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Phytotherapy Anti-Diabetic: Ethnobotanical Surveys among in the District of Mbour (Senegal)

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Authors' contributions

This work was carried out in collaboration among all authors. Authors DK and FAD conceptualized and Validated the study. Authors SA, SA and DSIM performed the methodology. Authors DK and MAI edited the manuscript. Authors DW and FAD contributed to supervised the study. All authors read and approved the final manuscript.

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ABSTRACT

Background: Despite the promises of a wide range of conventional medications, the prevalence of mellitus diabetes is steadily rising. Therefore, scientific researches on the antidiabetic effects of plants are required.
Aim: The objective of this study was to evaluate the diversity of medicinal plants used to treat diabetes mellitus.
Methodology: Ethnobotanical surveys were carried out among 30 randomly selected traditional practitioners using semi-structured interviews in the Mbour district.
Results: A total of 14 plant species belonging to 10 families was established. The most commonly used plant parts were leaves (44.20%), followed by barks (31%), roots (20.90%) and seeds

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(3.90%). The most common preparation techniques are infusion (61.20%), decoction (31%) and maceration (7.80%). The plants most frequently named by traditional practitioners were the following: *Neocarya macrophylla*, *Moringa oleifera*, *Terminalia avicennioides* and *Sclerocarya birrea*. And the least named plants are : *Garcinia kola*, *Anacardium occidentale*, *Vahlia dichotoma*, *Streptogyne gerontogaea*, *Combretum lecardii*, *Chrozophora senegalensis*, *Boscia senegalensis*, *Chrysobalanus icaco*, *Allium cepa* and *Jatropha curcas*.

Conclusion: These results may be a database for the discovery of new molecules with antidiabetic potential and the development of improved traditional medicines (ITM).

Keywords: Ethnobotany; medicinal plants; diabetes mellitus; traditional practioners; Mbour; Senegal.

1. INTRODUCTION

Diabetes is a public health problem. In 2014, the WHO estimated that 8.5% of the adult population (aged 18 and over) had diabetes. In 2015, diabetes was the direct cause of 1.6 million deaths, and in 2012 hyperglycaemia caused a further 2.2 million deaths [1]. Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion and/or insulin action [2]. The chronic hyperglycemia in diabetes is associated with long-term damage, dysfunction, and failure of different organs, especially the eyes, kidneys, nerves, heart, and blood vessels. Failure of these organs is frequently associated with development of macro- and microvascular diseases [3]. Nowadays, DM is becoming a disease of major concern both globally and regionally and is a leading cause of death in most countries [4]. It is one of the four major non-communicable diseases comprising, cardiovascular diseases, cancers and chronic respiratory diseases, which jointly contributes to 63% according to epidemiological predictions by the World Health Organisation (WHO), diabetes could be the seventh leading cause of death by 2030, due to its increasing prevalence. In 2015, approximately 5.0 million deaths were attributed to diabetes, albeit in the same year, more than 12% of the global health expenditure was dedicated to coping with the disease and its complications [5]. Diabetes complications are common among patients with type 1 or type 2 diabetes but, at the same time, are responsible for significant morbidity and mortality. The chronic complications of diabetes are broadly divided into microvascular and macrovascular, with the former having much higher prevalence than the latter [6].

In Senegal, an estimated 400,000 people have diabetes, representing a prevalence of 3.4%, but only a small minority of the population is diagnosed. This prevalence varies according to geographical area, reaching around 10% in Saint-Louis, the region most affected by diabetes [7].

Treating diabetics requires considerable resources and is not always within the reach of most of the African population. In Africa, 80% of the population relies on traditional medicine for primary healthcare. Many plant-based recipes are used in traditional African medicine to treat diabetes [8]. In addition to their standard therapies, many diabetes patients are known to take herbal medications with antidiabetic qualities. This can be advantageous or potentially harmful to the efficient management of their disease.

Despite the availability of many conventional prescription medications, numerous side effects, which are intolerable for many patients is on the rise. In recent years, the search for alternative therapeutic agents in the treatment of diabetes has been the focus of scientific research, as medicinal plants with diverse actions have been used traditionally for the control, management and/or treatment of DM in many parts of the world [9].

