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# Ethnobotanical Survey of Phytotherapeutic Management of Diabetes and Hypertension Diseases in Mpigi District, Uganda

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Abstract

Diabetes and hypertension are escalating global health challenges, affecting over 500 million and 1.3 billion people respectively, and significantly contributing to mortality, especially in less developed regions. The prevalence of these diseases is rapidly increasing underscoring the urgent need for effective prevention, management, and treatment strategies. Various allopathic medicines have been produced but with low curative efficiency and side effects. On the other hand, medicinal plants have been a key alternative form of treatment for human ailments including diabetes and hypertension. Despite their importance, the majority of them have not been studied and documented. This study was conducted to assess the use of medicinal plants in the management of diabetes and hypertension diseases in the Mpigi district, Uganda. Semi-structured interviews were conducted with traditional herbalists followed by field visits for taxonomic classification of the plants. Data was analysed using Atlas.ti software and IBM SPSS Statistics 29 was used to calculate frequencies. Fifty-four herbalists were interviewed, and 64% of them had an experience of more than 6 years in treating diabetes and hypertension. One hundred and twenty plant species were mentioned to be used by herbalists to manage diabetes and hypertension. Forty-seven percent (47%) of these plants treat diabetes, 24% treat hypertension and 29% treat both diabetes and hypertension. These plants were distributed to 52 different families, key among them include Asteraceae, Solanaceae, and Euphorbiaceae. The most frequently used parts included leaves (38.7%) and bark (20.6%). Highly mentioned plants included *Tithonia diversifolius*, *Aloe vera*, *Catharanthus roseus*, *Kigelia africana*, *Prunus africana*, *Momordica foetida*, and *Centella asiatica*. Key threats and conservation strategies were also mentioned. It is concluded that traditional healing knowledge still plays a key role in managing human ailments and therefore these findings are key for the management of diabetes and hypertension and for future research in drug development.

Keywords: *Diabetes; Ethnobotanical; Hypertension; Management Medicinal plants; Mpigi; Phytotherapeutic*

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## Introduction

Diabetes and hypertension are the diseases under the non-communicable diseases (NCDs) category. This category has diseases that are not transmitted from one person to another but are of slow progression and stay for a longer duration within the affected person (Kakudidi *et al.*, 2017; WHO, 2022). These diseases are also defined as diseases that share alike risk factors such as long-

time exposure to unhealthy diets, physical inactivity, stress, harmful use of alcohol, and smoking/tobacco use which contribute to conditions like obesity, elevated blood pressure, and elevated cholesterol levels, eventually leading to the onset of disease (WHO, 2022). NCDs pose a significant contemporary global health challenge due to their widespread occurrence within communities and the resulting loss of life they entail (Davids *et al.,* 2016). They stand as the primary cause of mortality on a global scale, accounting for a staggering 74% of all deaths worldwide (WHO, 2022). What is striking is that 86% of NCD fatalities occur in low- and middle-income countries (Shu and Jin, 2023). Over the next decade, mortality rates from NCDs are expected to rise significantly in low-income countries, with the World Health Organization projecting a 10% increase in NCD-related deaths in these regions between 2015 and 2030 (Elkomy and Jackson, 2024). The World Health Organization projects that by 2030, NCDs will comprise 77% of the global disease burden (Shu and Jin, 2023).

Diabetes mellitus is a metabolic disorder identified by high levels of blood glucose (Mohajan and Mohajan, 2023), caused by problems in insulin production or abnormality in insulin action (Karou *et al.,* 2011; Mohajan and Mohajan, 2023; Muema *et al.,* 2023). Diabetes is categorized into two types: type 1 diabetes, an autoimmune disorder marked by a lack of insulin, and type 2 diabetes, which is characterized by impaired insulin function (Muema *et al.,* 2023). Diabetes Mellitus (DM) stands as a significant NCD impacting millions globally, and being one of the most prevalent chronic endocrine disorders (Hoda *et al.,* 2019). Diabetes cases have increased at an alarming rate over the years. In 2017, approximately 425 million people worldwide were affected by DM, a rise from 108 million in 1980 (World Health Organization, 2016), and the number of diabetes patients is expected to rise to 700 million by 2045 (Mohajan and Mohajan, 2023). Although diabetes is estimated to cause approximately 1.5 million deaths annually (Bhattacharya *et al.,* 2023), the actual toll could be much higher. For instance, the International Diabetes Federation (IDF) reported that diabetes was responsible for 4.2 million deaths globally in 2019 (Mohajan and Mohajan, 2023). The disease causes have been triggered by both genetic as well as non-genetic factors. External factors include lack of physical exercise, diets, occupational risks, and environmental factors but internal cause factors are changes in genes and the non-functioning of several receptors and proteins (Hoda *et al.,* 2019; Mohajan and Mohajan, 2023).

Hypertension (HTN) is characterized by elevated systemic arterial blood pressure (Karou *et al.,* 2011) when it is consistently higher than 140 mmHg systolic over 90 mmHg diastolic (Kamyab *et al.,* 2021; WHO, 2023). HTN is a significant chronic disease affecting both developed and low-income countries. It is the leading global risk factor for mortality, contributing to 10.8 million deaths in 2019 (Schutte *et al.,* 2023) and accounting for an average of 9.4 million deaths annually worldwide (Meher *et al.,* 2023). Over the past four decades, the number of people with hypertension has risen by 90%, predominantly in low- and middle-income countries (Schutte *et al.,* 2023). Worldwide, an estimated 1.3 billion adults were affected by hypertension in 2019—double the 650 million cases reported in 1990 (WHO, 2023). Hypertension is estimated to impact 33% of adults aged 30 to 79 worldwide. Approximately 78% of adults with hypertension live in low- and middle-income countries (WHO, 2023). According to projections, over 1.56 billion people will be affected by hypertension by 2025, significantly raising the global burden of this condition in the coming decades (Meher *et al.,* 2023). In sub-Saharan Africa (SSA), the prevalence of hypertension has risen, reaching 48% among women and 34% among men in 2019 (Gafane-Matemane *et al.,* 2024). In 2000, Sub-Saharan Africa had 80 million cases of hypertension, and projections from the African Regional Health Report anticipate a rise to 150 million by 2025 (Lange-Jacobs *et al.,* 2020). Hypertension and diabetes disease are interlinked. Research indicates that 30% of individuals with type 1 diabetes also have hypertension, while 50-80% of those with type 2 diabetes are at an increased risk of developing hypertension (Frimpong and Nlooto, 2019).

Allopathic medications have been developed to address these illnesses; however, they often encounter obstacles such as reduced efficacy and

side effects. One notable example is the incapacity of these drugs to restore normal glucose homeostasis in individuals with diabetes (Rahmatullah *et al.,* 2012). On the other hand, medicinal plants have played a key role in traditional systems to cure human ailments since ancient times. The World Health Organization reports that 85% of people globally rely on medicinal plants for healthcare. Additionally, in developing countries, 80% of the population uses traditional and complementary medicine as their main approach to preventing, diagnosing, or treating physical and mental health conditions (Rapoliene and Matuleviciute, 2024). This highlights that the widespread and increasing utilization of herbal medicine persists as the prevalent and growing approach for addressing NCDs (Kakudidi *et al.,* 2017), including conditions like diabetes and hypertension.

