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PHARMACOGNOSTIC STUDY OF *MORINGA OLEIFERA* LAM. (*MORINGACEAE*), A PLANT USED IN THE TREATMENT OF DIABETES IN MALI

Mahamane Haidara [1, * 2], Sekou Doumbia [1], Daouda L. Dembele [1] and Rokia Sanogo [1, 2]

Faculty of Pharmacy of the University of Sciences [1], Techniques and Technologies of Bamako (USTTB), Mali.
National Institute for Research on Traditional Medicine and Pharmacopoeia (INRMPT) [2], Mali.

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Correspondence to Author:
Dr. Mahamane Haidara

Associate Professor,
Faculty of Pharmacy of the University of Sciences, Techniques and Technologies of Bamako (USTTB), Mali.

E-mail: mahamanehaidara83@gmail.com

ABSTRACT: *Moringa oleifera* is the plant most frequently used by diabetic patients in Bamako (Mali) for the management of their diabetes. The present study aimed to determine the pharmacognostic parameters of the leaves of *Moringa oleifera* harvested in Mali. The pharmacognostic study consisted of determining the botanical characters (organoleptic features and microscopic elements), physicochemical parameters (water and ash contents), and chemical constituents according to methods described in the European Pharmacopoeia. The powder of leaves of *M. oleifera* was green in color, with a semi-coarse texture, an uncharacteristic odor, and an insipid flavor. Micrograph revealed the presence of anomocytic stomata, calcium crystals, single-celled covering hairs and spiral vessels. Water content is greater than 10%. Acid-insoluble ash content was less than 1%. Phytochemical screening revealed the presence of polyphenols (flavonoids and tannins), saponins, sterols and triterpenes. Pharmacognostic parameters determined on this study can help in the efficient utilization of this medicinal plant.

INTRODUCTION: Diabetes is a public health problem in West Africa. Medicinal plants are a therapeutic remedy frequently used by diabetic patients for the management of their diabetes [1, 2]. The most frequently used plant by diabetic patients in Bamako (Mali) is *Moringa oleifera* Lam. [3]. *Moringa oleifera* can grow up to 12 m in tropical and subtropical environments [4]. It produces composite leaves that are alternate, bipinnate or partly tripinnate (which measures 30–70 cm long) with two to six pairs of opposite pinnate bearing leaflets in three to five pairs.

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Leaflet at the terminal end is larger than the other leaves, may or may not be glaborous with ovate to elliptic size. The leaves are one to two cm long and 0.5–1.5 cm in width with a rounded apex and base [5]. Although it is native to South Asia, the cultivation itself has already spread to the Middle East, Africa, Asia, and other areas [4].

The leaves of *M. oleifera* mainly contain bioactive compounds such as phenolic compounds, terpenoids and sterols [6] which are thought to be partly responsible for the numerous pharmacological activities observed *in-vitro* and *in-vivo* such as hypoglycemic, antioxidant, anti-inflammatory, antimicrobial activities [7–9]. Clinical studies conducted in type 2 diabetic patients have shown that the leaves of *M. oleifera* are beneficial in the management of type 2 diabetes and in the prevention of its complications [10]. In Mali, the

work of the National Institute for Research on Traditional Medicine and Pharmacopoeia (NIRTMP) has made it possible to develop an Improved Traditional Medicine (ITM) based on the leaves of *M. oleifera* called "MODIA" used in the treatment of type 2 diabetes [11–13]. However, it is necessary to conduct pharmacognostic studies in order to establish quality standards for *Moringa oleifera* leaves harvested in Mali. It is in this context that the present study was initiated and aimed to determine the pharmacognostic parameters of *Moringa oleifera* leaves harvested in Mali, more specifically to determine the botanical characters, physicochemical parameters and phytochemical constituents.

MATERIALS AND METHODS:

Plant Material: The plant material consisted of *Moringa oleifera* leaves harvested from the botanical garden of the National Institute for Research on Traditional Medicine and Pharmacopoeia (NIRTMP). The botanical identity of the plant was confirmed by Seydou Mamadou DEMBELE, Water and Forestry Engineer, head of the Ethnobotany and Raw Materials Department of NIRTMP.

