***Original Research Article***

**ETHNOBOTANICAL, PHYTOCHEMICAL STUDIES AND DETERMINATION OF MINERAL ELEMENTS OF *COMMIPHORA AFRICANA* (A. RICH) ENGEL. HAVERSTED IN MALI**

**ABSTRACT**

Since ancient times, people have treated themselves with the plants they had at their disposal. *Commiphora africana* (A. Rich) Engel., known as "African myrrh," is a medicinal plant belonging to the Burseraceae family, widely used in traditional Malian medicine. The objective of this study is to conduct an ethnobotanical survey, perform phytochemical screening of the plant powder, and determine the mineral content. A questionnaire was used to collect information from respondents regarding knowledge about the plant and the recommended preparation methods. The plant material consisted of root bark and leaves. These plant parts were harvested in November 2018 in Ségué, Bankass prefecture in the Mopti region of Mali. The extracts were prepared by aqueous decoction using reflux heating. The phytochemical families of the different extracts were identified using test tube reactions. Mineral elements were determined by Atomic Absorption Spectrometry (AAS). The ethnobotanical survey did not yield conclusive results, as the traditional therapists interviewed only mentioned the use of the plant's resin. Phytochemical analysis revealed the presence of various secondary metabolites, such as flavonoids, alkaloids, tannins, free quinones, terpenoids, sterols, triterpenes, anthraquinones, and reducing sugars. Furthermore, the studied plant parts (leaves and roots) showed varied concentrations of minerals, including Na (1.14; 1.55 mg/L), K (28.12; 22.88 mg/L), Mg (12.79; 11.35 mg/L), Ca (62.96; 38.93 mg/L), Fe (0.57; 2.23 mg/L), Pb (1.48; 1.21 mg/mL). Some elements were present in trace amounts: Zn (-1.29; 0.38 mg/mL) and Cu (0.28; 0.08 mg/mL).

***Keywords:*** *Commiphora africana (A. Rich) Engel.; ethnobotanical survey; phytochemical screening; mineral elements.*

1. **INTRODUCTION**

Traditional medicine remains the primary recourse for a significant portion of populations in addressing health problems. This phenomenon is explained not only by its central role as part of cultural heritage but also by its financial accessibility, particularly in contexts where conventional medicines are costly. Transmitted orally from generation to generation, traditional medicine risks losing valuable knowledge in the absence of proper documentation. In this context, ethnobotanical surveys are essential to inventory medicinal plants and understand their uses. These studies help leverage local knowledge about the therapeutic properties of plants, especially in regions where they still play a crucial role in combating various diseases (Koné, 2009). Medicinal plants are the richest bio-resources for medicines. It is necessary to validate research findings on medicinal and aromatic plants through an organized database (Ahmed *at al.,* 2016).

*Commiphora africana*, a shrub of the Burseraceae family, can reach up to 5 meters in height, sometimes exceptionally 10 meters. Although it is widely distributed across Africa, its exact distribution remains uncertain due to persistent taxonomic confusions. It thrives mainly in dry savanna and Sahel regions.

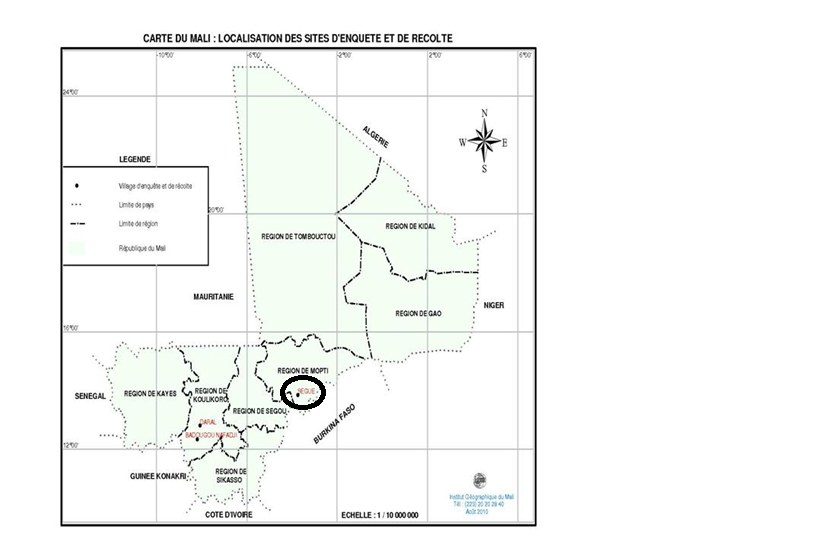
This plant is associated with numerous medico-magical and magico-religious uses. Therapeutically, it is known for its stomachic, calming, and soporific properties (Archna *at al.,* 2016). Various parts of *Commiphora africana* are used to treat multiple ailments: typhoid, dysentery, snake bites, wound healing, heartburn, and malaria (Bouakaz, 2006). Its bark is used to treat scorpion stings, rheumatism, conjunctivitis, and dermatoses. The leaves are used for treating bovine pleuropneumonia and male infertility (Archna *at al.,* 2016). In Burkina Faso and Côte d'Ivoire, a maceration of crushed leaves in oil is consumed as a sedative and soporific (Goji, 2009). The seeds are known for their vermifuge and purgative properties (Archna *at al.,* 2016).