The use of herbal medicine to manage diabetes and hypertension is a widespread practice across many countries. Studies have highlighted the importance of herbal medicines in various parts of the world. In Europe, some medicinal plants used for diabetes have been documented and studied (Przeor, 2022). Similar studies in European and Asian countries such as Croatia and Sri Lanka (Banjari *et al.,* 2019), Russia (Shikov *et al.,* 2021) Pakistan (Ahmad *et al.,* 2015), Mexico (Castillo-Espana *et al.,* 2009), and India (Chacko, 2003) have documented and highlighted the use of medicinal plants. In America, some of the plants used for diabetes have been documented especially in countries such as Belize, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, and Panama (Giovannini *et al.,* 2016), El Paso and Texas (Poss *et al.,* 2003), and in other South American countries such as Trinidad and Tobago (Mahabir and Gulliford, 1997).

In the African continent, studies have been also conducted. In Limpopo Province, South Africa 24 plants were reported to be utilized by THs to manage DM (Semenya *et al.,* 2012). In Cameroon, over thirty-three plant species have been identified to treat both diabetes and hypertension (Tsabang *et al.,* 2015). In Togo, ethnobotanical research by Gbekley *et al.,* (2018) documented 116 plants used by THs to cure hypertension. In South-eastern Morocco, 64 plants were documented to alleviate diabetes and hypertension (Tahraoui *et al.,* 2006). In Eastern Africa, studies have also been conducted, For instance, in Kenya, the study by Keter and Mutiso, (2012) documented thirty-nine species. In Tanzania, a study conducted by Moshi and Mbwambo, (2002) revealed 54 plants to be used by THs to treat DM. In Uganda, there has been limited research focused on documenting medicinal plants used for treating DM and HTN. For instance, a review paper by Kakudidi and colleagues (2017) identified 19 medicinal plants for hypertension. A study in the vicinity of the Mabira Forest Reserve identified five plant species used in the management of diabetes (Tugume *et al.,* 2016) while Ssenange *et al.,* (2015) documented 18 plants for type II diabetes in some selected districts in central Uganda.

Despite the fact that medicinal plants have been a key alternative form of treatment, the majority of them and their uses have not yet been studied and documented (Ssenyange *et al.,* 2015; Tugume *et al.,* 2016). This study was undertaken to document plants that are used to alleviate diabetes and hypertension diseases in the Mpigi district in Uganda. This was a key step first to inform on the plants that are used which can prevent this traditional knowledge from being lost, and second as a foundation/basis for further scientific studies on the pharmacological potentials of these plants and for the discovery of new drugs to manage the two diseases.

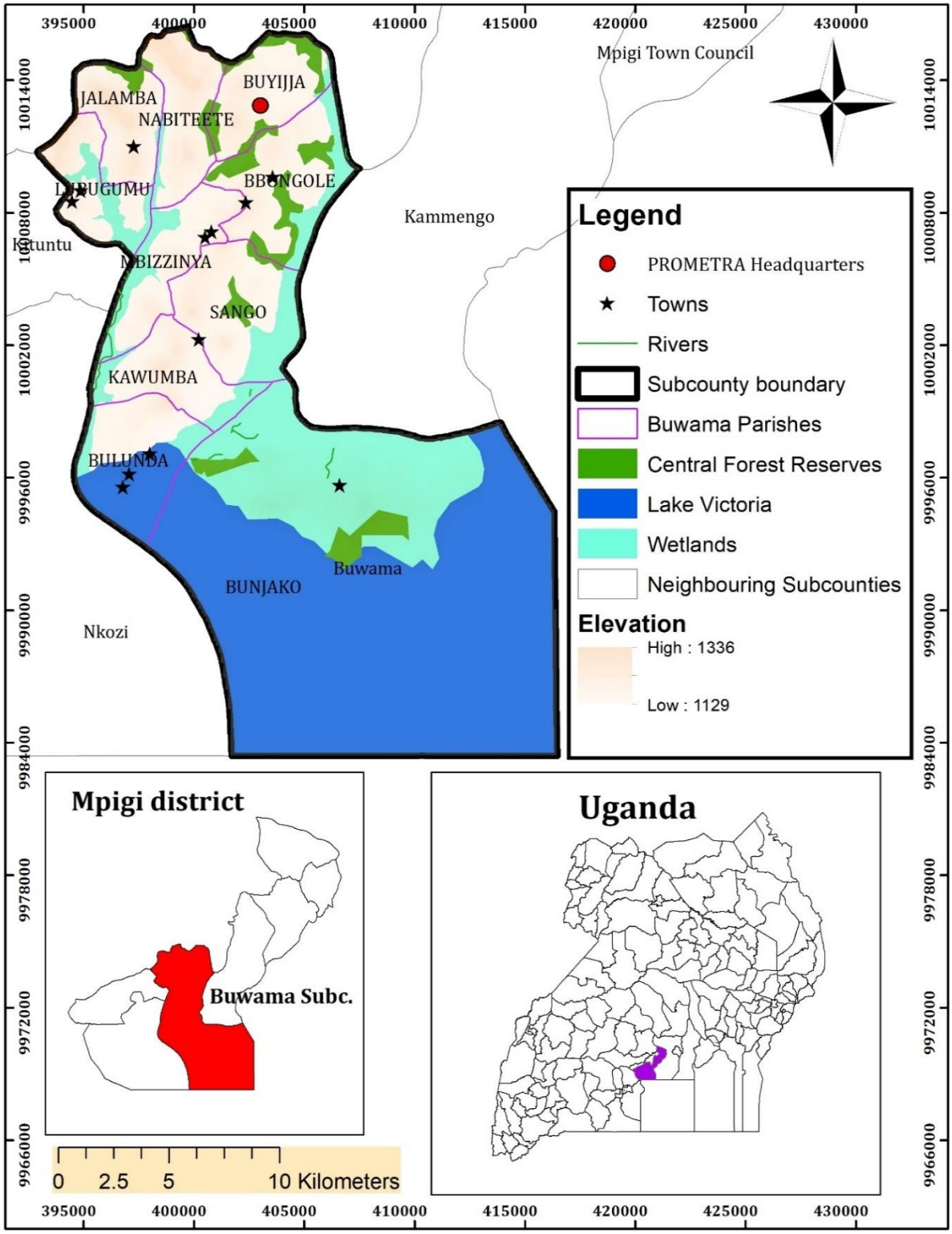
## Materials and Methods

### *Study area description*

This study was conducted in Buwama Sub County, situated in Mpigi district, located in Central Uganda. Mpigi district is positioned between latitudes 00° 13′ 48″ North and longitude 32° 19′ 48″ East (Nabukenya *et al.,* 2014), featuring an altitude ranging from 1100-1400m above sea level (Figure 1). Positioned along the shores of Lake Victoria, the largest freshwater lake in Africa, the district spans an area of 1,541.13 km$^2$, constituting 0.07% of Uganda's total land area.

**Figure 1**

*A Map Showing the Study Area (Buwama Subcounty) In Mpigi District.*



Approximately 91% of the district is comprised of land, while the remaining 9% is covered by water. Mpigi district headquarters are located 34 km west of Kampala along Masaka Road.

***Study design***

This ethnobotanical study employed a qualitative research design to document medicinal plants used in the management of diabetes and hypertension in Mpigi District, Uganda. Key informants, primarily traditional herbalists, were selected using purposive sampling, as they possess extensive knowledge of local medicinal plant use. Data collection involved semi-structured interviews, allowing for in-depth insights into the herbalists' knowledge, practices, and beliefs. In addition, guided field walks were conducted with the herbalists to identify and collect plant specimens.

