

Contribution to the ethnobotanical study and uses in the traditional pharmacopoeia of Kinkéliba (*Combretum micranthum* G. Don) in Mauritania

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Abstract

This study, conducted nationwide in Mauritania, aims to identify the knowledge and uses of *Combretum micranthum* G. Don in traditional pharmacopoeia, particularly for treating human and animal diseases. The methodology employed consisted of surveys conducted through questionnaires between January 2023 and December 2024. These questionnaires contained targeted questions and gathered responses from 200 people, including 29% women and 71% men. The results show that *C. micranthum* is widely known (95% of participants), especially for its therapeutic uses (61.5%). The plant is used to treat human ailments such as hypertension (43%), diabetes (21.5%), facility digestive issues (18.5%), constipation and toothaches (5.5%), paludism (3.0%), and dysentery (1.0%) etc. It is also used to treat animals, addressing issues such as digestive disorders (26.5%), fever (15.0%), diarrhea (10.0%), and wounds (2.5%), although nearly half of the participants are unaware of these uses. The leaves of the plant (70%) are the most commonly used parts, followed by the fruits (16%), the whole plant (7%), flowers (4.5%), roots (3%), and bark (1.5%). The most common methods of administration are decoction (43.5%), infusion (37.5%), external application (8%), inhalation (7.5%), and maceration (3.5%). A concerning point is that 88% of participants are unaware of the potential toxicity of the plant, which could pose risks if misused. The informant consensus factor for human and animal diseases shows that hypertension and digestive disorders have the highest values, respectively at 0.88 and 0.94. In terms of fidelity, the use of human diseases reaches 78.18%, primarily for hypertension, while for animal diseases, the fidelity levels range from 50% to 100% for digestive disorders, fever, and diarrhea. This study highlights the importance of the plant in traditional medicine while emphasizing the need to raise awareness about the risks associated with its use.

Keywords: ethnopharmacology; medicinal plants; phytochemical risk; traditional knowledge

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Introduction

In 1895, the American botanist J.W. Harshberger first proposed the term 'ethnobotany' to describe the study of plant uses among Indigenous peoples (Chavda *et al.*, 2022). However, ethnobotany is the study of the relationships between humans and plants, including those used as food, medicine, and for other economic applications (Ram *et al.*, 2004). Moreover, ethnobotanical studies are useful for identifying, disseminating, and documenting indigenous knowledge and the application of plant diversity for human and animal diseases (Martin, 1995). It plays a fundamental role in understanding traditional health systems, particularly in societies where local knowledge and ancestral practices are still widely used (Ram *et al.*, 2004).

Traditional medicine is the primary source of treatment for human and animal diseases, still playing a crucial role in meeting basic health needs in developing countries (Amenu, 2007). This is due to the fact that the use of medicinal plants is much cheaper than modern public health services and is culturally linked to tradition (Hunde *et al.*, 2006). The use of traditional and complementary medicine is increasing in many developed and developing countries. According to the World Health Organization, traditional remedies are the most important and sometimes the only source of treatments for nearly 80% of the global population (WHO, 2019). For example, about 85% of the world's population uses plant-based medicines for the prevention and treatment of diseases, and the demand is increasing in both developed and developing countries (Abera, 2014; Tefera and Kim, 2019). In South Asia, about 500 million people are reported to seek health security from plants (Demisse, 2001).

Like most African rural communities, local populations have limited access to healthcare services and often rely on traditional medical practices and medicinal plants for most of their healthcare needs. From prehistoric times to the present day, medicinal plants have remained the cornerstone of traditional herbal medicine among rural communities worldwide (Doughari, 2012) for the prevention and treatment of various diseases (Ogbole *et al.*, 2010). Approximately 80% of the African population depends on traditional medicine for primary healthcare (WHO, 2019). Several ethnomedicinal surveys have been conducted globally on the traditional uses of plant species as a starting point for plant-derived products (Chikowe *et al.*, 2020). Based on these surveys, it has been reported that traditional herbs provide a remarkable reservoir of active ingredients used in approximately 25% of all current Western medical therapies. More than 50% of the top 25 best-selling drugs in the world are directly linked to natural products (Chisamile *et al.*, 2023). There is no doubt that Africa is endowed with a vast diversity of plant species, which are of both economic and medicinal. However, the growing market and public demand for herbal medicine pose a significant risk, as many medicinal plants are now facing either continuous scarcity or imminent extinction (Sonibare and Abegunde, 2012).