The objective of this study is to identify the traditional medicinal uses associated with *Commiphora africana* and document local knowledge about this plant in collaboration with traditional healers, the custodians of this intangible heritage. The results will provide a comprehensive view of the curative properties attributed to this species as perceived by traditional healers.

1. **MATERIAL AND METHODS**
   1. **Plant Material**

The studied plant parts (leaves and roots) were harvested in Ségué, Bankass prefecture, Mopti region, which has a fairly arid Sahelian climate characterized by a rainfall index of 500 to 750 mm. The rainy season lasts a maximum of 3 months (July to September), and the vegetation is mainly thorny steppe and grasses on sandy soil.

The plant organs were harvested in November 2018; leaves in the morning around 7 AM and roots after 10 AM. The plant was identified by a botanical specialist at the Department of Medicinal Plants on the herbal number 2639/DMT. The plant materials were dried for two weeks at room temperature in the laboratory and then pulverized using a traditional mortar.



**Fig.1:** Map of Mali with the collection site (Geographic Institute of Mali)

**2.2 Ethnobotanical Survey**

Ethnobotanical surveys were conducted in December 2019 among herbalists and traditional healers in the Bamako district, particularly in Commune V (17 respondents at the Sabalibougou market and 7 at Kalaban Coura ACI). A structured interview guide with questionnaires was used to collect information on respondents' knowledge of the plants and their recommended preparation methods.

**2.3 Phytochemical Screening**

Phytochemical screening is a method used to detect the presence of specific chemical groups in a given substance. This study relied on:

* Formation of insoluble complexes using precipitation reactions;
* Formation of colored complexes based on color reactions. This analysis helps to qualitatively identify the main chemical families present.

Mineral Analysis of plants extracts and powder

The mineralization process aims to detect and quantify essential mineral elements for human health, such as sodium (Na), calcium (Ca), magnesium (Mg), and iron (Fe). The analysis was performed using Atomic Absorption Spectrometry (AAS).

To do this, 0.5 g of plant powder or extract (aqueous decoction) was weighed and dissolved in a 150 mL Erlenmeyer flask containing:

• 10 mL of concentrated acids (sulfuric and nitric);  
• 5 mL of hydrogen peroxide.

The obtained solution was filtered into a 100 mL flask and then brought to volume with distilled water. The mixture was then placed in a mineralizer (BUCHI-K-436) for 30 minutes.

Before analysis, the decoctions (aqueous and hydro-alcoholic) were dissolved in hot distilled water to facilitate dissolution. Calibrated standards for each mineral element (ranging from 2 to 8 ppm) were used, along with appropriate detectors.

Finally, the analysis was performed using an atomic absorption spectrometer (AAS), allowing the measurement of the mineral element concentrations present in the samples.

1. **RESULTS AND DISCUSSION**

The results obtained in this study are summarized in the following tables:

**Table I: Results of the Ethnobotanical Survey**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Diseases Treated** | Used Parts | Preparations | Mode of Use | **Number of Citations** |
| Headaches | Resin | Resin on hot embers | Head fumigation | 24 |
| Evil spirits | Resin | Resin on hot embers | Fumigation morning and evening until delivrance | 21 |
| Children's nighttime fear | Resin | Resin on embers | Fumigation | 4 |

The ethnobotanical data highlighted traditional uses of the resin in treating various conditions, including headaches, bad spirits, and children's nighttime fear.