***Study population and sample size***

The sampling framework for this study comprised traditional herbalists. The primary focus for understanding ethnomedicine practices was on traditional herbalists possessing the requisite knowledge. The study employed a purposive sampling technique to select the target population. This involved identifying and choosing traditional herbalists with significant knowledge and experience in using plants to treat the specified diseases as key respondents. The respondents were selected based on their prior expertise and experience in the field. Their expertise was determined by the length of time they had been practicing traditional medicine, having treated at least one patient with diabetes or hypertension (indicating a high level of knowledge), and their ability to accurately describe the key symptoms of diabetes and hypertension. All respondents were selected by their institutional leaders, considering the aforementioned criteria. Given the focus on experienced herbalists, a total of 54 herbalists were interviewed. The determination of the sample size was dependent on the availability of knowledgeable herbalists with expertise in the specific topic under investigation.

*Semi-structured individual interviews and field visits*

In ethnobotanical research, individual interviews stand out as the predominant method for collecting data (Jeffery, 2018). These interviews were guided by pre-prepared, semi-structured questions and were conducted in both English and Luganda, depending on the language proficiency of the respondents. Given the focus on experienced herbalists, 54 practitioners were purposefully selected and interviewed. All the herbalists involved in the interviews were affiliated with Dr. Sekagya Institute of Traditional Medicine (PROMETRA UGANDA), an institution led by the renowned traditional medicine practitioner Dr. Sekagya Yahaya Hills Kagali in Uganda. The institution's headquarters is situated in Buyijja parish, Buwama Sub-County. Following extensive interviews with participants, the gathering and taxonomic classification of plants cited for the treatment of diabetes and hypertension were conducted. Plants or voucher specimens were collected and subjected to additional assessment and identification at the Makerere University herbarium. The correctness of scientific names was also verified using available databases and software.

***Ethical consideration and clearance***

The involvement of participants in this study was entirely voluntary, granting them the freedom to withdraw from the study at any stage if they chose to do so. Informed consent formed the basis of participants' involvement, with individuals receiving advance information about the study's objectives and the potential implications of their participation. Each participant was required to sign a written informed consent form prior to engaging in the study, thereby ensuring voluntary and informed participation. Approval and clearance for the research were obtained from the Research Ethics Committee (REC) at Uganda Christian University before the commencement of the study (Registration number: UCUREC-2023-504).

***Data analysis***

The data collected was mainly qualitative except where frequencies were calculated, IBM SPSS Version 29 was used. The qualitative data was analysed by Atlas.ti (version 9) software and coded into themes to enhance the capture of views, and opinions from different informants. The data was carefully categorized into themes, patterns, or coherent categories that were summarized to bring out meaning to the text.

Some of the data was transformed into frequencies and percentages and presented through tables and figures. Information regarding treatment perspectives, including identified plants, preparation methods, and plant parts used, was entered and organized in Excel spreadsheets (Excel 2016) and later exported to Atlas.ti (version 9) for analysis.

## Results

***Socio demographics of herbalists (respondents)***

Fifty-four herbalists were interviewed, belonging to PROMETRA-UGANDA, an institution of traditional medicine found in Mpigi district, Uganda. Out of 54 herbalists, 68.5% were females while 31.5% were males. The majority (87%) had an age of more than forty years where 31.5% had an age of between 51-60 years and 24.1% had an age of between 41 – 50 years. Seventy percent (70.4%) of herbalists had only attained primary education and only 1.9% had university education. A hundred percent of respondents were herbal healers who also practice other economic activities such as agriculture (77.8%) (Table 1). Due to the fact that this study was conducted in Central Uganda, 92.6% of respondents were Baganda who belonged to the Buganda Kingdom, and the majority of them (37%) had stayed in their current residence for more than 30 years. Out of a hundred percent of interviewed respondents, 55.6% were married. Generally, herbal healing was dominated by less educated (primary education) people and more aged (87.1% had an age of > 41 years).

**Table 1**

*Biodata of Interviewed Traditional Herbalists (Respondents) (N = 54)*

| Variables | Frequency response | Percentage (%) |
|---|---|---|
| *Gender of respondents* | | |
| Male | 17 | 31.5 |
| Female | 37 | 68.5 |
| *Age of respondents (Years)* | | |
| 18-30 | 3 | 5.6 |
| 31-40 | 4 | 7.4 |
| 41-50 | 13 | 24.1 |
| 51-60 | 17 | 31.5 |
| 61-70 | 7 | 13.0 |
| More than 70 | 10 | 18.5 |
| *Education level attained* | | |
| No formal education attained | 3 | 5.6 |
| Primary education | 38 | 70.4 |
| Secondary education | 10 | 18.5 |
| Technical/College Education | 2 | 3.7 |
| University education | 1 | 1.9 |
| *Are you a traditional herbal healer?* | | |
| Yes | 54 | 100.0 |
| *Employment status* | | |
| No formal | 1 | 1.9 |
| Farmers | 42 | 77.8 |

| | | |
|---|---|---|
| Employed | 4 | 7.4 |
| Business person | 3 | 5.6 |
| Community Health Promoter (CHP) /Village Health Team (VHT) | 2 | 3.7 |
| Midwife | 1 | 1.9 |
| Local Government Officer (LC) | 1 | 1.9 |
| *Residence duration* | | |
| 1-10 | 9 | 16.7 |
| 11-20 | 14 | 25.9 |
| 21-30 | 11 | 20.4 |
| More than 30 | 20 | 37.0 |
| *Tribe* | | |
| Mufumbira | 1 | 1.9 |
| Baganda | 50 | 92.6 |
| Mukiga | 1 | 1.9 |
| Munyankole | 1 | 1.9 |
| Munyarwanda | 1 | 1.9 |
| *Marital status* | | |
| Single | 14 | 25.9 |
| Married | 30 | 55.6 |
| Widowed | 8 | 14.8 |
| Divorced | 2 | 3.7 |

***Symptoms of diabetes and hypertension as mentioned by herbalists***

To get an insight into the responses on the two targeted diseases, herbalists were asked to mention some of the symptoms that either they treated, knew, or used to confirm diabetes or hypertension sickness in patients. The responses are recorded in Table 2. Among all mentioned symptoms of diabetes, body weakness or loss of energy was mentioned by 40.7% of respondents, while frequent urination was mentioned by 29.6% of all respondents. Other highly mentioned symptoms include excessive sweating (27.8%), swollen legs (25.9%), and slow-healing wounds (16.7%). Fourteen hypertension symptoms were mentioned by respondents. Most frequent among them include; body weakness which was mentioned by thirty-five percent (35.2%) of respondents, excessive sweating (29.6%), abnormal heartbeat (18.5%), severe headache (14.8%), and difficulty in breathing (11.1%). Details of all other diabetes and hypertension symptoms mentioned are presented in Table 2.

