIONS

Adansonia digitata L. is a nutritionally and medicinally important multipurpose tree with considerable potential as a source of bioactive and dietary constituents. The available evidence indicates the presence of several phytochemical classes, including alkaloids, saponins, flavonoids, tannins, terpenoids, and steroids.

The fruit pulp is particularly notable for its vitamin C content, antioxidant potential, carbohydrate content, and high dietary fibre. Experimental studies summarized in the present review indicate antioxidant, antibacterial, amoebicidal, and hepatoprotective activities associated with different parts and extracts of the plant.

However, the existing evidence remains heterogeneous, and much of the reported activity is based on preliminary in-vitro or animal studies. Standardized extraction, detailed phytochemical characterization, toxicological evaluation, mechanistic studies, and controlled clinical investigations are required to establish the therapeutic significance of *A. digitata*. Thus, while the plant represents a promising nutritional and pharmacological resource, its medicinal applications require further scientific validation.

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