Table II: Results of phytochemical screening

|  |  |  |  |
| --- | --- | --- | --- |
| Chemical Compounds | | Roots | Leaves |
| Flavonoids | | + | + |
| Tannins | | + | + |
| Alkaloids (Mayer)  Alkaloids (Wagner) | + | + | + |
| + | + | + |
| Sterols and Triterpenes | | + | + |
| Quinones | | + | + |
| Terpenoids | | + | – |
| Anthraquinones | | + | + |
| Reducing Sugars | | + | + |
| Amines | | – | + |
| Saponosides | | – | – |

Legend :

+: Positive reaction; -: Negative reaction

Phytochemical screening revealed the presence of sterols, triterpenes, flavonoids, tannins, alkaloids, quinones, and anthraquinones, suggesting potential anti-inflammatory, antimicrobial, and antioxidant properties.

The results show a significant distribution of chemical compounds in the roots and leaves. The main observations include the presence of:

• Sterols and triterpenes: indicating possible anti-inflammatory or antimicrobial activity;

• Flavonoids and tannins: known for their antioxidant and astringent properties;

• Alkaloids: potentially responsible for various pharmacological effects;

• Quinones and anthraquinones: which could explain antibacterial or laxative properties.

Table III: Results of Mineral Elements

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Mass (g) | Pb | Cd | Cr | Fe | Mg | Cu | Ca | Zn | K | Na |
| Root | 1.013 | 1.21 | 0.22 | -1.23 | 2.23 | 11.35 | 0.08 | 38.93 | 0.38 | 22.88 | 1.55 |
| Leaves | 1.001 | 1.48 | 1.13 | -1.81 | 0.57 | 12.79 | 0.28 | 62.96 | -1.29 | 28.12 | 1.14 |
| Authorized Standard | | 0.1  mg/L | 5  µg/L | 50  µg/L | 200  µg/L | 50  mg/L | 2000  µg/L | 270  µg/L | 5000  µg/L | 200  mg/L | 150  mg/L |

Mineral analysis showed significant variations between roots and leaves, with notable levels of calcium, potassium, and iron.

Mineral Element Results

The mineral element contents vary between the roots and leaves, compared to the authorized standards.

• Toxic elements:

Lead (Pb): Exceeds acceptable thresholds (0.1 mg/L), posing a significant health risk.

Cadmium (Cd): Present in concerning amounts, especially in the leaves, exceeding the authorized limits (5 µg/L).

Chromium (Cr): Negative values reported, requiring methodological or instrumental verification.

• Essential elements:

Iron (Fe) and magnesium (Mg): Significant concentrations in roots and leaves, supporting their nutritional or therapeutic properties.

Calcium (Ca) and potassium (K): Particularly abundant in leaves, enhancing their value in dietary formulations.

Zinc (Zn): Variable concentrations but generally below regulatory limits.

1. **DISCUSSION**

The study on *Commiphora africana* is a significant contribution to the ethnobotanical and phytochemical documentation of a plant widely used in Malian traditional medicine. It highlights the bioactive compounds present in the plant and its therapeutic potential while emphasizing the limitations of current ethnobotanical knowledge.

The ethnobotanical survey did not yield conclusive results, as the traditional healers interviewed only mentioned the use of the plant’s resin for treating various ailments such as headaches, malevolent spirits, and children's nocturnal fears.

Several studies have addressed the use of *Commiphora africana* in African traditional medicine for treating various conditions, including digestive disorders (stomach aches, diarrhea, etc.), respiratory ailments (cough, bronchitis, etc.), skin problems (wounds, infections, etc.), pain (toothaches, muscle pain, etc.), as well as kidney and bladder conditions (Adjanohoun, 1989; Kokwaro, 1993; Gadir and Ahmed, 2014; Amare, 2019).