Traditional medicine in Mauritania faces sustainability challenges due to species disappearance, climate change, and the erosion of traditional knowledge. The diversity of medicinal plants has significantly decreased due to several factors, including environmental degradation, agricultural expansion, loss of forests and woodlands, overgrazing, deforestation, and urbanization, which represent the main threats to medicinal plants in Mauritania. In Mauritania, the use of medicinal plants is a valuable heritage passed down through generations. Over time, humans have learned to harness the benefits of plants, which provide the necessary elements to prevent, treat, or cure diseases (Welch, 2010; Tine *et al.*, 2024). These ancestral practices have allowed human traditions to develop profound knowledge about the properties and uses of medicinal plants. Among the many plants used in this context, *Combretum micranthum* G. Don (family *Combretaceae*) stands out for its therapeutic virtues. This plant is commonly used in the traditional Mauritanian pharmacopoeia due to its diverse medicinal properties, including for treating hypertension, diabetes, and digestive disorders. However, despite its popularity, knowledge regarding its use and management in local practices remains insufficiently documented and underexplored.

This study therefore aims to fill this gap by providing an in-depth analysis of the use of *C. micranthum* in traditional medicine in Mauritania. It seeks to identify the various therapeutic applications of this plant by collecting ancestral knowledge within local communities. The main objective is to contribute to a better

understanding of the importance of *C. micranthum* in the traditional Mauritanian pharmacopoeia by documenting its uses for treating both human and animal diseases.

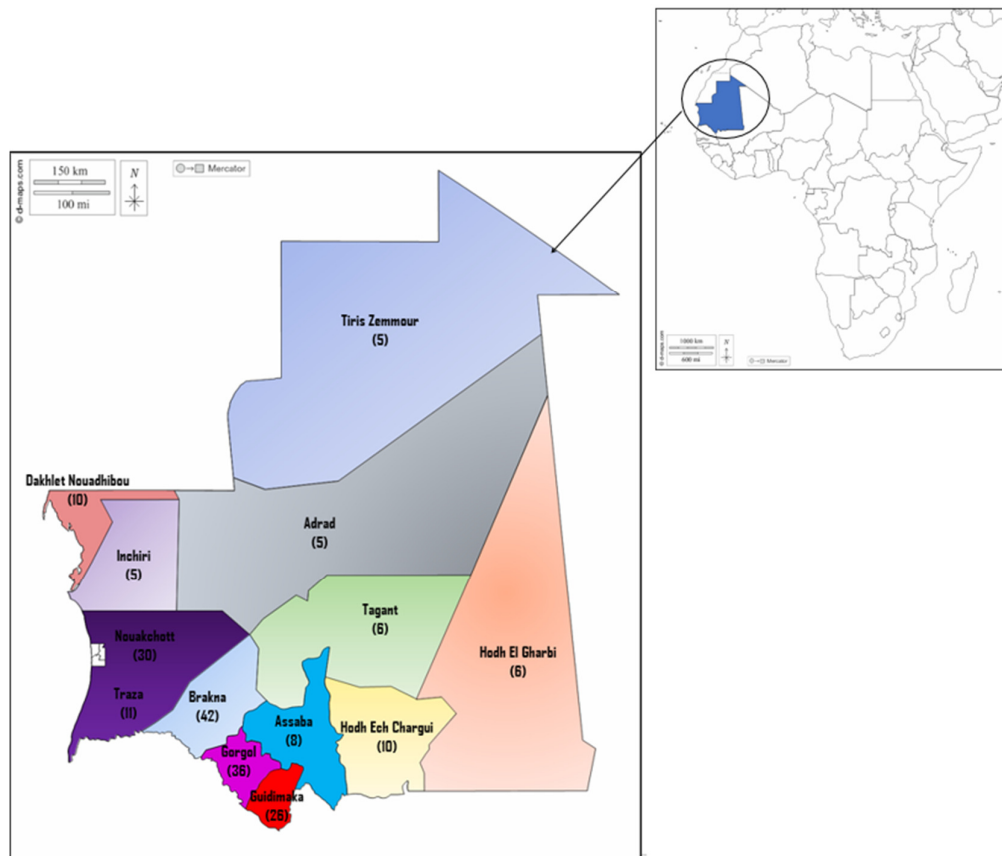


Figure 1. Geographical location of the Mauritania region and number of participants

General information on C. micranthum

C. micranthum, locally known as “Kinkéliba”, is a species from the Combretaceae family, with a geographic distribution extending across the Sahelo-Sudanian regions of West Africa (Amani *et al.*, 2015). It is a shrub with entire, oval, opposite or whorled leaves and small white flowers arranged in inflorescences (Figure 2). This species contains 155 organic compounds, including 34 flavonoids, 16 phenolic acids, 14 alkaloids, 15 fatty acids, 14 terpenoids/steroids, 24 amino acids, 8 carbohydrate substances, and 30 other organic compounds (Tine *et al.*, 2024). It is this richness in its biochemical composition that gives it several pharmacological properties.

Materials and Methods

Data collection (the questionnaire)

In order to gather information on the therapeutic use of *C. micranthum* for treating diseases in both humans and animals, an ethnobotanical survey was conducted using structured questionnaires between January 19, 2023, and December 24, 2024. A total of 200 participants were randomly selected from 13 regions of Mauritania, including Brakna, Gorgol, Guidimaka, Nouakchott, Trarza, Dakhlet Nouadhibou, Hodh Ech Chargui, Assaba, Hodh El Gharbi, Tagant, Tiris Zemmour, Adrar, and

Inchiri. The pre-established questionnaire included specific questions regarding: the participant's name, age group, gender, education level, region of origin, purpose of plant use, therapeutic applications for human and animal diseases, mode of administration, parts of the plant used, and potential toxic effects. Data were collected from 200 individuals aged between 15 and 65 years, including 142 women and 58 men.