***Herbalists' experience and diagnosis methods***

The following are the findings relating to the experiences of herbalists in treating diabetes and hypertension, along with the diagnostic methods employed to confirm these diseases before initiating treatment. Diabetes is locally known as *Sukali* and hypertension is *Entununsi* in Luganda. Results revealed that the majority of herbalists (35.2%) had an experience of 1 – 5 years followed by 6 – 10 years (33.3%). Sixteen percent (16.7%) had experience of 11 – 15 years, 13% had more than 20 years of experience and 1.9% had experience of 16-20 years. Each herbalist had treated at least one diabetes or hypertensive patient. In terms of diagnostic methods, 79.6% of herbalists depend on laboratory results, particularly those from patients who have previously received a diagnosis in hospitals. Even when patients approach these practitioners without prior laboratory results, many healers typically advise them to undergo a medical check-up first to confirm whether the symptoms align with diabetes, hypertension, or other

ailments. A small percentage of traditional healers (11.1%) conducted the diagnosis independently. This self-diagnosis, performed through traditional methods, was exclusively employed for diabetes. In this process, herbalists instructed patients to urinate on the soil and observe the presence of insects, specifically bees and ants, around the urine spot, serving as an indicator of sugar in the urine (DM). Forty-six (46.3) percent interviewed the patients to confirm diabetes/hypertension and 37% relied on signs shared by the patients.

**Table 2**

*Reported Diabetes and Hypertension Symptoms by Herbalists*

| Diabetes Symptoms | Percentage (%) response | Hypertension Symptoms | Percentage (%) response |
|---|---|---|---|
| Excessive sweating | 10.5 | Stroke | 3.3 |
| Swollen legs | 9.8 | Paralysis | 4.4 |
| Joints pain | 2.8 | Abnormal heartbeat | 11.1 |
| Body weakness/losing energy | 15.4 | Excessive sweating | 17.8 |
| Excessive thirst | 5.6 | Anxiety | 3.3 |
| Frequent urination | 11.2 | Loss of sleep | 1.1 |
| Passing out smelling urine | 2.1 | Body weakness | 21.1 |
| Weight loss | 2.8 | Poor vision | 7.8 |
| Fatigue | 0.7 | Dizziness | 3.3 |
| Loss of appetite | 2.8 | Difficulty in breathing | 6.7 |
| Fainting loss of consciousness | 3.5 | Severe headache | 8.9 |
| Severe headache | 4.2 | Inability to distance walk/ heavy lifting | 2.2 |
| Slow healing wounds | 6.3 | Easily scared | 2.2 |
| Body pain | 3.5 | Gaining weight | 6.7 |
| Blurred vision | 4.9 | | |
| Frequent hunger | 0.7 | | |
| Body spots | 0.7 | | |
| Fever | 1.4 | | |
| Body itching | 2.1 | | |
| Sweet urine that attracts insects | 4.2 | | |
| Skin infections/ Colour change | 4.9 | | |

When asked about gender which forms the majority of diabetes and hypertension patients as well as the most frequent age groups of diabetes and hypertension, fifty-five percent (55.6%) of herbalists said the majority of their patients were females, 38.9% were from both genders and 5.6% said were males. On the most frequent age groups of patients, 38.9% of herbalists said the patients were 40 years and above, 33.3 % said were 30 years and above, 20.4% said they were 50 years and above, 5.6% said 60 years and above while 1.9 % said the patients were below 30 years old. This indicated that the majority of DM and HT patients were elderly (> 40 years) and mostly females.

***Anti-diabetic and anti-hypertension medicinal plants***

One hundred and twenty plant species were reported to be used to manage diabetes and hypertension diseases by traditional herbalists in the study area. These plants are distributed into 52 different families. Families with the majority of plants include Asteraceae, Solanaceae, and Euphorbiaceae with 12, 8, and 7 plants respectively. Among the total plant species, 56 treat diabetes, 29 treat hypertension and 35 species treat both diabetes and hypertension. The highly mentioned plants include *Tithonia diversifolius*, *Aloe vera*, *Catharanthus roseus*, *Kigelia africana, Prunus africana*, and *Momordica foetida*. Traditionally a single species with minor differences would be used separately to treat different symptoms of a single disease or two different diseases. For example, during interviews, some herbalists mentioned using *Catharanthus roseus* with white flowers only to treat high blood sugar and red flowers to treat low blood sugar although others use this species without considering the difference in flower colour. Details of all mentioned medicinal plants in local names and scientific names, used parts, diseases treated as well as their frequency index is presented in table 3.

***Plant parts used and life forms***

Leaves were the most used parts of the plants with 38.7% usage, followed by bark at 20.6% and whole plant at 14.2% (Figure 2). Sometimes more than one part of a single plant was used together. For example, the stem and leaves of *Microglossa pyrifolia* were mixed, *Spathodea campanulata* flowers and bark, *Zanthoxylum leprieurii* bark and leaves among a few others. On plant life forms, the majority of plants used by herbalists to treat the two diseases were herbs (36.8%), trees (34.2%), and shrubs (13.7%) (Figure 3).

***Herbs preparation and dosage administration***

Herbalists prepared the majority of anti-diabetic and anti-hypertension herbs by either boiling them individually or in combination with other species, except for some fruits that were consumed in their raw form. Some TH simply provided patients with a powdered form of the medicinal herbs, instructing them to swallow it directly with water. Some of the other medicines were important vegetables and fruits that were consumed in conjunction with meals (Table 3). Following the boiling process, the doses administered to patients did not exhibit dissimilarities among different traditional healers, although minor differences in dosage length were observed even for the same herb species. All doses were measured in either a cup (locally known as Nice (a manufacturer brand name)) or a glass. Most doses were given in half a cup (72.2% of herbalists) and three times a day (88.9%). A minimum single dosage length recorded was five days and the maximum dose was three months. Notably, 22.7% of herbalists opted for a one-month dosage regimen. In certain instances, the dosage was individualized for each patient, and, in some cases, patients were instructed to continue taking the medicines until complete recovery. Dosage lengths were not uniform across age groups, as they were tailored to factors such as age, gender, and the overall health condition of each patient. Additionally, doses were occasionally determined based on the specific plants used; if the herbalist perceived a particular plant as potent due to its pronounced sourness or bitterness, a minimum dosage was prescribed.

