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Kalaya Goumou
Department of Chemistry, Faculty of Natural Sciences, Julius Nyerere University of Kankan, PO Box: 209, Republic of Guinea

Abdoulaye Traoré
Department of Biology, Faculty of Natural Sciences, Julius Nyerere University of Kankan, PO Box: 209, Republic of Guinea

Nyanga Luopou Haba
Department of Biology, Faculty of Natural Sciences, Julius Nyerere University of Kankan, PO Box: 209, Republic of Guinea

Théophile Olayé
Department of Chemistry, Faculty of Natural Sciences, Julius Nyerere University of Kankan, PO Box: 209, Republic of Guinea

Gbato Martin Soumaoro
Department of Biology, Faculty of Natural Sciences, Julius Nyerere University of Kankan, PO Box: 209, Republic of Guinea

Mohamed Sahar Traoré
Guinea Institute for Research and Development of Medicinal and Food Plants, Phytochemistry Laboratory, Gamal Abdel Nasser University of Conakry, Republic of Guinea

Corresponding Author:
Kalaya Goumou
Department of Chemistry, Faculty of Natural Sciences, Julius Nyerere University of Kankan, PO Box: 209, Republic of Guinea

Ethnobotanical and phytochemical study of the leaves of *Clerodendrum umbellatum* Poir

Kalaya Goumou, Abdoulaye Traoré, Nyanga Luopou Haba, Théophile Olayé, Gbato Martin Soumaoro and Mohamed Sahar Traoré

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Abstract
Clerodendrum umbellatum Poir. is a plant belonging to the Lamiaceae family that is widely used in traditional Guinean medicine. The aim of this study is to evaluate the ethnopharmacological potential of the leaves of this plant. To achieve this, an ethnobotanical survey was conducted in four prefectures of Guinea. The leaves of this plant were then screened for phytochemicals. The results of the ethnobotanical survey showed that this plant is known and widely used in traditional Guinean medicine to treat abdominal pain, constipation, intestinal parasites, snake bites, painful periods, sexual weakness, insect bites, and bad breath. Phytochemical analysis revealed the presence of alkaloids, flavonoids, anthocyanins, catechin tannins, and triterpene saponosides, and the absence of anthraquinones and fatty acids.

Keywords: *Clerodendrum umbellatum*, ethnobotanical study, traditional healers, phytochemistry

1. Introduction
Throughout history and across the globe, the soothing properties of medicinal plants have contributed to maintaining human health. This ancestral empirical knowledge remains widely used by current generations despite the advances of modern medicine. The traditional use of medicinal plants is one of the subjects of ethnobotany, a scientific discipline whose term was coined by Harshberger in 1896 [1]. Plants offer excellent prospects for the discovery of new biologically active molecules. In developed countries, the popularity of so-called complementary or alternative medicine is fueled by concerns about the harmful effects of chemical drugs [2]. It has been assumed that if a drug is effective, it will have side effects. However, medicinal plants are generally considered safe and effective agents [3]. Interest in herbal preparations is growing worldwide. Among the sources of medicines, medicinal plants are paramount and remain an inexhaustible source of drugs for humankind and constitute invaluable resources for the pharmaceutical industry [4].
Plant resources play a significant role in the lives of populations. Current statistics from the World Health Organization (WHO) show that over 80% of African populations rely on traditional medicine and pharmacopoeia to address health issues. This interest in ethnomedicine stems from the availability and accessibility of medicinal plant resources in developing countries, given the 300,000 species found on Earth [5].
In Africa, the therapeutic power of plants was known empirically to ancestors and relatives, but the chemical composition of the medicines used daily by these numerous populations for their healthcare was unknown. Indeed, for most of these plants, the chemical compounds responsible for their reported biological activities, as well as their toxicity, remain unknown [5]. Enormous progress has already been made within the institutes. Multidisciplinary researchers are discovering new medicines in African plants every day. According to some studies by the Inter-African Pharmaceutical Association, "70% of medicines imported into Africa from Western countries can be replaced by traditional medicinal remedies with equivalent results" [6]. Guinea possesses a rich and varied plant life. Its flora constitutes a true symbiosis of African flora, reflecting the specific characteristics of each of its four natural regions (Lower Guinea, Middle Guinea, Upper Guinea, and Forest Guinea) [4]. Much work has been carried out in recent years to raise awareness of the potential of Guinean flora, but it is clear that despite the enormous efforts made, much remains to be done. Ethnobotanical and ethnomedicine investigations conducted in all natural regions of the country have identified a number of plants used to treat various ailments. Among the plants listed, *Clerodendrum umbellatum* Poir occupies a prominent place in the many therapeutic indications for which it is

used in traditional Guinean medicine. Therefore, the present study aims to evaluate the ethnopharmacological potential of the leaves of this plant.