Many medicinal plants with hypoglycaemic properties have been used since ancient times to treat hyperglycaemia [10]. Nowadays, a large number of medicinal plants are believed to possess antidiabetic properties and have been utilised to manage diabetes [4,5,11]. For example, many herbal medicines possess antioxidant properties which could be beneficial for reducing oxidative stress, a key pathogenic factor of diabetes [12,13,14]. Several pharmaceutical agents effective in reducing diabetic mortalities (e.g., 3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitors) have also been shown to have antioxidant activities [12]. Antioxidants including ascorbic acid have shown to have a prospect in the treatment of DM [15].

Africa is the world's leading region for undiagnosed diabetes, according to the WHO. Only 46% of people with diabetes on the African continent are aware of their condition, which increases the risk of serious illness and death. For this reason, we have set out to research medicinal plants with hypoglycaemic properties, which will provide practitioners with an overview of the scientific aspect of medicinal plants used clinically to treat diabetes.

2. MATERIALS AND METHODS

2.1 Study Area

Mbour is a town in western Senegal, located on the Petite-Côte, about 80 km south of Dakar and bordering the seaside resort of Saly. It is the capital of the department of Mbour. The nearest towns are Saly Niakhniakhal, Saly-Portudal, Malikounda Sas, Malicounda ngoukhoudji, Falokh, Sintiou Mbadane, Nianing and Warang.

Located between 14° 24′ 42″ north, 16° 57′ 57″ west and the altitude is 0m. Mbour covers an area of 1,607 km2. Mbour has a semi-arid steppe climate, with an average annual temperature of 26.2°C and low rainfall of around 585 mm per year.

According to the 2023 report by the National Agency of statistic of demography (NASD), the department of Mbour has 215 facilities comprising: 01 hospital, 04 health center, 74 health posts and 136 health huts for an estimated population of 937,189 inhabitants. Fig. 1 shows the map of study area.

2.2 Study Design

Surveys based on direct questioning about the uses of anti-diabetic plants were conducted over 3 months in two markets visited in the town of Mbour.

2.3 Study Population

The target population consisted of 30 traditional healers interviewed without distinction as to sex, age, social status or religion.

2.4 Sampling

Using a questionnaire, surveys were carried out in the field with 30 traditional practitioners.

2.5 Data Collection Instruments

The questionnairy consisted of two parts a first part on the respondent, in which identification parameters are entered (sex, age, education, marital status, length of service, etc.) A second part which collects information about the plants used to treat diabetes (name of the plant, part used, method of preparation).

Fig. 1. Map of study area

2.6 Data Processing

To process the data collected, we used the method of calculating percentages or citation frequencies (CF), which is the ratio of the number of times the species was cited (n) to the total number of players (N).

CF =n/N

3. RESULTS

The main data collected in the localities of the town of Mbour were the socio-demographic characteristics of the people surveyed and information on the plants used for diabetics by traditional practitioners.

3.1 Distribution by Locality

Most of the traditional healers we met were in the central market, with a total of 25 out of 30, i.e. 83.33%. Fig. 2 shows the distribution according to locality.

3.2 Distribution by Gender

A total of 30 traditional practitioners were surveyed, including 22 men (72%) and 08 women (28%), giving a sex ratio of 0.36. Fig. 3 shows the distribution by sex.