**Figure 2**

*Plant Parts Used for Diabetes and Hypertension Treatment*

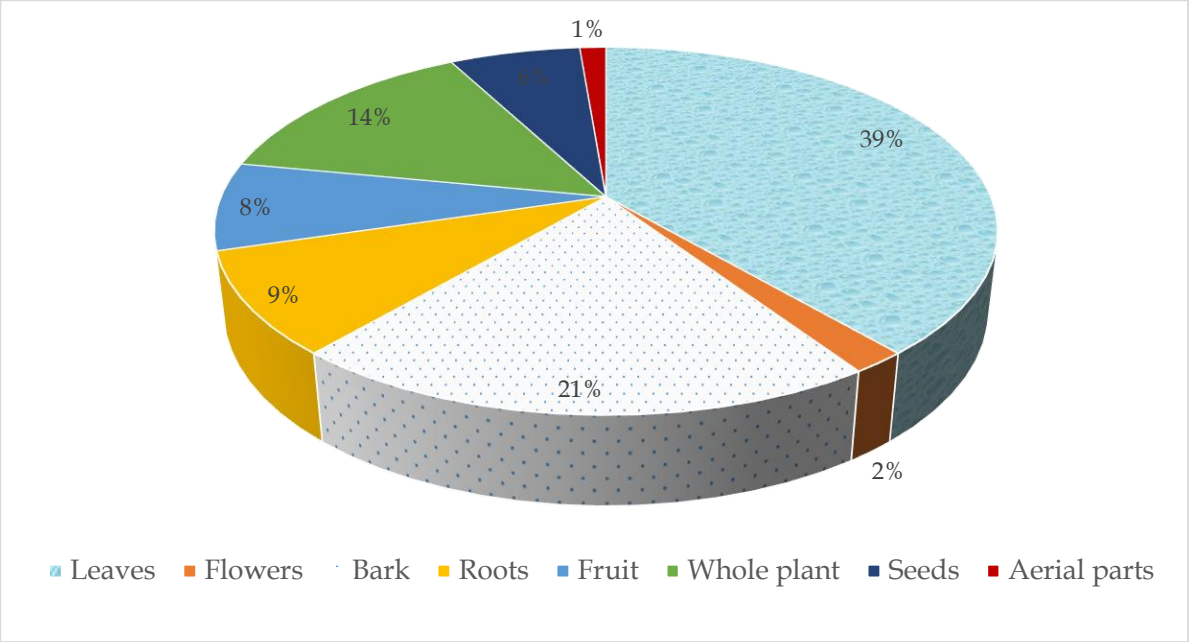



**Figure 3**

*Diabetes and Hypertension Medicinal Plants Life Forms*

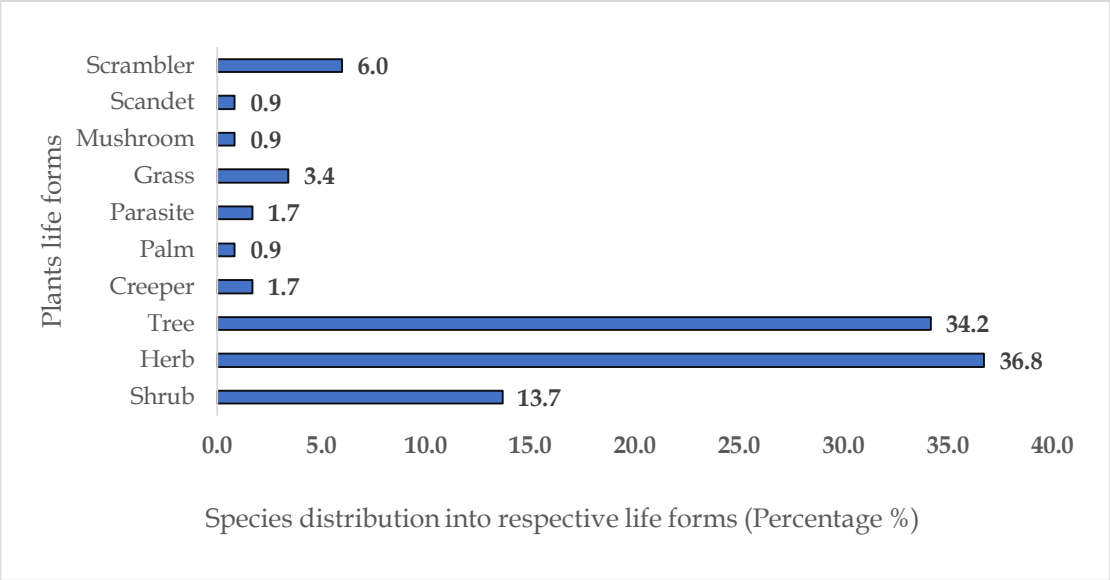


**Table 3**

*Anti-Diabetes and Anti-Hypertension Medicinal Plants Mentioned by Respondents*

| Scientific name | Local Name (Luganda) | Family | Growth form | Part Used | Disease treated | Preparation | Frequency Index (FI) |
|---|---|---|---|---|---|---|---|
| *Tithonia diversifolius* (Hemsl.) Gray | Ekimyula | Asteraceae | S | S, B, L | D | Decoction of fresh parts or powder | 40.7 |
| *Aloe vera* (L.) Burm.f. | Ekigajji | Asparagaceae | H | L | D | Blended, or boiled fresh or powder | 33.3 |
| *Catharanthus roseus* (L.) G. Don | Ssekajja/ Akakukulu | Apocynaceae | H | Wh | D and H | Boiled fresh or powder | 31.5 |
| *Kigelia africana* Benth. | Omussa/Ebeere | Bignoniaceae | T | AP | D and H | Decoction in fresh or in powder form | 27.8 |
| *Prunus africana* (Hook.f.) Kalkman | Entaseesa | Rosaceae | T | Wh | D and H | Boiled in powder form | 22.2 |
| *Momordica foetida* Schumach. | Ebbombo | Cucurbitaceae | Sr | Wh | D | Squeezed to make juice or boiled fresh or powder | 22.2 |
| *Centella asiatica* (L.) Urb. | Mbutamu | Apiaceae | Cr | Wh | D and H | Decocted fresh or powder | 20.4 |

| Scientific name | Local Name (Luganda) | Family | Growth form | Part Used | Disease treated | Preparation | Frequency Index (FI) |
|---|---|---|---|---|---|---|---|
| *Piptadeniastrum africanum* (Hook.f.) Brenan | Empewere | Mimosoideae | T | B, L | D and H | Decoction in powder form | 18.5 |
| *Bidens pilosa* L. | Seere | Asteraceae | H | Wh | D and H | Boiled fresh or in powder form | 16.7 |
| *Aspilia africana* (Pers.) C. D. Adams | Makayi | Asteraceae | H | L | D and H | Leaves are boiled | 16.7 |
| *Solanum anguivii* Lam. | Katunkuma/ Obutura | Solanaceae | H | Fr, S | D and H | The powder is boiled or steamed in water | 14.8 |
| *Syzygium cuminii* (L.) Skeels | Jambula | Myrtaceae | T | B, S | D and H | Decoction in powder form | 13.0 |
| *Albizia coriaria* Oliv. | Omugavu | Mimosoideae | T | B | D and H | Boiled in powder form | 13.0 |
| *Vernonia amygdalina* Del. | Omululuza | Asteraceae | T | L, R | D and H | Boiled either fresh or powder | 13.0 |
| *Eucalyptus grandis* Maiden | Kalitunsi | Myrtaceae | T | L | D and H | Leaves are boiled fresh | 9.3 |
| *Cleome gynandra* (L.) Briq. | Ejjobyo | Capparaceae (Cleomaceae) | H | L | D and H | Boiled | 9.3 |
| *Clerodendrum rotundifolium* Oiv. | Ekisekeseke | Verbenaceae | H | L | D and H | Fresh leaves are decocted | 9.3 |
| *Ficus saussureana* DC. | Omuwo | Moraceae | T | B | D | Fresh stem bark or powder is boiled | 7.4 |

| Scientific name | Local Name (Luganda) | Family | Growth form | Part Used | Disease treated | Preparation | Frequency Index (FI) |
|---|---|---|---|---|---|---|---|
| *Senna didymobotrya* Fres. | Omucuura | Caesalpinioideae | S | L | D | Fresh leaves are boiled | 7.4 |
| *Aristolocchia elegans* Mast. | Serumbete/ Kaseero | Aristolochiaceae | Sr | L, S | D | Decocted fresh or in powder form | 7.4 |
| *Hoslundia opposita* Vahl | Kamunye | Lamiaceae | S | L, Fl | D and H | Boiled fresh or in powder form | 7.4 |
| *Canarium schweinfurthii* Engl. | Omuwafu | Berseraceae | T | B | D and H | Boiled in hot water | 7.4 |
| *Persea americana* Mill. | Avocado | Lauraceae | T | S | D and H | Decocted in powder form | 7.4 |
| *Punica granatum* L. | Enkoma-mawanga | Punicaceae | T | L, Fr, S, R | D and H | Fruits are eaten in raw form, other parts are boiled in powder form | 7.4 |
| *Stachytarpheta urticifolia* Sims | Nayire | Verbenaceae | H | B, L | D and H | The powder is boiled in hot water or taken in tea | 7.4 |
| *Microglossa pyrifolia* (Lam.) O. Ktze. | Kafugankande | Asteraceae | S | L, B, R | H | Parts are boiled fresh or in powder form | 5.6 |