Phytochemical screening results reveal the presence of sterols, triterpenes, flavonoids, tannins, alkaloids, quinones, and anthraquinones. Studies conducted by Baser and Demirci (2007) and Sánchez-Morgado (2000) have identified various bioactive compounds in *Commiphora africana*, such as: Terpenoids (Compounds with anti-inflammatory, antimicrobial, and antioxidant properties), Flavonoids(Known for their antioxidant and anti-inflammatory properties), Alkaloids (Compounds with analgesic and anti-inflammatory properties). These studies suggest that the medicinal properties of *Commiphora africana* may be attributed to the presence of these bioactive compounds.

The determination of mineral elements in *Commiphora africana* is crucial for understanding its nutritional value and health impact. The analysis revealed the presence of essential elements such as iron (Fe), magnesium (Mg), calcium (Ca), potassium (K), and zinc (Zn). Studies have confirmed the presence of key minerals in this plant, including: Calcium (Essential for bone and dental health), Iron (Crucial for red blood cell formation and oxygen transport), Potassium (Important for muscle and nerve function), Magnesium: Essential for muscle and nerve function, as well as blood sugar and blood pressure regulation (Orwa *at al.,* 2009). These findings suggest that *Commiphora africana* could serve as a valuable source of essential minerals for the body.

1. **Conclusion**

Ethnobotanical, phytochemical, and mineral element studies on *Commiphora africana* reveal its potential as a medicinal plant and a source of bioactive compounds and essential minerals. However, further in-depth research is needed to explore its chemical constituents for the development of promising natural pharmaceutical products.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

**REFERENCES**

Adjanohoun, E. V. (1989). Contribution to ethnobotanical and floristic studies in the People's Republic of Benin.

Ahmed, Ibtisam; Gadir, Suad; Elgilany, Elsheikh; Abdallah, Taguldien. (2016). *Commiphora africana* Resin Phytochemical Analysis & Some Biological Aspects. *European Journal of Medicinal Plants, 13.* DOI: 10.9734/EJMP/2016/22531

Amare, S. (2019). *Bioprospecting Potential of Commiphora africana for Access and Benefit Sharing*. Genetic Resources Access and Benefit Sharing Directorate.

Archna Suman, Priyanka Verma, Ajar Nath Yadav, R. Srinivasamurthy, Anupama Singh, and Radha Prasanna. (2016). *Development of Hydrogel-Based Bio-Inoculant Formulations and their Impact on Plant Biometric Parameters of Wheat (Triticum aestivum L.).* *International Journal of Current Microbiology and Applied Sciences, 5(3),* 890-901.

DOI: <http://dx.doi.org/10.20546/ijcmas.2016.503.103>

Baser, K. H. C., & Demirci, B. (2007). *Fumigacins and Other Biologically Active Components of Myrrh.* *Natural Product Communications, 43(6),* 661-667.

Bouakaz, I. (2006). *Phytochemical Study of the Plant Genista Microcephala.* Master's Thesis, Batna.

Donatien KONE. (2009). *Ethnobotanical Survey of Six Malian Medicinal Plants – Extraction, Identification of Alkaloids, Characterization, and Quantification of Polyphenols: Study of Their Antioxidant Activities.*

Gadir, S. A., & Ahmed, I. M. (2014). *Commiphora myrrha and Commiphora africana Essential Oils.* *Journal of Chemical and Pharmaceutical Research, 6(7),* 151-156.

Goji, A. D. T., Dikko, A. A. U., Bakari, A. G., Mohammed, A., Ezekiel, I., & Tanko, Y. (2009). *Effect of Aqueous-Ethanolic Stem Bark Extract of Commiphora africana on Blood Glucose Levels in Normoglycemic Wistar Rats.* *International Journal of Animal and Veterinary Advances, 1(1),* 22–24.

Kokwaro, J. O. (1993). *Medicinal Plants of East Africa.*

Orwa, C., Mutua, A., Kindt, R., Jamnadass, R., & Simons, A. (2009). *Agroforestree Database: A* Tree Reference and Selection Guide, Version 4.0.

Sánchez-Morgado, S., Martín, M. A., & Cabo, J. (2000). Analysis of Essential Oils from Oleogum Resins of Four Commiphora Species. Journal of Essential Oil Research, 12(6), 723-728.