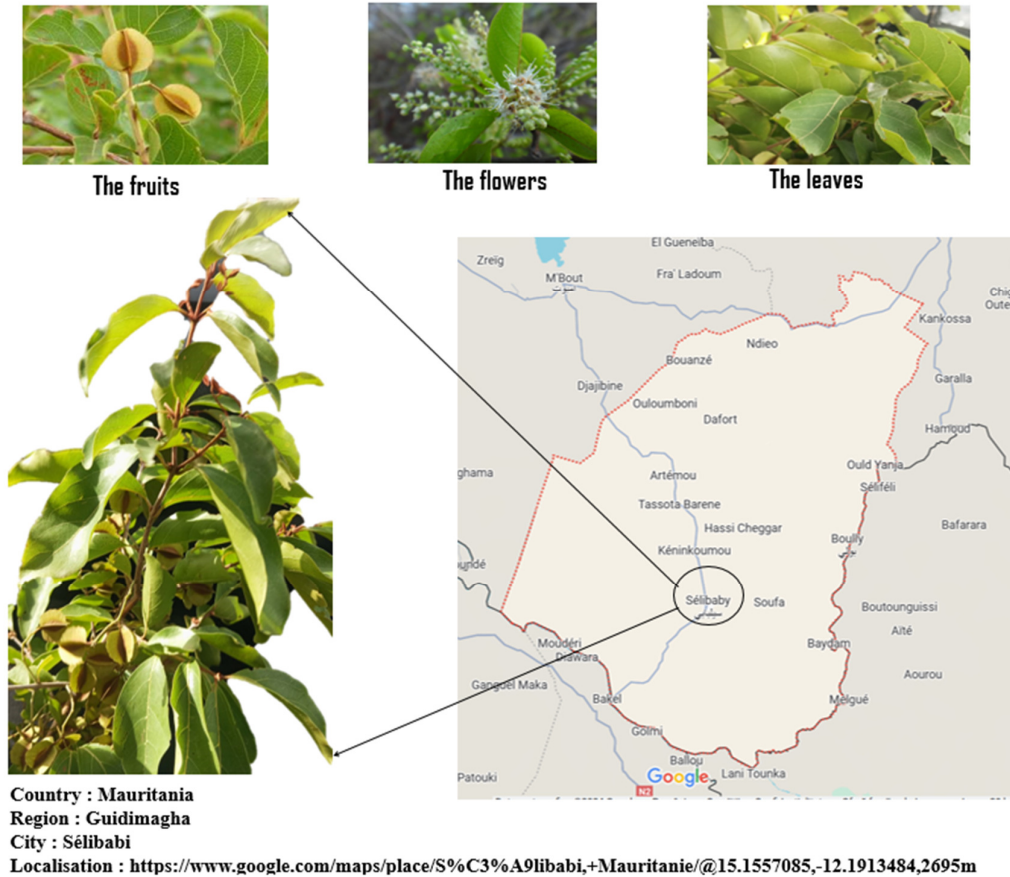


Figure 2. *C. micranthum* identified and harvested at Sélibabi in Mauritania

Data analysis

The data recorded on the survey forms were processed in Excel. Simple descriptive statistics methods were used to analyze the data. Quantitative variables are described using percentages.

Informant Consensus Factor (ICF):

This value was calculated to assess the degree of homogeneity in knowledge among participants in the study area regarding the use of plants as remedies for diseases. The ICF was calculated using the following formula (Mootoosamy and Mahomoodally, 2014)

ICF calculated as follows: $ICF = (Nur - Nt) / (Nur - 1)$

Nur: Number of use report for a category; Nt: Total number of plants used for that specific category of use by all informants.

ICF ranges from 0 to 1. A high ICF value, close to 1, indicates a strong consensus among informants regarding the use of a plant for a specific category of disease. Conversely, a low ICF value, close to 0, indicates a low consensus (Lara Reimers *et al.*, 2019).

Fidelity Level (FL)

It represents the percentage of informants declaring the use of a specific plant for the same primary purpose, which can be calculated as follows:

$$FL = N_p / N \times 100$$

N_p : is the number of informants stating the use of a plant species for a particular purpose; N : is the total number of usage reports for that specific purpose

A high FL value indicates a high frequency of use of plant species to treat a particular category of ailment by informants in the study area. It is interesting to determine the ideal species used to treat a specific disease category (Mechaala *et al.*, 2022).