2. Materials and Methods

2.1 Materials

2.1.1 Plant material

Leaves of *Clerodendrum umbellatum* constituted the plant material on which phytochemical analyses were performed. They were harvested in October 2021 from the botanical garden of the Institute for Research and Development of Medicinal and Food Plants of Guinea-Dubreka, transported to the Institute's botany laboratory, dried at ambient laboratory temperature, and then pulverized into a coarse powder. Botanical identification was carried out by the botany department of the Institute for Research and Development of Medicinal and Food Plants of Guinea-Dubreka (Guinea). A herbarium specimen has been deposited at the Institute's herbarium.

2.1.2 Chemicals

The chemicals used consist mainly of the following solvents and reagents: Water, methanol, chloroform, acetone, concentrated sulfuric acid, Bouchardat's reagent, Dragendorff's reagent, Mayer's reagent, neutral lead acetate, metallic zinc, potassium hydroxide, hydrochloric acid, ammonia, and ferric chloride.

2.2 Method

2.2.1 Ethnobotanical Survey Method

Ethnobotanical data were collected during an ethnobotanical survey conducted from October 2021 to August 2022 in the prefectures of Dubréka, Kankan, Lola, and N'zerekoré. Traditional healers were interviewed using a questionnaire. The questions concerned the healers' age, education level, status, method of acquiring the recipe, vernacular names, parts of the plant used, and methods of preparing and administering the remedies. This survey was based on an interactive method, which involved interviewing the traditional healers individually about their use of *Clerodendrum umbellatum*.

2.2.2 Determination of moisture content

A mass of 1.0018 g of leaf powder of *Clerodendrum umbellatum* was subjected to drying at 100 to 105 ° C for one hour in an oven. The weight loss upon drying was then determined [2].

The percentage of moisture content is determined by the following formula:

$$T\% = \frac{P1-P2}{Pe} X100$$

Hence;

- **T%**: percentage of moisture content,
- **P_1**: weight of the bottle and the drug before drying,
- **P_2**: weight of the bottle and the drug after drying,
- **P_e**: test socket.

2.2.3 Preparation of extracts for phytochemical screening

Chloroform extract

Five (5) grams of the plant material were macerated under magnetic stirring, at room temperature, for 2 hours, in 50 ml of chloroform. After filtration of the extract using Whatman paper, the filtrate was collected and used for the characterization of fatty acids, alkaloids, anthraquinones, and carotenoids.

Methanolic extract

Five (5) grams of the plant material were macerated under magnetic stirring, at room temperature, for 2 hours with 100 ml of methanol. The filtrate was used for the characterization of the following chemical groups: Coumarins, Flavonoids, and Leucoanthocyanins.

Aqueous extract

Five (5) grams of the plant material were macerated in 50 ml of distilled water at room temperature, under magnetic stirring for 2 hours. After filtration using Whatman filter paper, the filtrate was collected and used to characterize the saponins.

2.2.4 Chemical screening

The different phytochemical groups were identified from the chloroformic, methanolic and aqueous extracts, by color and precipitation tests [2].

Identification of fatty acids

To 5 mL of the chloroform solution, 5 mL of 1% KOH were added, and the mixture was stirred. To the alkaline aqueous solution, 3 mL of concentrated HCl and 3 mL of chloroform were added, followed by stirring and then filtration through filter paper. The presence of an oily spot indicates the presence of fatty acids.

Identification of alkaloids

To 10 ml of the chloroform solution, 1.5 ml of 2% HCl were added, and the mixture was stirred. After settling and decantation, the acidic aqueous solution was divided into four test tubes, one of which served as a control, while the reagents of Bouchardat, Dragendorff, and Mayer were added to the other three, respectively.