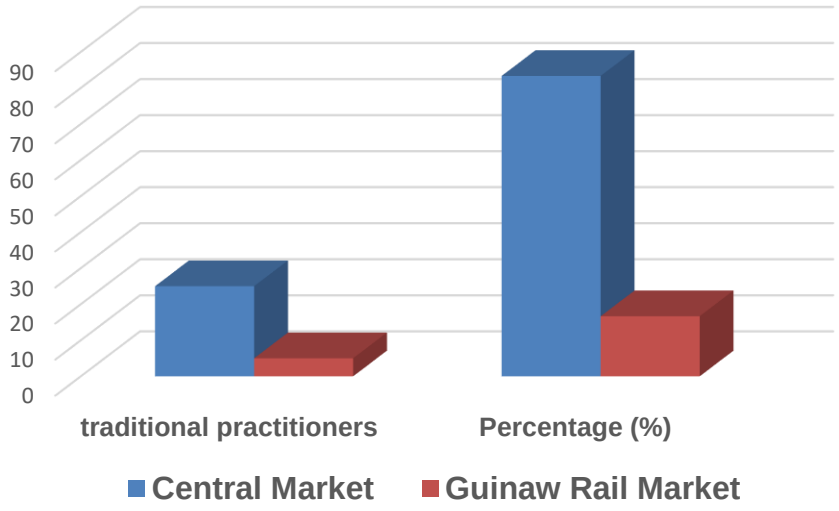

Fig. 2. The distribution according to locality

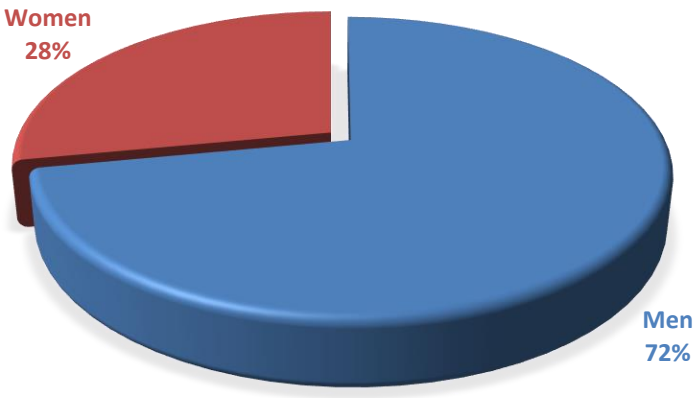

Fig. 3. The distribution by sex

3.3 Distribution According to Marital Status

The majority of the traditional healers were married with a rate of 90% (i.e. 27 out of 30). Fig. 4 shows the distribution according to marital status.

3.4 The Distribution by Age

The most represented age group is [40-60] with 46.66%, followed by [20-40] and [60-80] with 26.66% each. The Fig. 5 shows the distribution by age.

3.5 The Distribution by Number of Years in the Business

86.66% of those surveyed had been in the trade for more than 5 years. The age group most represented was [10-15] with 33.33%, followed by [5-10] with 30%, then [15-20] with 16.66%, then [0-5] with 13.33% and finally [20-25] with 6.66%. Fig. 6 shows the distribution by number of years in the business.