Results

Age groups

The most frequently encountered age group is 25 to 35 years, which represents 44.0% of the studied sample. This is followed by individuals aged 15 to 25 years, making up 36.5%. The next age group is 35 to 45 years, with 9.0% of individuals. The age groups 45 to 55 years and 55 to 65 years rank fourth, each representing 5.0% of the analyzed population. Figure 3 highlights the respondents in the different age groups, as well as the corresponding citation frequencies.

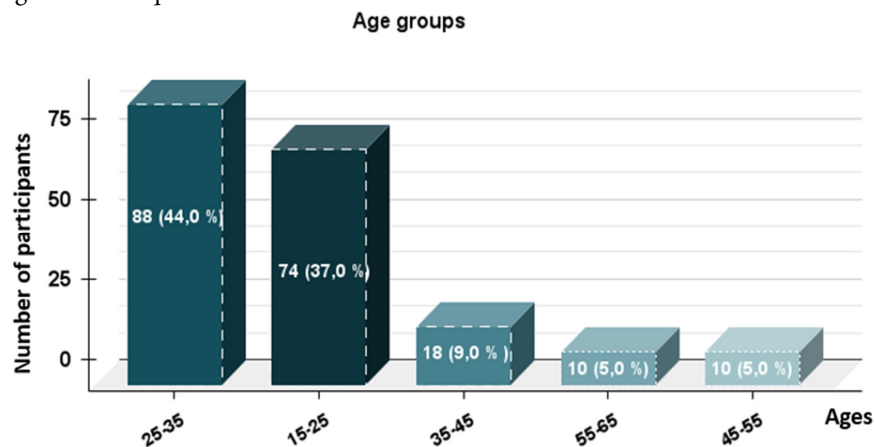


Figure 3. Profile of respondents by age group

Sex

It appears that in the surveyed population, men are more numerous, with 142 individuals, representing 71.0%, while women, fewer in number with 58 individuals, account for 29.0% (Figure 4).

Education levels

Regarding the education levels of the interviewed individuals, both religion and modern schools represent the majority of the surveyed sample, with 55.0%, followed by individuals who attended modern schools at 29.0%, then illiterate individuals at 12.0%, and finally, those who attended Quranic schools, representing 3.0% (Figure 5).

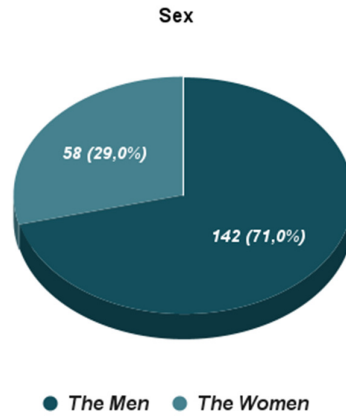


Figure 4. Distribution of the studied population by gender

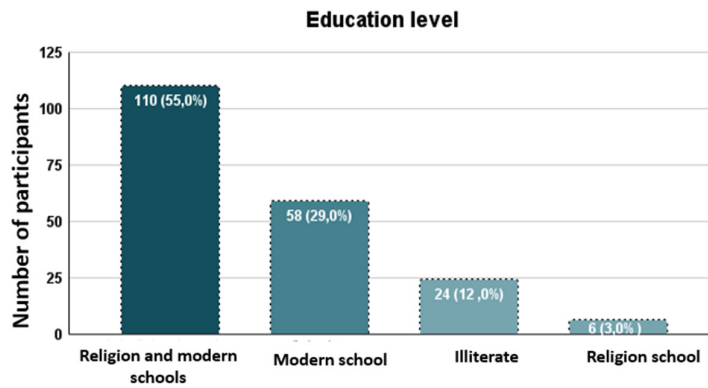


Figure 5. Profile of the surveyed individuals by education level

Plant knowledge C. micranthum

The plant is widely recognized by the majority of the population, with 95% of respondents from all regions of Mauritania being familiar with it. In contrast, only 5% of the respondents have not heard of it (Figure 6).

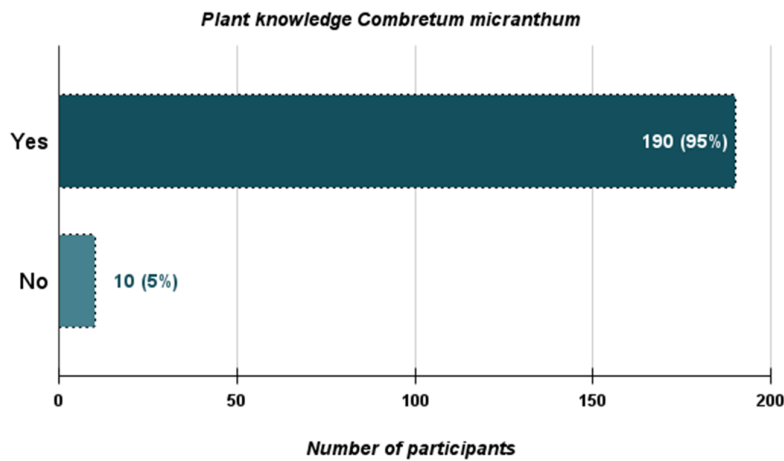


Figure 6. Knowledge of *C. micranthum* in different regions of Mauritania

Participants from different regions of Mauritania

A total of 200 people were surveyed across different regions of the country. Among them, 21% are from the Brakna region, 18% from Gorgol, 13% from Guidimakha, 15% from Nouakchott, 5.5% from the Trarza region, 5% from the Dakhlet Nouadhibou and Hodh Ech Chargui regions, 4% from Assaba, 3% from the Hodh Ech Gharbi and Tagant regions, and finally, 2.5% from the Tiris Zemmour, Adrar, and Inchiri regions (Figure 7).

