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Ethnobotanical Study and Vulnerability of *Uvariodendron molundense* (Annonaceae) in Gbado-Lite City (Ubangi Eco-region), Democratic Republic of the Congo

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ABSTRACT

Democratic Republic of the Congo is a real reservoir of medicinal plants. These plants play a major role in the treatment of certain common pathologies in tropical regions. The aim of this study was to list the ethnomedical uses of *Uvariodendron molundense*, a medicinal and aromatic plant from the Ubangi ecoregion. The ethnobotanical survey was carried out in Gbado-Lite with 200 people using stratified probability sampling. The respondents were interviewed individually on the basis of free consent. The study revealed that the majority of respondents were men (72%) and had a secondary education (37%), followed respectively by illiterates (34%) and those with a primary education (28%), and finally, university graduates represented only 1% of the respondents. 83% of the respondents were farmers, while 79% of the respondents were married. The leaf is the most used organ (81%) followed by stem and root bark. *U. molundense* is used both as food and medicine. The plant treats eight diseases (pain, malaria, cold, hypertension, gastritis, infection, headache and rheumatism). The calculated value of the informant consensus factor is 0.96 and indicates that there is a high degree of consensus among informants regarding the use of *U. molundense* against these diseases in Gbado-Lite. Decoction is the most commonly used method of preparation (89%) and 50% of the respondents stated that the species is currently not very abundant, while 31% of the respondents felt that the plant was rare. The calculated value of the vulnerability index shows that *U. molundense* is very vulnerable in its natural environment (Iv > 2.5).

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1. Introduction

Democratic Republic of the Congo (DRC) is a real reservoir of medicinal plants. These play a major role in the treatment of certain common tropical diseases [1]. According to the WHO (World Health Organization), more than 80% of the populations in Africa in general and in the DRC in particular, use Traditional Medicine (TM) to solve the problem of primary health care [2,3]. The use of medicinal plants for various health problems is not only a choice, but is also reportedly linked to poverty and the high costs of modern medicines [4,5]. WHO defines TM as the sum of knowledge, skills and practices that are grounded in the theories, beliefs and experiences of a given culture and that are used to maintain human health or to prevent, diagnose, treat and cure disease [3]. Based on scientific evidence, research on renewed TM aims at the production and distribution of improved traditional medicines (ITMs) formulated from these medicinal plants in order to contribute to the achievement of MDGs 3 (health), 12 (sustainable consumption) and 15 (life on earth).

In recent years, a few studies on the ethnobotany of local wild medicinal and/or food plants have been carried out in Kinshasa and in the province of North-Ubangi in the DRC, including those by Masengo et al. [6,7], Ngbolua et al. [8], Ngbolua et al. [9]. It should be noted, however, that data specifically on aromatic medicinal plants remain very fragmentary. Thus, the present study was initiated with the aim of cataloguing the ethno-medical uses of an aromatic plant from the Ubangi ecoregion, *Uvariodendron molundense*. The specific objectives of this study are to determine the socio-demographic characteristics of the respondents (sex, age, level of education, profession, family situation) who use *U. molundense* in Gbado-Lite; to identify the most commonly used organs of the plant and the diseases treated, as well as the different ways in which medicinal recipes derived from the plant are prepared, and the population's perception of the frequency of use of the species over the last 10 years.