| Scientific name | Local Name (Luganda) | Family | Growth form | Part Used | Disease treated | Preparation | Frequency Index (FI) |
|---|---|---|---|---|---|---|---|
| *Warburgia ugandensis* Sprague subsp. ugandensis | Abasi | Canelaceae | T | L | D | The powder is decocted in hot water | 5.6 |
| *Plectranthus barbatus* Andr. | Ekibwankulata | Lamiaceae | S | L | D and H | Boiled fresh | 5.6 |
| *Annona muricata* L. | Ekitafeeri | Annonaceae | T | L, Fr, S, R | D and H | The powder is either boiled or added to hot water | 5.6 |
| *Bridelia micrantha* (Hochst.) Baill. | Katazamiti | Euphorbiaceae | T | B | D and H | The stem bark is boiled in hot water | 5.6 |
| *Markhamia lutea* (Benth.) K. Schum. | Omusambya | Bignoniaceae | T | L, Fl | H | Decocted either fresh or powder | 5.6 |
| *Tamarindus indica* L. | Enkoge | Caesalpinioideae | T | S, B, L | H | Parts are boiled in powder form | 5.6 |
| *Digitaria abyssinica* (A. Rich.) Stpf | Olumbugu | Poaceae | G | Wh | D | Fresh parts are boiled | 5.6 |
| *Callistemon citrinus* (Curt.) Stapf | Mwambala butonya | Myrtaceae | T | L | D | Fresh leaves are boiled | 5.6 |
| *Maesa lanceoata* Forssk. | Ekiwondowondo | Myrsinaceae | T | L | D and H | Decocted in powder form | 5.6 |

| Scientific name | Local Name (Luganda) | Family | Growth form | Part Used | Disease treated | Preparation | Frequency Index (FI) |
|---|---|---|---|---|---|---|---|
| *Zanthoxylum leprieurii* Guill. and Perr. | Omunyenye | Rutaceae | T | B, L | D | Boiled in powder form | 5.6 |
| *Leonotis nepetifolia* (L.) Ait.f. | Ekifumufumu | Lamiaceae | H | L | D | Leaves are boiled fresh | 5.6 |
| *Siegesbeckia orientalis* L. | Seziwundu | Asteraceae | H | L | D and H | Decocted fresh | 5.6 |
| *Phoenix reclinata* Jacq. | Empirivuma | Arecaceae | P | S | D and H | Boiled in powder form | 5.6 |
| *Physalis peruviana* L. | Entuntunu | Solanaceae | H | L | D | Leaves are boiled fresh | 3.7 |
| *Spathodea campanulata* P. Beauv. | Ekifabakazi | Bignoniaceae | T | Fl, B | D | Flowers are boiled fresh. The bark is decocted in powder form | 3.7 |
| *Dracaena steudneri* Engl. | Ekajjolye njjovu | Dracaenaceae | T | B | D | The bark is ground into powder and then boiled | 3.7 |
| *Rhus vulgaris* Meikle | Kakwansokwanso/ Tebbuda | Anacardiaceae | S | R | D | Roots are ground into powder and boiled | 3.7 |
| *Rumex usambarensis* (Dammer) Dammer | Kaseke kambajwe | Polygonaceae | H | Wh | D | Decocted fresh or in powder form | 3.7 |

| Scientific name | Local Name (Luganda) | Family | Growth form | Part Used | Disease treated | Preparation | Frequency Index (FI) |
|---|---|---|---|---|---|---|---|
| *Justicia betonica* L. | Nalongo | Acanthaceae | H | L | D and H | Leaves are either squeezed to make juice or boiled | 3.7 |
| *Agelanghus entebbensis* (Sprague) Polh. and Wiens | Enzirugaze | Loranthaceae | Pr | L | D | Leaves are boiled fresh or in powder form | 3.7 |
| *Alchornea cordifolia* (Schumach. Thonn.) Muell. Arg. | Oluzibaziba | Euphorbiaceae | T | L | D and H | Leaves are boiled. | 3.7 |
| *Ficus asperifolia* Miq. | Ekitonto | Moraceae | T | Wh | H | Squeezed to make a juice or decocted in powder form | 3.7 |
| *Citrus limon* (L.) Burm.f. | Nnimu/ Eniimu | Rutaceae | T | Fr | D and H | Squeezed to make a juice | 3.7 |
| *Azadirachta indica* A Juss. | Neem | Meliaceae | T | L, B | D | Decocted fresh or in powder form | 3.7 |
| *Mangifera indica* L. | Omuyembe | Anacardiaceae | T | L | D and H | Leaves are boiled fresh. | 3.7 |

| Scientific name | Local Name (Luganda) | Family | Growth form | Part Used | Disease treated | Preparation | Frequency Index (FI) |
|---|---|---|---|---|---|---|---|
| *Lillium cepa* L. | Akatunguru | Alliaceae | T | Fr | D and H | Fruits (bulb) are ground and either smelt or smeared under the foot, also boiled | 3.7 |
| *Aframomum angustifolium* | Ettunguru | Zingiberaceae | H | L | D and H | Leaves are boiled fresh | 3.7 |
| *Oxalis cornicula* L. var. corniculata | Kajampuni | Oxalidaceae | H | Wh | D and H | Decocted fresh or in powder form | 3.7 |
| *Artocarpus heterophylla* Lam. | Feene | Moraceae | T | S | D | Boiled in powder form | 3.7 |
| *Amaranthus dubius* Thell. | Dodo | Amaranthaceae | H | L, B | D | Boiled | 3.7 |
| *Cassia mimosoides* L. | Akoloola akomudo/ Kasere akatono | Caesalpinioideae | H | L | H | Boiled in powder form | 3.7 |
| *Portulaca quadrifida* L. | Bwanda | Portulacaceae | Cr | L | D | Leaves are boiled | 3.7 |
| *Tetradenia riparia* (Hochst.) Codd. | Ekiwamala | Lamiaceae | S | L | D | Boiled | 3.7 |
| *Toddolia asiatica* (L.) Lam. | Kawule | Rutaceae | S | R | D | Boiled in powder form | 3.7 |

| Scientific name | Local Name (Luganda) | Family | Growth form | Part Used | Disease treated | Preparation | Frequency Index (FI) |
|---|---|---|---|---|---|---|---|
| *Fleroya rubrostipulata* (K. Schum.) Y. F. Deng. | Enzigu | Rutaceae | T | B | H | Decocted in powder form | 3.7 |
| *Aerva lanata* (L.) Schultes | Olweza | Amaranthaceae | H | L | D | Fresh leaves are boiled | 3.7 |
| *Vernonia cinerea* (L.) Less. | Kayayana | Asteraceae | H | L | D | Fresh leaves are boiled in hot water | 3.7 |
| *Erythrina abyssinica* DC. | Ejirikiti | Papilionaceae | T | B | H | Boiled in powder form | 3.7 |
| *Abutilon mauritianum* (Jacq.) Medic. | Ekifuula | Malvaceae | H | L | H | Fresh leaves are boiled | 3.7 |
| *Kalanchoe glaucescens* Britten | Kiyondo ekyeru | Crassulaceae | H | L | D | Fresh leaves are boiled | 3.7 |
| *Cyanotis arachnoidea* C. B. Clarke | Nsenekerezi | Commelinaceae | H | Wh | H | Fresh parts are boiled in hot water | 3.7 |
| *Justicia engleriana* Lindau | Muwanga | Acanthaceae | S | L | H | Fresh leaves are squeezed to make a juice or chewed | 3.7 |
| *Acalypha vallicaulis* A. Rich. | Magunda | Euphorbiaceae | H | Wh | D | Fresh parts are boiled in hot water | 3.7 |