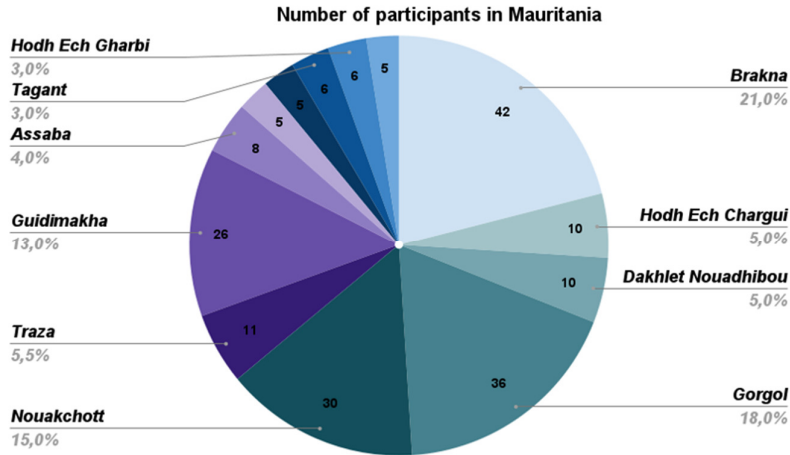


Figure 7. Survey participants in the various regions of Mauritania

Objective of C. micranthum plant use

Among the 200 responses, 61.5% report using it for therapeutic purposes, 24% use it to prepare tea, and 14% use it both for therapeutic purposes and for tea (Figure 8).

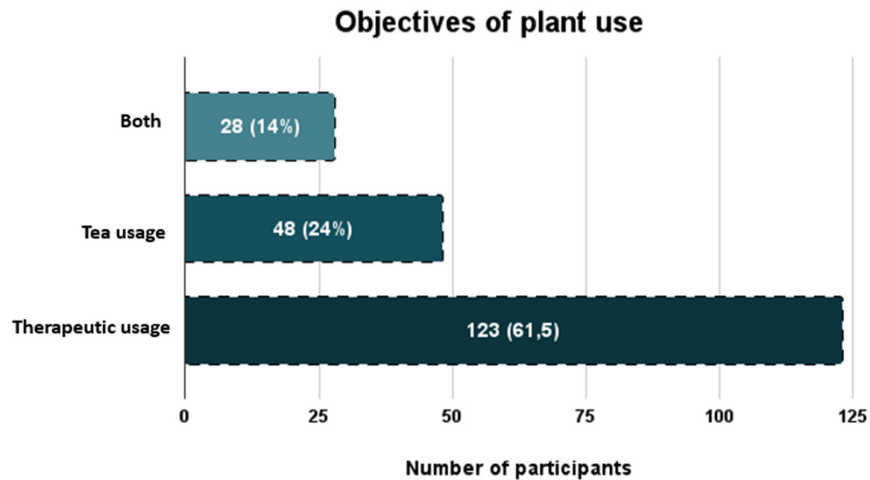


Figure 8. Objectives of using *C. micranthum*

Treatments of animal diseases in traditional pharmacopoeia

The most frequently treated diseases with *C. micranthum* are digestive disorders, according to 26.5% of the respondents, followed by fever (15.0%), diarrhea (10.0%), and wounds (2.5%) (Fig. 7). Additionally, 46.0% of the participants are unaware that *C. micranthum* is used to treat animal diseases (Figure 9).

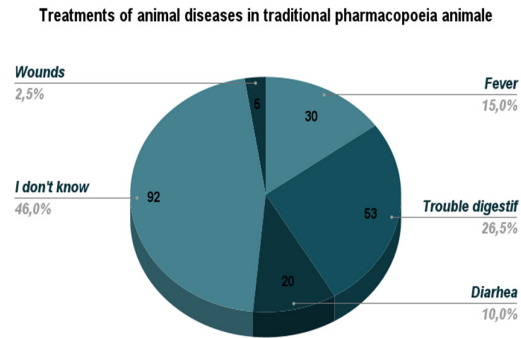


Figure 9. Animal diseases are treated with *C. micranthum*

Treatments human disease in traditional pharmacopoeia

The results of the ethnobotanical surveys, it appears that *C. micranthum* is used in the treatment of human diseases by all the respondents. The most frequently treated human diseases are hypertension (43.0%), followed by diabetes (21.5%), aiding digestion (18.5%), constipation and toothaches (5.5%), paludism treatment (3.0%), and dysentery (1.0%). Anti-inflammatory, antibacterial treatments, digestive pathologies, and obesity are less represented, with only 0.5% (Figure 10).