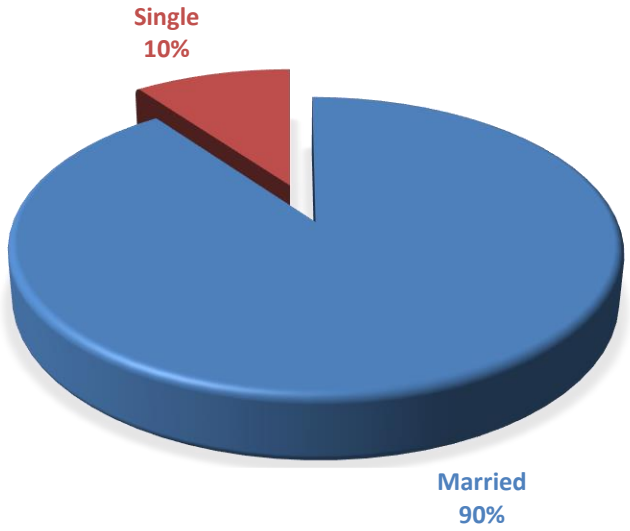

Fig. 4. The distribution according to marital status

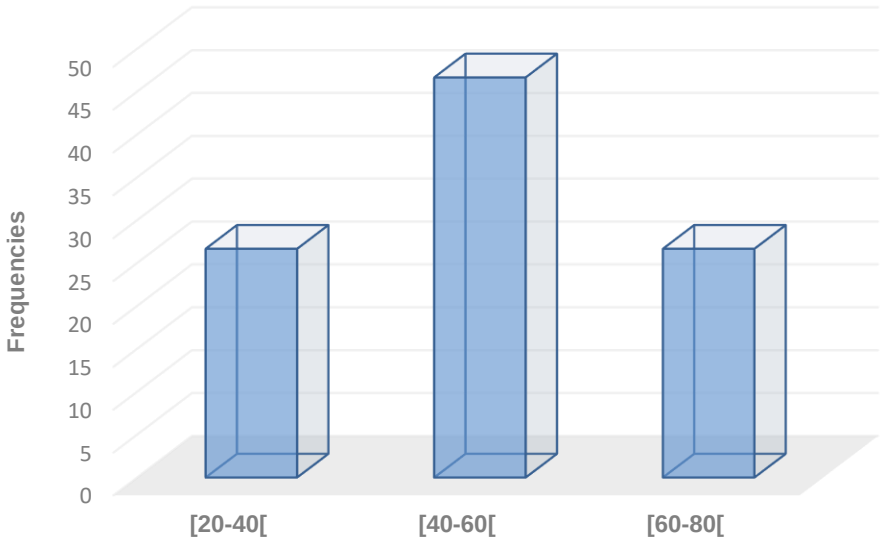

Fig. 5. The distribution by age

3.6 The Distribution by Level of Education

Most of the traditional healers interviewed (56.6%, or 17 out of 30) had attended school, while 44.4% had not. Fig. 7 shows the distribution according to level of education.

3.7 The Inventory of Plants Named in the Treatment of Diabetes

At the end of the survey, 14 plants used to treat diabetes were named. These plants are divided into 10 families, the most represented being the Euphorbiaceae, Combretaceae and Anacardiaceae. They will be translated into a table showing their scientific names, families, vernacular names, parts used and methods of use. Table 1 shows inventory of plants named.

3.8 Frequency of Plant Citations

Table 2 shows that the most frequently named plant among the 14 was *Neocarya macrophylla* with 21 citations (70%), followed by *Moringa oleifera* with 53.33%, *Terminalia avicennioides* (46.66%) and *Sclerocarya birrea* (40%).