Bouchardat's reagent gives a brown precipitate, Dragendorff's reagent gives a red-orange precipitate and Mayer's reagent gives a white-yellow precipitate in the presence of alkaloids.

Identification of anthraquinones

NH_4OH solution or 1 ml of 10% KOH solution was added, and the mixture was stirred. A red coloration of the extract indicates the presence of free anthraquinone derivatives in oxidized form.

Identification of carotenoids

A few drops of concentrated sulfuric acid were added to 5 ml of the chloroform solution. The mixture was heated in a water bath for 30 minutes; a red coloration of the extract indicates the presence of these compounds.

Identification of flavonoids

Ten (10) ml of the methanolic solution were divided into five tubes, one of which served as a control, and then tests were carried out in the other four tubes by adding the following reagents:

- A few drops of 3% neutral Pb acetate; the appearance of a precipitate denotes the presence of flavonoids.
- A few drops of 1% FCl_3; the appearance of a precipitate denotes the presence of flavonoids.
- 1 ml of concentrated HCl with a piece of metallic Zn, heated for 30 minutes. In the presence of flavonoids, a yellow color is observed, which turns red.

- A few drops of 1% NaOH; the yellow color indicates the presence of flavonoids.

Identification of leucoanthocyanins

In a test tube, 0.5 ml of concentrated HCl was added to 5 ml of the methanolic extract; the mixture was heated in a water bath for 30 minutes. A reddish-purple color indicates the presence of leucoanthocyanins.

Identification of saponosides

- **Aphrogenic power:** Five (5) ml of the aqueous extract were placed in a test tube, vigorously shaken lengthwise, and left to stand for 30 minutes. Persistent foaming indicates the presence of saponins in the drug.
- **Test with 1% KOH:** In a test tube, 5 ml of the aqueous extract and a few drops of 1% KOH were mixed, then shaken for 10 seconds and left to stand for 15 minutes. The appearance of a persistent foam for 30 minutes indicates the presence of steroidal saponins.
- **Test with 1% HCl:** In a test tube, 5 ml of the aqueous extract and a few drops of 1% HCl were mixed and shaken for 10 seconds. The mixture was then left to stand for 15 minutes. Persistent foaming indicates the presence of triterpene saponins.

Tannin identification

In a test tube, 1 ml of water was added. After shaking, a few drops of 1% FCl_3 were added to this aqueous solution. A dark blue color indicates the presence of gallic tannins, dark green indicates the presence of catechins.

3. Results and discussion

3.1 Botanical Description

Clerodendrum umbellatum Poir. is a plant belonging to the family Lamiaceae or Labiatae (formerly Verbenaceae) [7]. The *Lamiaceae* are commonly called the Mint family of the order Lamiales, they They are a family of flowering plants in the order Lamiales, comprising annual or perennial herbs and shrubs with opposite leaves. The stem is mostly square, and the leaves, when crushed, release pleasant aromas. The *Lamiaceae family* includes 240 genera and over 7,000 taxa worldwide [8]. A climbing shrub with finely pubescent branches, measuring 0.2 to 3 m in height; the branches and twigs are tetragonal, medullous or hollow, puberulent, sometimes lenticellate, with leaf scars often raised [9, 10].

The leaves are decussate-opposite. The blades are oval, elliptic, or oblong, 4 to 13 cm long and 2 to 9 cm wide, with an obtuse or subcordate base, a shortly acuminate or acute apex, and an entire margin, depressed and punctate below. The midrib is puberulent, and the secondary veins are 5-7 pairs long. The lower veins are 1-2 pairs, palmately emerging from the base. The petioles are puberulent and 1-3 cm long. The axillary inflorescences are cymose, terminal panicles, 10-25 cm long and 12-24 cm wide. The individual cymes are severally branched [10].