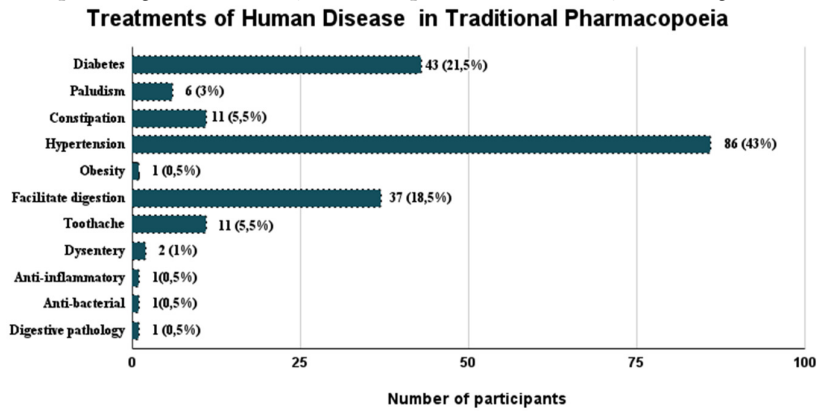


Figure 10. Types of human diseases treated with *C. micranthum*

Parts used of plant

The plant parts used to treat animal and human diseases are mainly leaves, cited in 70% of cases, followed by fruits (16%). The whole plant is used in (7%) of cases, flowers represent (4.5%), roots (3%), and barks (1.5) are also used 1%, although less commonly, to treat animals and humans in Mauritania (Figure 11).

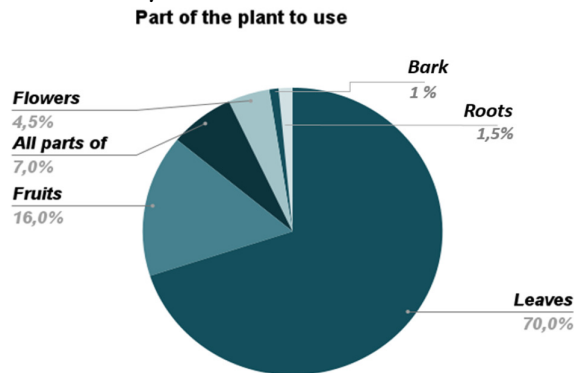


Figure 11. Frequency of use of plant parts in treatment

Preparation method and administration mode

The most used modes of administration are decoction (43.5%), followed by infusion (37.5%), external application (8%), inhalation of the powder (7.5%), and finally maceration (3.5%) (Figure 12).

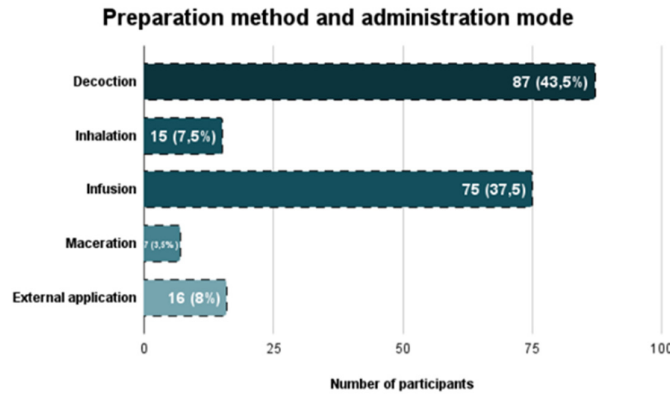


Figure 12. Frequency of methods preparation of plants

Dose and duration of use

C. micranthum is used one-two times a day by 57.9% of the study population; 24.1% use it two or more times a week; 16.4% two or more times a month, and 1.5% of the population use it rarely (Figure 13).

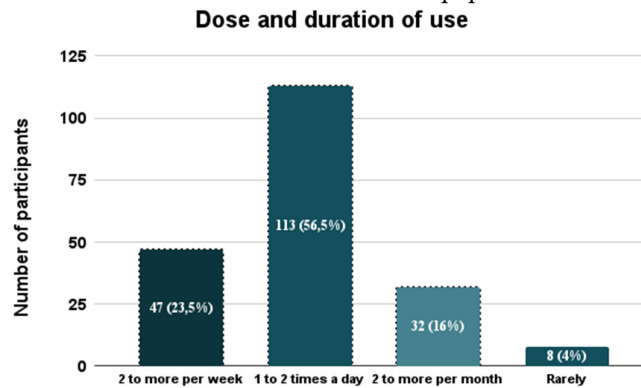


Figure 13. Dose and duration of use

Plant toxicity

Of the 200 responses, 88% were unaware of *C. micranthum* toxicity, while 12% were aware of its toxic effects (Figure 14).