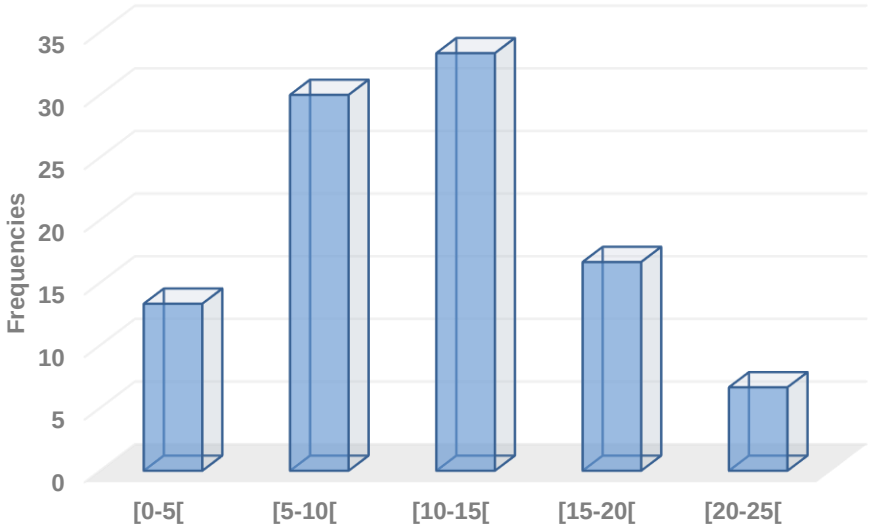

Fig. 6. The distribution by number of years in the business

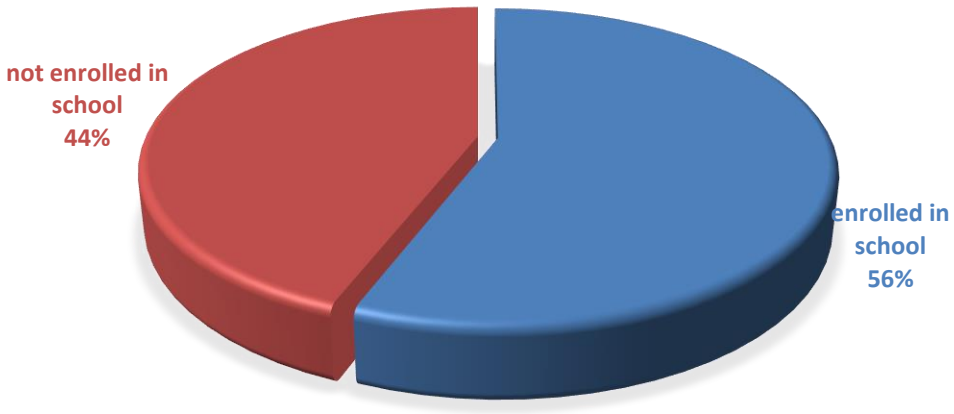

Fig. 7. The distribution according to level of education

Table 1. The inventory of plants named

Scientifics names	Families	Vernaculars Names	Parts used	Modes of use
Sclerocarya birrea (Höchst)	Anacardiaceae	Beer (W) Arik (s) Kouten Diao (S)	Leaves, Barks	Infusion, Decoction
Garcinia kola (Heckel)	Clusiaceae	Bitikola (W)	Seeds	Maceration
Anacardium occidentale (Köhler)	Anacardiaceae	Darkassé (W) Darkassou (s) Finza (b)	Barks	Infusion
Streptogyne gerontogaea (Hook. F.)	Poaceae	Fékh	Roots	Infusion
Vahlia dichotoma (Murray)	Vahliaceae	Mbélam (W)	Leaves	Decoction
Combretum lecardii (Engl. Et Diels)	Combretaceae	Ndadél (W) Piroriem (B)	Leaves	Infusion
Chrozophora senegalensis (A.Juss.)	Euphorbiaceae	Ndiamat (W) Mbélo (S)	Leaves	Infusion
Boscia senegalensis (Poir.)	Capparaceae	Ndiandam (W)	Leaves	Infusion
Moringa oleifera (Lam)	Moringaceae	Nebeday (W) Némédayo (S)	Leaves, Barks, Roots and Seeds	Decoction, Infusion
Neocarya macrophylla (F.White)	Chrysobalanaceae	Neew (W) Niamoui (P) Néoudi (P)	Leaves, Barks and Roots	Decoction, Infusion
Chrysobalanus icaco (L.,)	Chrysobalanaceae	Radji (W) Moholo (P)	Leaves, Roots	Maceration
Terminalia avicennioides (Guill. Et Perr.)	Combretaceae	Reub reub (W) Bori billel (P)	Leaves, Barks and Roots	Infusion, Decoction
Allium cepa (L.,)	Amaryllidaceae	Soblé (W)	Seeds	Maceration
Jatropha curcas (L.,)	Euphorbiaceae	Timi timi (W) Tabanano (S) Tabanani (s)	Leaves	Infusion

W: Wolof; P: Pulaar; S: Socé; s: Sérère; B: Balante and b: Bambara

Table 2. Frequency of plant citations

Scientifics Names	Number of citation	Percentage of citation
Sclerocarya birrea (Höchst, 1844)	12	40%
Garcinia kola (Heckel, 1883	2	6.66%
Anacardium occidentale (Köhler)	3	10%
Streptogyne gerontogaea (Hook. F.)	1	3.33%
Vahlia dichotoma (Murray)	2	6.66%
Combretum lecardii (Engl. Et Diels)	1	3.33%
Chrozophora senegalensis (A.Juss.)	1	3.33%
Boscia senegalensis (Poir., 1819)	2	6.66%
Moringa oleifera (Lam, 1785)	16	53.33%
Neocarya macrophylla (F.White, 1976)	21	70%
Chrysobalanus icaco (L., 1753)	2	6.66%
Terminalia avicennioides (Guill. Et Perr.)	14	46.66%
Allium cepa (L., 1753)	1	3.33%
Jatropha curcas (L., 1753)	1	3.33%

3.9 The Frequency with which Parts of the Plant are Mentioned

The leaf of the tree is the part most frequently named by actors, with a frequency of 44.2%, followed by bark (31%), roots (20.9%) and seeds (3.9%). Fig. 8 shows the frequency with which the parts used on the plant are named.

3.10 The Frequency of Citation that Methods Used

Use after infusion is cited most frequently (61.2%), followed by decoction (31%) and maceration (7.8%). Fig. 9 shows the frequency with which methods of use are named.

4. DISCUSSION

Our survey was carried out in the commune of Mbour, with the aim of listing plants used in the treatment of diabetes. This study was initiated with 30 traditional practitioners.