Thus, the documentation of local naturalist knowledge on *U. molundense* is essential because bio-resource management policies can only be sustainable if they integrate the social, cultural and economic values that local communities associate with them [6,7].
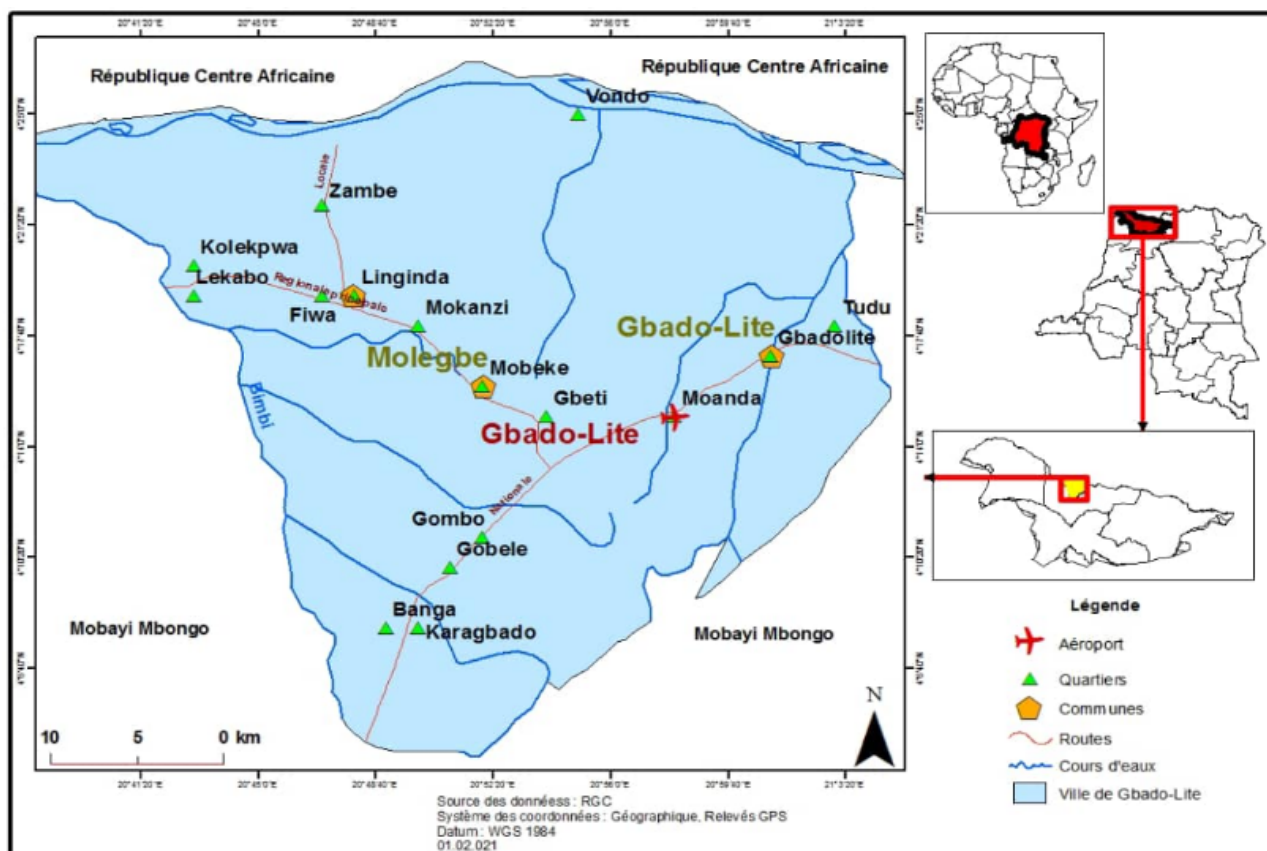
Figure 1. Geographical location of the town of Gbado-Lite and its surroundings (North Ubangi Province, Democratic Republic of Congo)

2. Materials and Methods

2.1 Study Area

The present study was carried out in Gbado-Lite (Latitude: 4° 16′ 41″ North; Longitude: 21° 00′ 18″ East; Altitude: 300-500 m above sea level). The town of Gbado-Lite (Figure 1) is located in the Ubangi eco-region, a subset of the *Northeastern Congolian lowland forests*. This eco-region is one of the 200 global priority terrestrial eco-regions known as the "G200". It has an area of 278 km² and an estimated population of 198,839 [10-15].

2.2 Methods

The ethnobotanical survey was conducted in Gbado-Lite city with 200 people using the stratified probability sampling method as previously described [1,6,7,16]. To collect the ethnobotanical data, this sample of 200 people was randomly drawn. The respondents were interviewed individually on the basis of a survey form. The main data collected were socio-demographic data (sex, age, socio-cultural group, level of education, occupation and marital status) and ethnobotanical data (vernacular name, part used, diseases treated, category of use and method of preparation of medicinal recipes, etc.). The survey was carried out according to the principles of the Helsinki Declaration (free consent of respondents, etc.) and in the local language (Lingala).

The vulnerability index was calculated according to the ECOFAC (Central African Forest Ecosystems) method based on the identification of a certain number of characteristics or constraints of the species, namely frequency of use (c_1), plant organ used (c_2), stage of plant development (c_3), mode of collection (c_4), pharmaceutical form (c_5), biotope (c_6), mode of diaspora dissemination (c_7), morphological types (c_8) and perceived abundance (c_9) [1].