Knowledge of plant toxicity

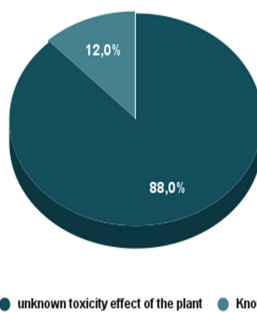


Figure 14. The percentage of people who are unaware of toxic effects

Informant Consensus Factor (ICF)

The ICF calculated for the category of human diseases shows that hypertension has the highest value at 0.88, followed by diabetes at 0.76, and digestion facilitation at 0.72 (Table 1). On the other hand, for the category of animal diseases, digestive disorders have a value of 0.94, followed by fever at 0.89, wounds at 0.84, and finally diarrhea with a value of 0.40 (Table 2).

Table 1. Informal consensus factor and fidelity level for the use of *C. micranthum* in the treatment of human disease

Plant	Use for the treatment of human diseases	ICF	FL (%)
<i>C. micranthum</i>	Hypertension	0.88	78.18
	Diabetes	0.76	39.09
	Facilite digestion	0.72	33.63
	Consipation	0	10
	Toothaches	0	10
	Paludism	-	5.4
	Dysentery	-	1.81
	Antiinflammatory	-	0.90
	Antibacterian	-	0.90
	Pathology digestiv	-	0.90
	Obesity	-	0.90

Fidelity Level (FL)

Regarding this index, we placed particular importance on uses in human and animal diseases with a fidelity level of 50% or higher. However, only the use of human diseases showed a fidelity level of 78.18%, recorded for hypertension, followed by diabetes (FL = 39.09%), then digestion facilitation (FL = 33.63%), (Table 1). On the other hand, three uses in animal diseases showed a fidelity level of 100%, recorded for digestive disorders, followed by fever (FL = 75%) and diarrhea (FL = 50%) (Table 2).

Table 2. Informal consensus factor and fidelity level for the use of *Co. micranthum* in the treatment of animal disease

Plant	Use for the treatment of animal diseases	ICF	FL (%)
<i>C. micranthum</i>	trouble digestive	0.94	100
	fever	0.89	75
	wounds	0.84	50
	diarrhea	0.4	15

Discussions

This study, focusing on the knowledge and uses of *C. micranthum* in the traditional pharmacopoeia of Mauritania, led to several findings. A total of 200 people were surveyed across various regions of the country. Among them, 21% are from the Brakna region, 18% from the Gorgol region, 13% from the Guidimakha region, 15% from the Nouakchott region, 5.5% from the Trarza region, 5% from the Dakhlet Nouadhibou and Hodh Ech Chargui regions, 4% from the Assaba region, 3% from the Hodh Ech Gharbi and Tagant regions, and finally, 2.5% from the Tiris Zemmour, Adrar, and Inchiri regions. Of the participants, 71% are men and 29% are women. These results regarding gender differences contrast with a previous study conducted by (Hama *et al.*, 2019). This imbalance could be due to a bias in the selection of participants or differences in the involvement of men and women in the collection or use of *C. micranthum*. It would be interesting to explore

the underlying reasons for this difference, whether due to cultural practices or access to information and resources about the plant.

Regarding the age groups, those aged 25 to 35 years and 15 to 25 years are the most represented, with 44.0% and 36.5% of the studied sample, respectively, showing a predominance of young adults. This could be related to several factors: these groups are often more involved in traditional practices or popular uses of medicinal plants, particularly for preventive or therapeutic health reasons. This trend may also indicate that young adults are more open to using alternative treatments such as *C. micranthum*. Older age groups (35-65 years) represent a smaller proportion of the sample, which could suggest that traditional practices, although still present, are less aligned with older generations. This may be due to changes in health behaviors over generations, with a greater reliance on modern medicine. These results confirm previous studies (Mehdioui and Kahouadji, 2007).

Regarding the level of education, individuals who attended both Quranic and modern schools represent the majority, with 55%, suggesting a certain level of modern or religious education among the studied population. About 29% attended only modern schools, while 12% had no access to formal education and are thus illiterate. Finally, only 3% of the interviewees received exclusively Quranic education. This could reflect some diversity in access to education in Mauritania and how education influences knowledge of traditional medicinal practices. These results contradict those of (Hama *et al.*, 2019), which showed that the majority of participants (69.74%) were illiterate, as well as the study by (Gnagne *et al.*, 2017), which indicated that 64% of the respondents had not received formal schooling. This discrepancy can be explained by several factors, including the fact that these two studies were conducted in other countries, namely Niger and Benin, which have cultural, educational, and religious diversities different from those of Mauritania.

It appears that *C. micranthum* is widely recognized by 95% of the participants, indicating general familiarity with this plant in the population. This highlights the significant place of the plant in the traditional Mauritanian pharmacopoeia. The majority of respondents, 61.5%, use the plant for therapeutic purposes, while 24% use it to prepare tea, and 14% combine both uses. This underscores the importance of *C. micranthum* in health management, particularly for digestive disorders, hypertension, and other common ailments. This dual use also shows that the plant is versatile and is part of a wide range of cultural and medicinal practices.