The fragrant flowers are white and measure 5-11 cm long and 3-12 cm wide, with terminal, sub-umbellate panicles. The pubescent peduncles are 2.5-6 cm long; pedicels 5-15 mm long; bracts narrowly elliptic [10]. *Clerodendrum umbellatum* is an African species found in Ivory Coast, in the Gagnoa region among the Bété people, in Cameroon, Ethiopia, Sudan, Congo, Senegal, Mali, southeastern Kenya and Tanzania [3, 10, 11]. In Guinea, *Clerodendrum umbellatum* is found mainly in the regions of Lower Guinea and Forest Guinea.

3.2 Ethnobotanical Survey

3.2.1 Sociodemographic characteristics of traditional healers

Profile of traditional healers by gender and age

Thirty-seven (37) traditional healers were contacted, of whom 25 (68%) were men and 12 (32%) were women. This male predominance is explained by the fact that women are often occupied with housework. Their ages ranged from 24 to 81 years, with an average of 53.94 years. The results show that traditional healers aged between 41 and 60 years (17, 46%) were the most numerous, followed by those over 60 (13, 35%). Those under 41 years of age were rare (7, 19%). This scarcity of young people practicing traditional medicine is due to the gradual disappearance of initiation practices in sacred forests for men and traditional practices of female genital mutilation, which were once trusted places for the transmission of traditional secrets.

Profile of traditional healers according to ethnic group and level of education: The people surveyed belong to the following ethnic groups: Konon 26 (70%) who call the plant "Kaawanalaa", Manon 5 (14%) who call it "Mènèkènèlée", Soussou 4 (11%) who call it "Firiforèt", and Guerzé 2 (5%) who call it "Kaliwanalaa". The majority of the traditional healers contacted have a primary school education (16, 43%), followed by illiterate individuals (10, 27%), secondary school and university education (5, 14% each), and finally, high school education (1, 3%). The low level of education among the majority of healers is due to a lack of educational support, which is one of the characteristics of poverty.

Profile of traditional healers according to their status and method of acquisition of recipe

The traditional healers contacted consisted of 14 farmers (38%), 10 healers (27%), 7 others (19%), and 3 hunters and herbalists (8%) each. Of these informants, 2 (5%) were identified as professional healers, while the others practiced traditional medicine clandestinely.

The survey results showed that 18 (49%) of the traditional practitioners acquired knowledge of traditional medicine practice through inheritance, 14 (38%) from former patients, 4 (11%) through revelation and 1 (3%) through apprenticeship.

On the other hand, in Upper Guinea, two (2) women herbalists from the sogbè market in Kankan told us that *Clerodendrum umbellatum* is a plant unknown to the people of Kankan.

Table 1: Sociodemographic data of the respondents

Parameters	Category	Effective	Percentage
Gender	Man	25	68%
	Women	12	32%
Age	Under 41 years old	7	19%
	41-60 years old	17	46%
	Over 60 years old	13	35%
Level of education	Illiterate	10	27%

	Primary	16	43%
	College	5	14%
	High school	1	3%
	University	5	14%
Status of the traditional healers surveyed	Herbalist	3	8%
	Healer	10	28%
	Hunter	3	8%
	Farmer	14	38%
	Other	7	19%
Acquisition method	Former patient	14	38%
	Learning	1	3%
	Legacy	18	49%
	Revelation	4	11%
Locality	Dubréka	6	16%
	Kankan	1	3%
	Lola	29	78%
	N'zérékoré	1	3%

3.2.2 Information on the traditional use of the plant

Regarding information related to the traditional use of the plant, our survey reveals that 21 (57%) traditional healers use the decoction and 16 (43%) use the maceration of the leaves orally, topically, as a mouthwash and body wash, for intimate hygiene, and in rituals, to treat conditions such as abdominal pain, constipation, and intestinal parasites. These same uses were reported in an ethnomedicine survey conducted on *Clerodendrum umbellatum* in Kenya [12] and in the Democratic Republic of Congo [9]. It is also used to treat leukorrhea and vaginal itching. These results corroborate those obtained in Cameroon [7, 13, 14].

Finally, according to the traditional healers contacted, the leaves of *Clerodendrum umbellatum* are used to treat snake bites, painful periods, rumbling stomach, internal hemorrhoids, sexual weakness, insect bites, female infertility, lower abdominal pain, tooth decay, candidiasis, bad breath, headaches, galls, boils, wounds, and loss of appetite.