3. Results and Discussion

The results of this study show that the majority of respondents are men (72% vs. 28% of women). The majority of respondents had a secondary education (37%), followed respectively by illiterates (34%) and those with a primary education (28%), and finally, university graduates represented only 1% of the respondents. 83% of respondents were farmers. They are followed respectively by students (10%), civil servants (5%) and teachers (2%). 79% of the respondents were married compared to 21% who were single.

Table 1 gives the socio-demographic parameters of the respondents.

The fact that the main activity of the respondents is

**Table 1.** Socio-demographic parameters of respondents

Socio demographic paremeters	Number	Frequency (%)
1. Sex		
Male	144	72
Female	56	28
Total	200	100
2. Age		
18-35 years	70	35
36-50 years	70	35
>50 years	60	30
Total	200	100
3. Education level		
Primary	56	28
Secondary	74	37
Universitary	2	1
Illiteracy	68	34
Total	200	100
4. Profession		
Farmers	166	83
Elèves	20	10
Teachers	4	2
Civil servants	10	5
Total	200	100
5. Marital status		
Single	42	21
Married	158	79
Total	200	100

traditional slash-and-burn agriculture can have a negative impact on the environment, particularly forest ecosystems. Indeed, it has been shown that the practice of traditional slash-and-burn agriculture in the province of North Ubangi in DRC is the main cause of deforestation and forest degradation. The latter are converted into agricultural space leading to the disappearance of forest and non-timber products (NTFPs) that generate income for poor households in the town of Gbado-Lite [17]. This is why it is essential to extend agricultural activity to the domestication of NTFPs in order to develop reasoned, multifunctional and sustainable peasant agriculture and thus ensure the resilience of the population in the face of current changes.

The education level of the population has a very significant impact on the adoption of innovations and/or the transfer of knowledge and technology to increase productivity in all sectors of activity and in decision making [18]. The present study reveals that the majority of the respondents have a secondary education. This justifies the need to strengthen their capacity in NTFP management. Thus, agro-ecology, defined as the science of natural resource

management for the benefit of the poorest people facing an unfavorable environment, is a discipline to be developed and popularized in North Ubangi Province [19].

Figure 2 shows the different vegetative organs (parts) used in the plant.
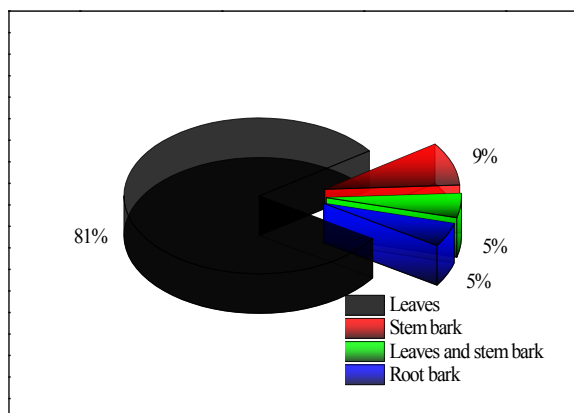

Figure 2. Different used vegetative organs (parts) of the plant

The Figure 2 shows that the most commonly used part of the plant is the leaf (81%), followed by stem bark (9%), leaves and stem bark and root bark (5% each).

These results corroborate those found by [9,20,21]. The use of these organs is justified by the simple fact that they are rich in bioactive secondary metabolites that give the plant its therapeutic virtues. It should be noted, however, that harvesting practices such as debarking and uprooting of plants are dangerous as they prevent the plant from reaching flowering, promote infections and are the cause of the threat of species extinction [22]. Similarly, stem removal is an ecologically unsustainable practice that results in the immediate loss of the medicinal plant taxon.

Figure 3 shows the categories of use of the plant.
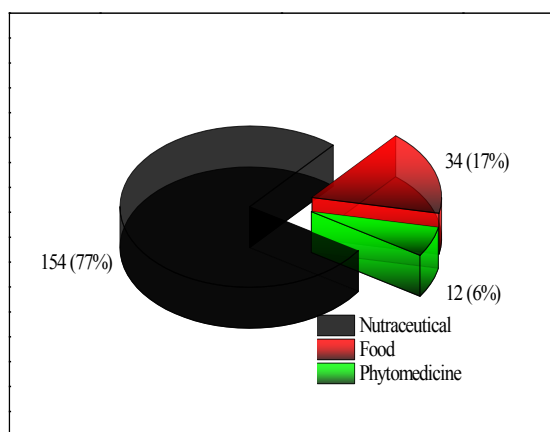
Figure 3. Categories of use of the plant

Figure 3 shows that the plant *Uvariodendron molundense* is a nutraceutial, i.e. it is used as both food and medicine.