During our study, almost all the traditional healers we met told us that they had inherited their knowledge. The study revealed that 72% were men and 28% were women. This large predominance can be explained by the fact that it is rare for women to inherit traditional knowledge.

All age groups were represented, with a minimum age of 22 and a maximum age of 78. The most represented age group was [40-60] with 46.66%, followed by [20-40] and [60-80] with 26.66% each. The low rate of representation in the over-60s may be explained by the old age and activity of older subjects.

The level of education among actors is relatively low, with only 56.66% having attended school. We also noted that 70.58% of those attending school had left at elementary level.

The majority of our actors are married, representing 90% (27 out of 30), compared with 10% who are single. This may be due to the fact that they earn their living.

The longest periods of practice were [5-10] and [10-15], with 30 and 33.33% respectively. In other words, 93.33% of actors have been in practice for [0-20] years, and 6.66% for more than 20 years. This can be explained by a more marked start to practice after the age of 40 and retirement in old age.

With regard to the anti-diabetic plants cited by traditional practitioners, this work enabled us to identify 14 species divided into 14 genera in 10 families, the most common of which are: Anacardiaceae, Combretaceae, Chrysobalanaceae and Euphobiaceae. This low number of species can be explained by the fact that the people surveyed live in the same locality and cite the same plants for the treatment of diabetes. The number of citations for each plant shows that the species most frequently cited by the in this study to treat diabetes are: *Neocarya macrophylla, Moringa oleifera, Terminalia avicennioides and Sclerocarya birrea.*

The anti-diabetic effect of *Neocarya macrophylla* is very well known, even from Diatta's work in 2022 on the anti-diabetic properties of *Neocarya macrophylla* [16]. These studies revealed that the flavonoids contained in *N. macrophylla* leaves prevent diabetic cataracts by inhibiting aldose