The leaf samples were dried in the shade in the drying room of the NIRTMP for 2 weeks. After drying, the dried leaf samples were pulverized with a Resch type SM2000 OSI /1430 upm grinder. An herbarium specimen of the leaves is deposited in the NIRTMP Herbarium under the number 1391/DMT.

Determination of Botanical Characters: The botanical characters of *M. oleifera* leaf powder were determined according to methods described by Fofie *et al.* [14]. The botanical characters determined concerned the organoleptic characters and the microscopic elements.

Determination of Organoleptic Characters: The organoleptic characters of *M. oleifera* leaf powder were determined using the method described by Fofie *et al.* [15]. The organoleptic characters determined concerned the color, taste, smell and texture of the powder.

Microscopic Examination: Micrographs of *M. oleifera* leaf powder were carried out according to the method described by Fofie *et al.* [14]. The *M. oleifera* leaf powder was mounted between slide and coverslip in a 5% diluted aqueous solution of potassium hydroxide (KOH).

The microscopic elements were observed with the objective 40 of an OPTIKA ITALY microscope and then photographed using an iPad device that was directly connected to the microscope.

Physicochemical Analyses: Physicochemical parameters such as water content, ash content (total ash and acid-insoluble ash), and water-soluble extractive and 70% ethanol-soluble extractive content were determined according to methods described in the European Pharmacopoeia water and 70% ethanol were determined according to methods described in the European Pharmacopoeia [16].

Phytochemical Screening: Phytochemical analysis was conducted to determine the presence of alkaloids (Dragendorff reagent), anthocyanins (acid and base reaction), anthraquinones (Bornträger reaction), flavonoids (Cyanidine reaction), saponins (foaming test), sterols and triterpenes (Lieberman reaction) and tannins (trichloride reaction) [17]. The results were categorized as follows:

- Strongly positive reaction: +++
- Moderately positive reaction: ++
- Weakly positive reaction: +
- Negative reaction: -

RESULTS AND DISCUSSION:

Botanical Characters: The powder of *M. oleifera* leaves collected from the NIRTMP garden in Bamako, Mali was green in color, with a semi-coarse texture, an uncharacteristic odor, and an insipid flavor.

Micrograph of *M. oleifera* leaves powder revealed the presence of anomocytic stomata (a), calcium crystals (b and b'), single-celled covering hairs (c) and spiral vessels (d) (see **Fig. 1**). These botanical characters of *M. oleifera* leaf powder will contribute to their identification and the determination of falsifications.