The results indicate that *C. micranthum* is commonly used in the treatment of various animal ailments, such as digestive disorders, fever, and diarrhea. However, a significant proportion of participants (46.9%) seem to be unaware of its use in treating animal diseases. Regarding human ailments, the plant is primarily used to treat hypertension, diabetes, and digestive disorders, among other diseases. This diversity of uses highlights the importance of *C. micranthum* G. in traditional medicine, where it serves to treat a wide range of conditions. This use is supported by several previous studies (Ferrea *et al.*, 1993; Karou *et al.*, 2005; Chika and Bello, 2010).

The leaves of *C. micranthum* are the most commonly used parts (70%), followed by the fruits (16%). The majority of those who use the plant favor the leaves as the primary part for their preparations, likely due to the concentration of active ingredients found there. These results are consistent with previous research by (Hachi *et al.*, 2015; Chaachouay *et al.*, 2020), indicating that leaves were the most used plant parts due to their practices. These two methods are popular because they allow for the extraction of bioactive compounds from the plant, which may have therapeutic effects. They are also easy to prepare and widely used in traditional medicine. These practices demonstrate ancient know-how and the transmission of knowledge regarding the preparation and use of medicinal plants (Hama *et al.*, 2019).

The population surveyed uses a variety of preparation methods to extract medicinal plant derivatives. The most frequent methods of administration are decoction (43.5%) and infusion (37.5%), reflecting traditional methods of remedy preparation. The frequent use of decoction can be attributed to its effectiveness in extracting the most active principles and mitigating or eliminating the toxic effects of certain recipes. Our results were correlated with those studied by (Benkhniqne *et al.*, 2010; Hassani *et al.*, 2013).

C. micranthum is frequently used, with 57.9% of respondents using it 1 to 2 times a day. However, a concerning point emerges: 88% of participants are unaware of the plant's toxicity, which could pose risks if the

plant is misused or administered inappropriately. Raising awareness about the toxicity of the plant is an area that requires particular attention to avoid undesirable effects.

Given that this Informant Consensus Factor index represents a coefficient of cultural importance of locally known species, it is possible to conclude that these results testify to a homogeneity of information between the different people interviewed.

A high value of the informant consensus factor has also been recorded in some studies conducted in the Mediterranean basin region, such as those carried out in Morocco and Italy (Silbernag and Despopoulos, 2001; Es-Safi *et al.*, 2020). However, this high value can be explained by several factors. It is possible that hypertension in the treatment of human diseases and digestive disorders in the treatment of animal diseases are very common in a given population, leading to in-depth knowledge of *C. micranthum* and the remedies used to treat these conditions. Additionally, the widespread transmission of traditional knowledge related to these issues can contribute to the preservation of this knowledge within a given community. Finally, the availability of this medicinal plant, which is abundant and often used for these diseases, may also play a role. These factors can thus contribute to the high value of the informant consensus factor.

In general, a fidelity level of 100% for a specific plant indicates that all reports on its use refer to the same treatment method (Srithi *et al.*, 2009). Uses for human and animal diseases with the highest fidelity levels indicate a good therapeutic potential of *C. micranthum* for treating the specific diseases mentioned. On the other hand, a lower fidelity level suggests that a particular use of the plant is not favored (Asnake *et al.*, 2016).

Conclusion

The study demonstrates that *C. micranthum* holds an important place in traditional medicinal practices in Mauritania and helps to better understand its uses in the country's traditional pharmacopeia, as well as assess its role in local medicinal practices. However, demographic disparities (such as age, gender, education level, etc.) and a lack of information on the toxicity of the plant can influence its use. Information and awareness about the potential risks, as well as the integration of traditional and modern knowledge, are important areas to ensure the safe and effective use of this plant. The study shows that *C. micranthum* plays a vital role in traditional medicinal practices in Mauritania, thus enhancing our understanding of its uses in the local pharmacopeia and evaluating its role in traditional healthcare. However, demographic disparities such as age, gender, and education level can influence its use. Moreover, a major challenge lies in the lack of information regarding the toxicity of *C. micranthum*. Although the plant is widely used for its medicinal properties, there is an urgent need for in-depth studies on its side effects, recommended doses, and potential interactions with other substances. Incorrect use, often due to a lack of knowledge, could lead to undesirable effects, highlighting the need for better awareness and appropriate education for users.

Authors' Contributions

Conceptualization: IMS; Methodology: IMS and AFT; Collected the data: IMS, SSP; writing: IMS, RP and AFT; data analysis, data storage: IMS; supervisor: AFT; Revision, editing and original version: IMS, RP, AD, SE, SSP and AFT.

All authors read and approved the final manuscript

Ethical approval (for researches involving animals or humans)

Not applicable.

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Conflict of Interests

The authors declare that there are no conflicts of interest related to this article.

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