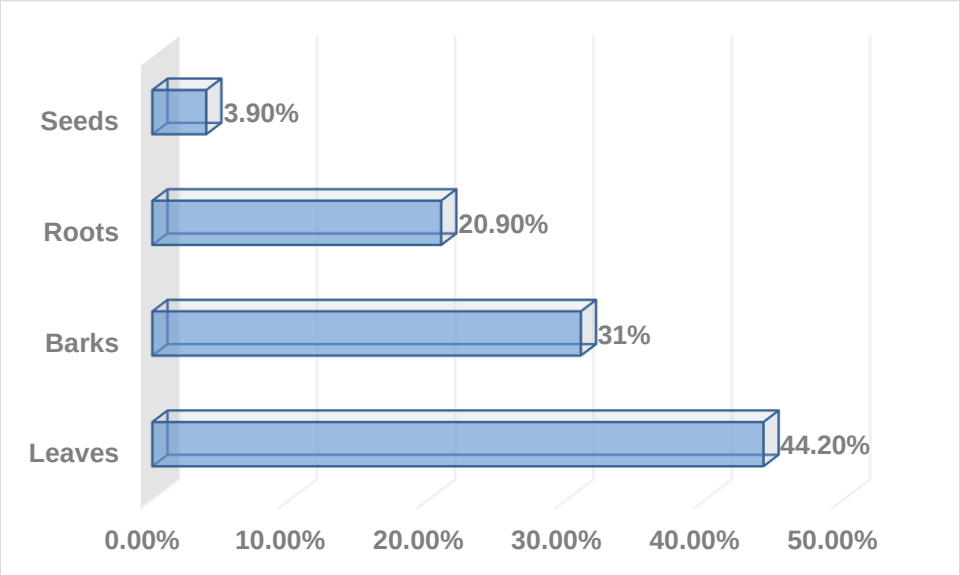

Fig. 8. The frequency with which parts of the plant are mentioned

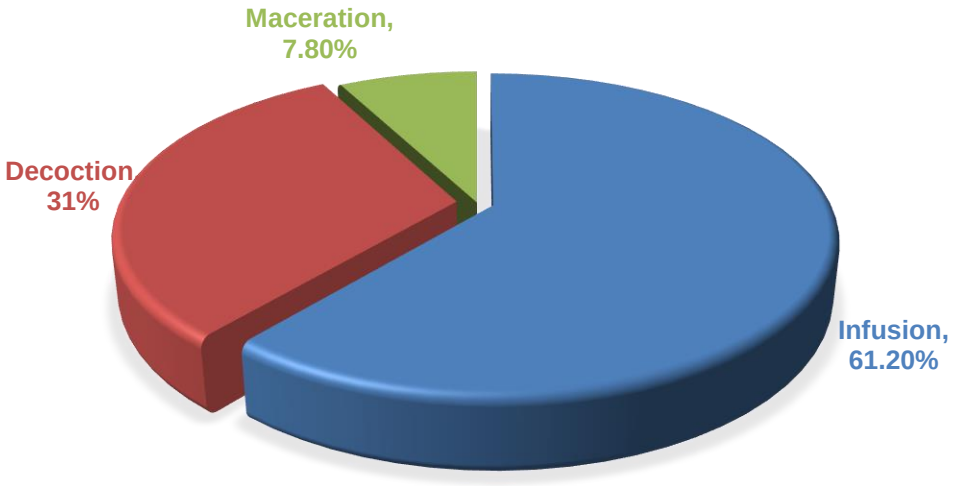

Fig. 9. The frequency of citation that methods used.

reductase in the lens. In fact, myricetin has hypoglycaemic effects in diabetic animals. This confirms its anti-diabetic effect.

As regards *Moringa oleifera*, studies according to Gupta R *et al.,* investigated the anti-diabetic and antioxidant effects of methanolic extracts of *M. oleifera* pods in streptozotocin-induced diabetic albino rats. These results showed that the progression of diabetes was significantly reduced after treatment with *M. oleifera*, confirming that the latter has anti-diabetic properties [17].

The studies of Yahaya SF et al., on the hypoglycaemic effects of *Terminalia avicennioides*. This study evaluated *Terminalia avicennioides* stem bark extracts for their effect on alloxan-induced diabetes mellitus in male wistar rats [18]. These results obtained in the course of this work demonstrate the hypoglycaemic effects of *T. avicennioides* cited in our survey.

Previous work by Ojewole JAO, reported a hypoglycaemic action of the aqueous extract of *Sclerocarya birrea* stem bark, studied in rats.

These results confirm our work, that *Sclerocarya birrea* contains anti-diabetic properties [19].

The studies according to Diouf P, 2016 on the contribution to the study of *Anacardium occidentale* in the city of Thiès, shows that this plant is used in the treatment of diabetes [20].

There are studies showing the antihyperglycaemic property of certain species of Chrysobalanaceae, such as *Chrysobalanus icaco*, confirming its use in traditional medicine [21].

Niang K in his studies on the antioxidant activity of the hydroethanolic extract of *Boscia senegalensis* leaves showed an anti-hyperglycaemic activity of *Boscia senegalensis* on albino rabbits [22].

Studies by Pradeep SR et al., indicated *Allium cepa* amplified the amelioration of diabetic hyperglycaemia and related metabolic abnormalities in experimental rats [23]. The present study evaluates the enhanced benefits of onion seed addition on oxidative stress in diabetic rats.

5. CONCLUSION

At the end of this study, a repertory of 14 plant species belonging to 10 families was established. The most commonly used plant parts were leaves (44.20%), followed by barks (31%), roots (20.90%) and seeds (3.90%). The most common preparation techniques are infusion (61.20%), decoction (31%) and maceration (7.80%).

In the course of our work, the plants most frequently cited by traditional practitioners were the following: *Neocarya macrophylla*, *Moringa oleifera*, *Terminalia avicennioides* and *Sclerocarya birrea*. And the least cited plants are: *Garcinia kola*, *Anacardium occidentale*, *Vahlia dichotoma*, *Streptogyne gerontogaea*, *Combretum lecardii*, *Chrozophora senegalensis*, *Boscia senegalensis*, *Chrysobalanus icaco*, *Allium cepa* and *Jatropha curcas*. The scientific literature has shown that these plants have anti-diabetic properties and may be an alternative treatment for diabetes.

Phytochemical, toxicological and pharmacological studies need to be carried out to help validate their traditional use and find new plants with anti-diabetic potential.

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.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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