It is thus well known that in tropical Africa, wild medicinal plants are the most exploited resources in rural areas [23,24,25]. However, these plants are increasingly being abandoned by the local population in favor of so-called exotic plants, mainly due to their scarcity, but also their lack of knowledge and the absence of scientific evidence on their toxicity and other pharmaco-biological evidence [8].

However, wild plants are currently of great importance in nutritherapy due to their medicinal and nutritive properties. In a study on the evaluation of the chemical composition and bioactivity of *U. molundense* against sickle cell disease and associated bacterial pathogens, the results revealed that the leaves and stem bark contain various secondary metabolites (total phenols, flavonoids, anthocyanins, tannins, quinones, saponins, alkaloids, steroids, terpenoids and leucoanthocyanins) and are endowed with anti-sickle cell activity in vitro. At 100 μg/mL, the normalization rate was 89% for the total organic acid extract (ED50 = 0.391 μg/mL) and 82% for the anthocyanin extract (ED50 = 0.659 μg/mL). The antibacterial activity of the tested extracts was very good against *Staphyloccocus areus* (MIC ≤ 31.25 μg/mL) whereas, for *Escherichia coli*, only the extraction of total organic acids presented an interesting activity (MIC = 31.25 μg/mL) [26]. Thus, despite its nutritional properties, this plant can be useful for sickle cell patients.

Figure 4 shows the frequency of diseases treated by the plant *Uvariodendron molundense*.

The figure shows that this plant cures eight diseases, of which pain, malaria and colds are the most frequently cited, followed by hypertension and gastritis, infection, headaches and rheumatism respectively.

The calculated value of the informant consensus factor (number of citations Nr minus number of diseases treated Na divided by number of citations Nr minus 1) [1] is 0.96 and indicates that there is a high consensus among informants regarding the use of *U. molundense* against these diseases in Gbado-Lite city. Indeed, according to the WHO (World Health Organization), more than 80% of the population in Africa and other poor regions of the world rely on traditional medicine for the treatment of common diseases [4,5].

Figure 5 shows the different modes of preparing the plant. The figure shows that decoction is the most commonly used preparation method (89%), while expression accounts for only 11%. Either processes or modes of preparation are also reported by Masunda et *al.* [27] in Central Kongo Province, Ngbolua et *al.* [9,20,21] in Kinshasa. Decoction is most commonly used as an oral drink (per os). Consumption is often done in a fresh state so as not to alter the properties of the bioactive molecules.

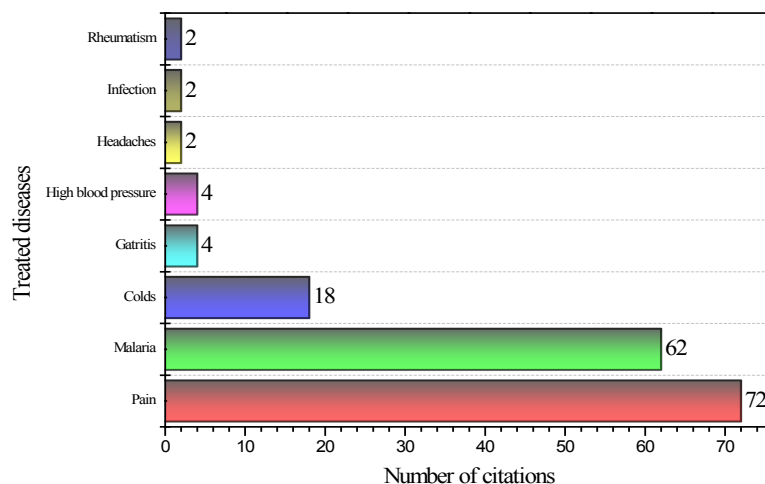Figure 6 gives the population's perception of the fre-

Figure 4. Diseases treated by the plant *Uvariodendron molundense*

quency of the species over the last 10 years.