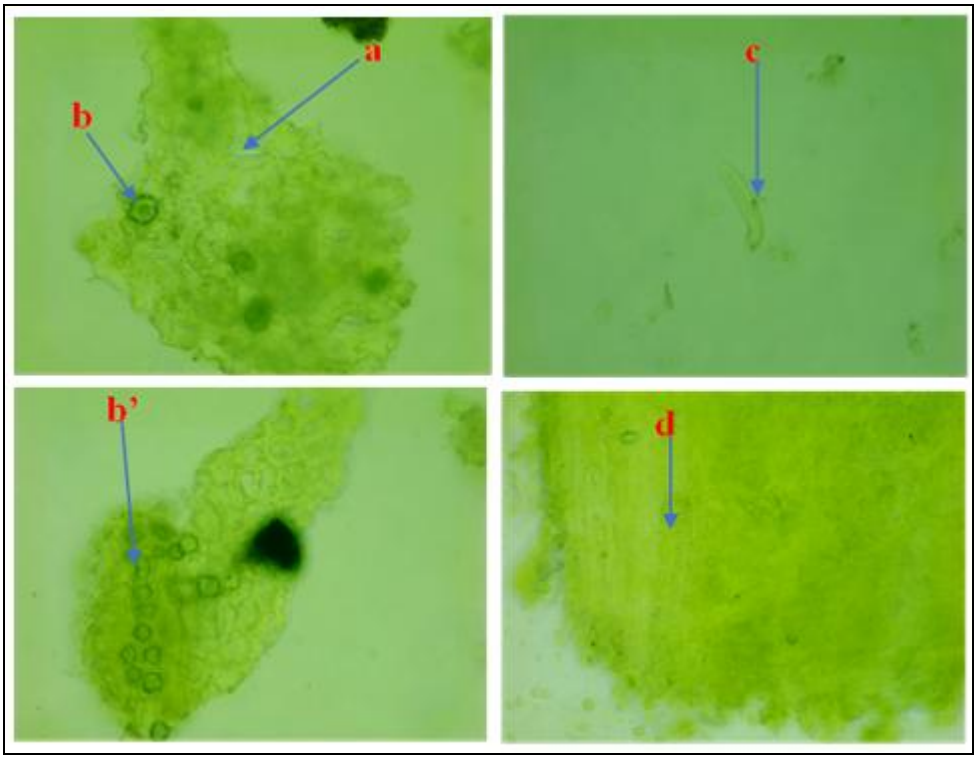

FIG. 1: MICROGRAPH OF *M. OLEIFERA LEAF* POWDER (40X40). a: anomocytic stomata; b and b: calcium crystals; c: single-celled covering hairs; d:spiral vessels.

Physicochemical Parameters: Physicochemical analysis is an essential element of quality control of plant material. The results of the physicochemical parameters studied are presented in **Table 1**. The water content in *M. oleifera* leaf powder is greater than 10% (see **Table 1**). This value is higher than the limit recommended by Pharmacopoeias, which generally require a water content of less than 10% [16, 18]. A high-water content promotes oxidation and fermentation reactions and the development of mold, which are phenomena that can alter the active ingredients during storage [19].

Physicochemical analysis conducted on samples of *M. oleifera* leaf powder collected in Nigeria showed that the water content in *M. oleifera* leaf powder varies from 4 - 14.2% [20–23]. This variability could be due to drying conditions (humidity in the air in August in Mali). The total ash content was 8.07 ± 0, 36%. Total ash content values in *M. oleifera* leaf samples collected in Nigeria ranged from 7-16% [20–23]. The insoluble ash content in 10% HCl were less than 0.5% (see **Table 1**). This result suggests that the powder of *M. oleifera* leaves contains a low proportion of siliceous elements such as sand and dust [19]. The high total ash content coupled with a low content of hydrochloric acid insoluble ash suggests that the powder of the leaves of *M. oleifera* are good sources of minerals when compared to the cereals, dairy products, some fruits and vegetables [24]. Water-soluble extractive content was higher than those 70% ethanol-soluble extractive content. This result suggests that the chemical constituents of *M. oleifera* leaves are more soluble in water than in hydroethanolic solution, which is in favor of the traditional form of use (decoction, infusion).

TABLE 1: PHYSICOCHEMICAL PARAMETERS OF *MORINGA OLEIFERA* LEAVES

Physicochemical parameters	Value (%)
Water content	11.99 ± 0.29
Total ash	8.07 ± 0,36
Acid insoluble ash content	0,33 ± 0,06
Water-soluble extractive content	14.7 ± 1.69
70% ethanol-soluble extractive content	7.82 ± 1.7

Phytochemical Constituents: Phytochemical screening revealed the presence of anthraquinones, flavonoids, saponins, sterols, triterpenes, and tannins in the powder of leaves of *M. oleifera* (see **Table 2**). These compounds have been identified in *M. oleifera* leaves harvested in other localities in Mali [25, 26] and Africa [27, 28]. In addition to these compounds, the presence of alkaloids has been reported in *M. oleifera* leaf samples collected in Nigeria [20] and India [29].

The presence of some of these compounds could justify the use of *M. oleifera* leaves in the management of diabetes and its complications. Growing evidence indicates that polyphenols (flavonoids, tannins) may influence blood glucose at different levels and may also help control and prevent diabetes complication [30, 31]. Triterpenes are also promising agents in the prevention of diabetic complications. They have strong antioxidant activity and inhibit the formation of advanced glycation end products, implicated in the pathogenesis of diabetic nephropathy, embryopathy, neuropathy or impaired wound healing [32].