| Scientific name | Local Name (Luganda) | Family | Growth form | Part Used | Disease treated | Preparation | Frequency Index (FI) |
|---|---|---|---|---|---|---|---|
| *Tragia brevipes* Pax | Kamyu | Euphorbiaceae | C | Wh | H | Squeezed to make juice or boiled in hot water | 3.7 |
| *Solanum mauritianum* Scop. | Omunyera nyonyi/ Setaaba | Solanaceae | S | L | D | Fresh leaves are boiled in hot water | 3.7 |
| *Siegesbeckia orientalis* L. | Sekoteka | Asteraceae | H | L | H | Fresh leaves are boiled | 3.7 |
| *Eriobotrya japonica* (Thunb.) Lindl. | Omusaali | Rosaceae | S | L, B | H | Leaves and stem powder are boiled or taken in hot water | 3.7 |
| *Lantana camara* L. | Kapanga | Verbenaceae | S | L | D | Fresh leaves are boiled | 3.7 |
| *Moringa oleifera* Lam. | Molinga | Moringaceae | T | L | H | Boiled fresh | 3.7 |
| *Acanthus polystachius* Delile | Amatovu | Acanthaceae | S | R | H | Decocted fresh or powder | 3.7 |
| *Aleurites maluccana* Willd. | Kabaka enjjagala | Euphorbiaceae | T | B | D | Boiled in powder form | 3.7 |
| *Shiraklopsis elliptica* (Hochst.) Esser | Omusasa | Euphorbiaceae | T | B | D | Decocted in powder form | 3.7 |

| Scientific name | Local Name (Luganda) | Family | Growth form | Part Used | Disease treated | Preparation | Frequency Index (FI) |
|---|---|---|---|---|---|---|---|
| *Solanum macrocarpon* L. | Ntengotengo | Solanaceae | H | R | H | Boiled fresh or in powder | 1.9 |
| *Saccharum officinarum* L. | Ekikajjo | Poaceae | G | B | D | Boiled after ground into powder | 1.9 |
| *Abrus precatorius* L. | Olusitii | Papilionaceae | Cl | L | D | Decocted after ground into powder | 1.9 |
| *Citrus sinensis* (L.) Osbeck | Ebibbala (Muchungwa) | Rutaceae | T | B | H | Boiled in powder form | 1.9 |
| *Myrianthus holstii* Engl. | Ekibbala nantooke | Moraceae | T | B | H | Blended to make juice | 1.9 |
| *Tristemma mauritianum* J. F. Gmel. | Nantooke | Melastomataceae | H | L | H | Leaves are decocted fresh | 1.9 |
| *Craterispermum schweinfurthii* Hiern | Empomerezi | Rubiaceae | S | B | D | Boiled after drying and ground into powder | 1.9 |
| *Phyllanthus amarus* Schumach. and Thonn. | Kabalira kumngongo | Euphorbiaceae | H | L | H | Decocted fresh. | 1.9 |
| *Ananas comosus* (L.) Merr. | Akananasi ekiganda | Bromeliaceae | H | L | D | The inner part of the fruit (tongue) is removed then mixed with leaves and | 1.9 |

| Scientific name | Local Name (Luganda) | Family | Growth form | Part Used | Disease treated | Preparation | Frequency Index (FI) |
|---|---|---|---|---|---|---|---|
| | | | | | | boiled while covered then kept for three days | |
| *Termitomyces microcarpus* | Obutiiko | Tricholomataceae | M | Wh | H | Boiled fresh | 1.9 |
| *Curcuma longa* L. | Ekizaali ekiganda | Zingiberaceae | H | Fr | D | Pound when it is fresh and put in a tea | 1.9 |
| *Dioscorea odoratissima* Pax | Kaama | Dioscoreaceae | Sr | Fr, R | D | Parts are dried, ground, and boiled in warm water | 1.9 |
| *Colocasia esculenta* (L.) Schott | Obukopa | Araceae | H | L | D | Leaves are dried and ground then boiled or taken in hot water | 1.9 |
| *Mukia maderaspatana* (L.) M. J, Roem. | Akasunsa mukira | Cucurbitaceae | Sr | Wh | H | Decocted fresh | 1.9 |
| *Cyphomandra betacea* (Cav.) Standtner | Ekinyanya | Solanaceae | T | Fr | D | Fruits are eaten in raw form | 1.9 |
| *Bothriocline longipes* (Oliv. and Hiern) N. E. Br. | Etwatwa | Asteraceae | S | L | D | Leaves are boiled fresh | 1.9 |

| Scientific name | Local Name (Luganda) | Family | Growth form | Part Used | Disease treated | Preparation | Frequency Index (FI) |
|---|---|---|---|---|---|---|---|
| *Rubus pinnatus* Willd. var. afrotropicus (Engl.) C. E. Gust | Olukenene | Rosaceae | Sr | R | D | Roots are dried, ground then boiled | 1.9 |
| *Voacanga thouarsii* Roem. and Schult | Kinywa mazzi | Apocynaceae | T | L | D | Decocted fresh or in powder form | 1.9 |
| *Vernonia lasiopus* O. Hoffm. | Akaluluza ekasajja | Asteraceae | S | S | D and H | Decocted and drunk after a meal | 1.9 |
| *Commelina africana* L. | Enanda | Commelinaceae | H | Wh | D | Decocted in powder form | 1.9 |
| *Conyza steudelii* A. Rich. | Omuzikiza | Asteraceae | H | L | H | Boiled | 1.9 |
| *Oxygonum sinuatum* (Meisn.) Dammer | Kafumita bagenda | Polygonaceae | H | L | D | Leaves are either boiled fresh or in powder form | 1.9 |
| *Cymbopogon nardus* (L.) Rendle | Ekiteete | Poaceae | G | Wh | D | Decocted | 1.9 |
| *Cupressus lusitanica* Mill. | Akakomera | Cupressaceae | T | L | H | Fresh leaves are boiled | 1.9 |
| *Blighia unijugata* Bak. | Nku za nyana | Sapindaceae | T | B | D | Decocted fresh or in powder form | 1.9 |

| Scientific name | Local Name (Luganda) | Family | Growth form | Part Used | Disease treated | Preparation | Frequency Index (FI) |
|---|---|---|---|---|---|---|---|
| *Panicum trichocladum* K.Schum. | Kalandaluggo | Poaceae | G | Wh | D | Fresh parts are boiled | 1.9 |
| *Mimosa pudica* L. | Muke wewumbeko | Mimosoideae | H | Wh | H | Decocted fresh | 1.9 |
| *Curcuma maxima* Lam. | Ensujju ento | Cucurbitaceae | H | Fr | D | Decoction either fresh or powder | 1.9 |
| *Capsicum frutescens* L. | Kamulari | Solanaceae | H | Fr | H | Added to other plants as a catalyst | 1.9 |
| *Vigna unguiculata* (L.) Walp. | Egobe lyempindi | Papilionaceae | H | L | D | Leaves are boiled fresh | 1.9 |
| *Allium sativum* L. | Katuguluccumu | Alliaceae | H | Bulb | D | Boiled | 1.9 |
| *Maesopsis eminii* Engl. | Omusizi | Rhamnaceae | T | B | D | Decocted in powder form | 1.9 |
| *Artemisia annua* L. | Pasile | Asteraceae | H | L | D | Fresh leaves are boiled | 1.9 |
| *Cinnamomun verum* Ptesl. | Mudalasini | Lauraceae | T | L | D | Boiled in powder form | 1.9 |