Table 2: Vernacular names and diseases treated by *Clerodendrum umbellatum*

Common names	Local languages	Ethnic number	Preparation method	Method of administration	Diseases treated	Treatment duration
Kaliwanalaa	Guerzé	2	Maceration	Oral	Abdominal pain	Until fully recovered.
Kaawanalaa	Konon	26	Decoction and Maceration	Oral, local application, mouthwash and body wash, intimate and ritual cleansing.	Snake bite, abdominal pain, painful period, leukorrhea, vaginal itching, intestinal parasites, rumbling stomach, constipation, internal hemorrhoids, sexual weakness, insect bite, female infertility, lower abdominal pain, tooth decay, candidiasis, headaches, scabies, boils and sores.	Two (2) days, Three (3) days, Four (4) days and Until fully healed.
Mènèkènèlée	Manon	5	Decoction and Maceration	Oral and local application.	Abdominal pain, painful periods, stomach rumbling, sexual weakness, and insect bites	One (1) day, Three (3) days and Until fully healed.
Firiforèt	Soussou	4	Decoction	Oral, topical application, mouthwash and body wash.	Scabies, bad breath, tooth decay, sores, headaches and loss of appetite.	Until fully recovered.

3.3 Moisture content: The permissible content in moisture in a drug for its proper preservation should hardly exceed 10% [15]. That of the leaves of *Clerodendrum umbellatum* is 8.2%, which will allow us to preserve it for a long time for later use.

Table 3: Moisture content of *Clerodendrum umbellatum* leaves

Test shot	Loss on drying	Moisture content
1.0018 g	0.0823 g	8.2%

3.4 Phytochemical screening: The results of phytochemical tests carried out on chloroformic, methanolic and aqueous extracts of *Clerodendrum umbellatum* are mentioned in the table below.

Table 4: Phytochemical screening results of *Clerodendrum umbellatum*

Secondary metabolites		Results	Extraction solvents
Carotenoids		-	Chloroform
Anthraquinones		-	
Alkaloids		+	
Fatty acids		-	
Flavonoids		+	Methanol
Anthocyanins		+	
Tannins	Gallic	-	
	Catechists	+	
Saponosides	steroidal core	-	Water
	triterpene-based	+	

Legend: (+) indicates presence; (-) indicates absence.

Phytochemical analysis of extracts from *Clerodendrum umbellatum leaves* revealed the presence of alkaloids, flavonoids, anthocyanins, catecholic tannins, and triterpene-ring saponins, and the absence of anthraquinones and fatty acids. These results are consistent with those obtained by other authors in Cameroon [13, 16]. However, authors [16] noted the presence of lipids in the n-hexane and ethyl acetate fractions. Phenolic compounds possess potent antimicrobial effects because they can degrade bacterial membranes, inhibit enzymes essential for DNA degradation, and disrupt energy production by bacteria. These properties allow them to combat many types of pathogens, even some resistant to conventional antibiotics. However, their effectiveness depends on their chemical structure, particularly the presence of hydroxyl groups and their oily nature, as well as the quantity used. Thanks to their different modes of action and their natural origin, they are excellent candidates for food safety and the development of new methods of infection control [17].

Alkaloids possess potent antibacterial, antifungal, and antiviral properties. Their action is based on the degradation of cell membranes, the inhibition of DNA and RNA synthesis, the prevention of protein synthesis, the inactivation of essential enzymes, and the blocking of mechanisms by which bacteria eliminate harmful substances. Thanks to their great structural diversity, they can act against a wide range of microorganisms, even those resistant to common drugs. This property makes them valuable for the development of new antibiotics and the improvement of existing ones, by targeting different mechanisms of action of microbes [18].

4. Conclusions

An ethnobotanical survey conducted in the prefectures of Dubréka, Kankan, Lola, and N'zerekoré revealed the various medicinal uses of *Clerodendrum umbellatum* within the communities. The leaves are used to treat ailments including abdominal pain, constipation, intestinal parasites, snakebites, painful menstruation, sexual weakness, insect bites, and bad breath. Phytochemical analysis showed that this plant contains a large number of secondary metabolites that may contribute to its effectiveness in combating various diseases.

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