TABLE 2: PHYTOCHEMICAL CONSTITUENTS OF *M. OLEIFERA* LEAVES

Phytochemical constituents	Powder
Alkaloids	-
Anthocyanins	-
Anthraquinones	+
Flavonoids	++
Leucoanthocyanins	-
Sapononins	+
Sterols and triterpenes	+++
Tannins	+++

CONCLUSION: This study made it possible to determine, on the one hand, the botanical characters of the powder of *M. oleifera* leaves harvested in Mali and, on the other hand, the physicochemical and phytochemical parameters. These data will thus contribute to the identification of *M. oleifera* leaves, to the detection of falsifications and contamination by foreign bodies.

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CONFLICT OF INTEREST: No conflict of interest.

REFERENCES:

1. Baldé NM, Youla A, Baldé MD, Kaké A, Diallo MM, Baldé MA and Maugendre D: Herbal medicine and treatment of diabetes in Africa: an example from Guinea. Diabetes Metab 2006; 32(2): 171-5.
2. Dièye AM, Sarr A, Diop SN, Ndiaye M, Sy GY, Diarra M, Rajraji/Gaffary I, Ndiaye/Sy A and Faye B: Medicinal plants and the treatment of diabetes in Senegal: survey with patients. Fundam Clin Pharmacol 2008; 22(2): 211-6.
3. Koné MF: Plantes médicinales utilisées par les patients diabétiques dans le district de Bamako [Thèse de Pharmacie]. [Bamako, Mali]: USTTB, Mali; 2018.
4. Amin MF, Ariwibowo T, Putri SA and Kurnia D: *Moringa oleifera*: a review of the pharmacology, chemical constituents, and application for dental health. Pharmaceuticals 2024; 17(1): 142.
5. Boopathi NM and Abubakar BY: Botanical Descriptions of *Moringa spp*. In: The Moringa Genome. Springer 2021; 11-20.
6. Su X, Lu G, Ye L, Shi R, Zhu M, Yu X, Li Z, Jia X and Feng L: *Moringa oleifera* Lam.: a comprehensive review on active components, health benefits and application. RSC Adv 2023; 13(35): 24353-84.
7. Popoola JO, Aworunse OS, Oyesola OL, Akinnola OO and Obembe OO: A systematic review of pharmacological activities and safety of *Moringa oleifera*. J Herbmed Pharmacol 2020; 9(3): 174-90.
8. Bhattacharya A, Tiwari P, Sahu PK and Kumar S: A review of the phytochemical and pharmacological characters of *Moringa oleifera*. J Pharm Bioallied Sci 2018; 10(4): 181-91.
9. Padayachee B and Baijnath H: An updated comprehensive review of the medicinal, phytochemical and pharmacological properties of *Moringa oleifera*. South Afr J Bot 2020; 129: 304-16.
10. Kamrul-Hasan ABM, Talukder SK, Nagendra L, Alam MS, Aalpona FTZ, Dutta D and Selim S: Effect of *Moringa oleifera* leaf extract on glycemic parameters in patients with type 2 diabetes mellitus and prediabetes: a systematic review and meta-analysis. Bangladesh J Endocrinol Metab 2023; 2(3): 134-45.
11. Dramé BSI, Coulibaly DM, Koné A, Sow DS, Goita Y, Koné D, Haidara M, Diawara A, Sanogo R and Cissé BM: Evaluation of the modulating role of *Moringa oleifera* leaf powder on hyperglycemia in type 2 diabetics. Int J Recent Sci Res 2022; 04(B): 894-901.
12. Dramé BSI, Adama K, Sylla SD, Goita Y, Coulibaly DM, Sanogo R and Cissé BM: Capacité anti oxydante des feuilles du Moringa oleifera chez les diabétiques de type 2. Health Sci Dis 2022; 23(3).
13. Sissoko L, Diarra N, Nientao I, Stuart B, Togola A, Diallo D and Willcox ML: *Moringa oleifera* leaf powder for type 2 diabetes: a pilot clinical trial. Afr J Tradit Complement Altern Med 2020; 17(2): 29-36.
14. Fofie YBN, Coulibaly K, Traore K, Odoh E, Zihiri GN and Kone-Bamba D: Pharmacognostic study of *Ziziphus mauritiana* LAM. (Rhamnaceae). Int J Pharmacogn 2018; 5(6): 354-9.
15. Yvette FNB, Kiyinlma C and Diénéba KB: Phamacognostic study of *Ocimum gratissimum* Linn.: Pharma food plant. J Pharmacogn Phytochem 2014; 2(5): 74-9.
16. European Directorate for the Quality of Medicines &, HealthCare of the Council of Europe. European Pharmacopoeia. Tenth Edition. Vol. I. Strasbourg Cedex, France: Council of Europe 2019.
17. Bruneton J: Pharmacognosie, Phytochimie, Plantes médicinales. 5e édition. Lavoisier, Paris: Technique et Documentation, Lavoisier Paris, France 2016; 1487.
18. OUA: Pharmacopée africaine. Méthodes générales d'analyses. Vol. 1. Lagos: Lagos (Nigeria), CSTR/OUA; 1988; 264.
19. Chanda S: Importance of pharmacognostic study of medicinal plants: An overview. J Pharmacogn Phytochem 2014; 2(5): 69-73.