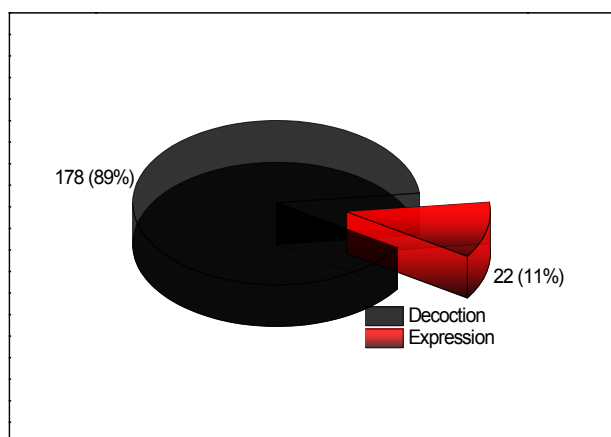With regard to the population's perception of the frequency of the species, the majority of respondents stated that the species is not very abundant (50%), while 31% of respondents considered the plant to be rare, compared to 19% who thought that it was abundant.

According to the work of Mongeke et *al.* [28], medicinal plant genetic resources constitute goods for humanity and require sustainable management with a view to their valorization according to the principle of access and benefit sharing (ABS). Indeed, these bio-resources are sources of natural bioactive substances that can be used as hit molecules or for the development of standardized phyto-drugs that are less costly and easily accessible to the population. Hence the need for participatory management, a strategy to combine socio-economic development and nature conservation, in order to prevent the erosion of biodiversity and limit the impact of agriculture on the environment [29].

The vulnerability index of *Uvariodendron molundense* is given in Table 2 below.

Figure 5. Different methods of preparation of plant-based recipes

Table 2. Vulnerability index of *U. molundense*

	Characteristics	Vulnerability level
C1	Frequency of use (**100% of respondents**)	3
C2	Plant organ (**leaves, bark, stem and roots**)	3
C3	Developmental stage (**Adult**)	2
C4	Collection (**Gathering**)	3
C5	Pharmaceutical form (Decoction)	3
C6	Biotope (**Forest**)	3
C7	Mode of dissemination of diaspores (**Sarcochorie**)	3
C8	Morphological type (**Tree**)	2
C9	Abondance (**Low**)	3
	Vulnerability index (Iv)	**2,78**

Legend: Level 1: Low vulnerability, Level 2: Medium vulnerability, Level 3: High [1].

Figure 6. People's perception of the frequency of the species

The calculated vulnerability index value according to

ECOFAC shows that *U. molundense* is very vulnerable (Iv > 2.5) in its natural environment because of its frequency of use and the parts used, its mode of collection by the local population, its pharmaceutical form, its biotope and the mode of dissemination of its diaspores as well as its low abundance in the environment. There is therefore reason to fear the disappearance of *U. molundense* in the wild if no conservation measures are taken in the short term. Indeed, the results of this study indicate that *U. molundense* is a wild food plant with a diversity of uses in Traditional Medicine. Moreover, this plant genetic resource is essentially a product of gathering. Hence, the need for its domestication from a wealth creation perspective as the available data on the properties makes this plant a raw material for the development of a bio-pharmaceutical industry.

Indeed, Traditional Medicine occupies a key position in the management of both urban and rural diseases in Africa [4,5]. To this end, the domestication of this bioactive medicinal plant can be a strategy to reduce human pressure on natural forests while improving the lives of communities through the creation of a productive ecosystem through the ecological rehabilitation/restoration of degraded peri-urban ecosystems.

4. Conclusions and Suggestions

The aim of this study was to identify the ethno-medical uses of *U. molundense* in Gbado-Lite with a view to its development according to the principle of access and benefit sharing. This study shows that:

o The majority of respondents is men (72%) and has a secondary education (37%);

o 83% of respondents are farmers while 79% of respondents are married;

o The leaf is the most used organ (81%) followed by stem and root barks;

o *U. molundense* treats pain, malaria, colds, hypertension, gastritis, infections, headaches and rheumatism;

o The calculated value of the informant consensus factor is 0.96;

o Decoction is the most used preparation method (89%);

o *U. molundense* is very vulnerable in its natural environment *(Iv > 2.5)*.

It is therefore desirable that further research be carried out to gain a better understanding of the ecology, phytochemistry, pharmaco-biological, toxicological and nutritional properties of this plant species and its domestication in North Ubangi.

Acknowledgements

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