20. Nweze NO and Nwafor FI: Phytochemical, proximate and mineral composition of leaf extracts of *Moringa oleifera* Lam. from Nsukka, South-Eastern Nigeria. IOSR J Pharm Biol Sci 2014;
21. Olumide MD, Ajayi OA and Akinboye OE: Comparative study of proximate, mineral and phytochemical analysis of the leaves of *Ocimum gratissimum*, *Vernonia amygdalina* and *Moringa oleifera*. J Med Plants Res 2019; 13(15): 351-6.
22. da S. Alves A, B. Teixeira EM, C. Oliveira G, Arantes-Pereira L, Oliveira CC and L. Costa L: Physicochemical characterization and antioxidant activity of decolorized *Moringa oleifera* Lam leaf flour. Nutrire 2017; 42(1): 31.
23. Okiki PA, Osibote IA, Balogun O, Oyinloye BE, Idris OO, Adelegan O, Asoso SO and Olagbemide PT: Evaluation of proximate, minerals, vitamins and phytochemical composition of *Moringa oleifera* Lam. cultivated in Ado Ekiti, Nigeria. Adv Biol Res 2015; 9(6): 436-43.
24. Harris GK and Marshall MR: Ash analysis. In: Food analysis. Springer; 2017; 287-97.
25. Djeneba C, Dembélé YK, Touré OB and Iknane AA: Caractérisation et composition biochimique et nutritionnelle du *Moringa oleifera* récolté dans le district de Bamako, Mali en 2020. Mali Santé Publiqu 2022; 5-13.
26. Hamata TW, Togola I and Sissoko L: Comparative study of phenolic compound contents and antioxidant potential of *Moringa oleifera* Lam. leaf extracts from the four climatic zones of Mali. Int J Biosci 2020; 17(3): 105-13.
27. Somé AA, Dabiré PA, Da FL, Sawadogo S, Ouédraogo M and Bayala B: The oral subacute toxicological activity of hydroalcoholic extract of *Moringa oleifera* Lam. (Moringaceae) growing in South West of Burkina Faso in Wistar Rats 2022; 11(16): 397-402.
28. Kasolo JN, Bimenya GS, Ojok L, Ochieng J and Ogwal-Okeng JW: Phytochemicals and uses of *Moringa oleifera* leaves in Ugandan Rural Communities 2010; 4(9): 753-7.
29. Patel P, Patel N, Patel D, Desai S and Meshram D: Phytochemical analysis and antifungal activity of *Moringa oleifera*. Int J Pharm Pharm Sci 2014; 6(5): 144-7.
30. Dragan S, Andrica F, Serban MC and Timar R: Polyphenols-rich natural products for treatment of diabetes. Curr Med Chem 2015; 22(1): 14-22.
31. Aryaeian N, Sedehi SK and Arablou T: Polyphenols and their effects on diabetes management: A review. Med J Islam Repub Iran 2017; 31: 134.
32. Nazaruk J and Borzym-Kluczyk M: The role of triterpenes in the management of diabetes mellitus and its complications. Phytochem Rev 2015; 14(4): 675-690.

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