| Scientific name | Local Name (Luganda) | Family | Growth form | Part Used | Disease treated | Preparation | Frequency Index (FI) |
|---|---|---|---|---|---|---|---|
| *Hydnora abyssinica* A. Braun | Omutima gwe'taka | Hydnoraceae | Pr | Wh | H | Dried and ground into powder, then taken in a tea | 1.9 |
| *Biophytum abyssinica* A. Rich. | Mutigumu | Oxalidaceae | H | Wh | H | Decocted fresh or in powder form | 1.9 |
| *Solanum nigrum* L. | Nakati (Nsuuga) | Solanaceae | H | Wh | D | Boiled fresh | 1.9 |
| *Caralluma distincta* E. A. Bruce | Akawulira | Apocynaceae | H | Wh | D | Fresh parts are boiled | 1.9 |
| Not identified | Ekimeere kyenkoko | | | L, B | D and H | Parts are boiled or steamed | 7.4 |
| Not identified | Ngaboya kabaka | | | B, L | D and H | Decocted fresh | 5.6 |
| Unknown | Kabajja nsaayi | | | B | D | Decocted fresh | 1.9 |
| Not identified | Akayiri kiakasaja | | | R | H | Roots are boiled fresh or in powder form | 1.9 |

Plants life forms: S-shrub, H-herb, T-tree, Cr-creeper, P-palm, Pr-parasitic, G-grass, M-mushroom, Sc-Scandet, Sr-scrambler. Parts used: S-seeds, L-leaves, Fr-fruits, Wh-whole, B-bark, AP-aerial parts, Fl-flowers, R-roots. Diseases treated: D-diabetes, H-hypertension

***Sources and practices for harvesting medicinal plants***

Initially, participants were inquired about the locations where they collected the specified medicinal plants. The responses indicated that 85.2% were gathered in the vicinity of their home gardens, 66.7% from wild areas or forests, and 14.8% purchased some of the plants from markets. On the time of harvesting, 94.4% said they harvested during midmorning from around 10 am to 12 pm. This time was favourite to most herbalists because traditionally they believed all plants sleep during the night and wake up in the morning around 10 am. This is to say plants are more active around 10 am and therefore when harvested at this time would be most potent (healing efficiency). On preservation, the majority of herbalists (63%) ground the harvested plants and stored the obtained powder in non-transparent tins. Fifty-one percent (51.9%) practiced proper drying without grounding into powder and 44.4 % of herbalists boiled the plants and stored them in jerrycans. Herbalists revealed that using natural preservatives such as bee honey and ash preserved these plants a bit longer. Also, other plants were added as preservatives to the boiled plants and these included *Bidens pilosa* and *Eucalyptus grandis*.

***Preference for medicinal plants***

The respondents believed that there was an increasing preference for using medicinal plants by patients in treating the two targeted diseases and other diseases. Some factors contributing to this shift in paradigm as by the respondents' responses are summarized in Table 4. These include among others; affordability of plants because they were either cheap or free of charge (51.9%), ease of availability and accessibility of plants (38.9%), healing efficiency (31.5%), and less side effects of plants compared to industrial drugs (29.6%). Few respondents (1.9%) believed patients opt for herbs because they feared using pharmaceutical drugs and tablets. Eleven percent of herbalists believed patients preferred plants because every single plant had a multi-curative potential in it (Table 4). For example, some herbalists said *Centella asiatica* is given to patients for diabetes and hypertension treatment but also the plant provides other healing benefits such as improving body immunity, detoxification, as well as treating hepatitis.

***Threats facing medicinal plants and conservation strategies***

Hundred percent of interviewed herbalists accepted that some mentioned medicinal plants were and are facing threats. Among the threats highly cited by herbalists included; chemical spraying specifically to kill weeds (herbicides) and pesticides in farms and around homes (53.7%). Forty percent (40.7%) said these plants are affected by pests mostly caterpillars, some of the highly affected plants include *Bridelia micrantha* and *Senna didymobotrya*. Deforestation of some of the important forests where these plants were found was also mentioned as a key threat by 27.8% of herbalists. The least mentioned threat was the effects of domesticated animals on plants cultivated in home gardens (5.6%) (Table 5).

Respondents suggested some of the conservation strategies that could be adopted to conserve and ensure the long-term survival of these medicinal plants where the cultivation of medicinal plants at home gardens (74.1%), proper harvesting (51.9%), and controlled spraying (31.5%) were the key mentioned strategies (Table 5).

**Table 4**

***Factors affecting Usage of Medicinal Plants as Identified by Respondents***

| Responses | Percentage (%) |
|---|---|
| Easy availability and accessibility of plants | 17.2 |
| Low toxicity/ side effects | 13.1 |
| Affordability (Cheap/Free) | 23.0 |
| Multi-nutrient contents in plants | 5.7 |

| | |
|---|---|
| Phytochemicals variety in plants | 1.6 |
| Multi-curative potentials of a single plant | 4.9 |
| Healing efficiency | 13.9 |
| Unaffordability of pharmaceutical drugs (Poverty) | 2.5 |
| Abundant and easy accessibility of herbalists | 1.6 |
| No overdose | 1.6 |
| Less bureaucracy and prescription in dosage administration | 2.5 |
| Less efficiency of pharmaceutical drugs | 7.4 |
| Plants are fresh, natural, and contain no additional substitutes | 4.1 |
| Pharmacophobia | 0.8 |

**Table 5**

***Threats Facing Medicinal Plants and Suggested Conservation Strategies by Respondents***

| **Threats** | **Percentage (%)** | **Conservation strategies** | **Percentage (%)** |
|---|---|---|---|
| Spraying | 27.6 | Proper harvesting | 23.9 |
| Overharvesting | 13.3 | Controlled spraying | 14.5 |
| Improper harvesting strategies | 8.6 | Public sensitisation | 4.3 |
| Pests and diseases | 21.0 | Afforestation | 8.5 |
| Charcoal burning | 2.9 | Cultivation at home gardens | 34.2 |
| Bush burning (fire) | 3.8 | Establishment of medicinal plant conservation areas | 6.8 |
| Deforestation | 14.3 | Good implementation of government policies on forest management | 6.0 |
| Forest encroachment/ land grabbing | 5.7 | Good stakeholders' involvement in the management of natural forests | 1.7 |
| Reared animals in home gardens | 2.9 | | |

**Discussion**

***Socio demographics of herbalists (respondents)***

The practice of traditional healing was predominantly carried out by older individuals, primarily females, with a basic level of education (Table 1). Age factor among traditional healers has been a consistent observation, as evidenced by studies conducted in Kenya (Kamau *et al.*, 2016), Morocco (Belhaj *et al.*, 2021), and Nalbari district, Assam, India (Chakravarty and Kalita, 2012). These studies affirm that traditional healers tend to be older individuals. This is supported by the fact that older individuals possess more experience and knowledge gained through long-term interactions with plants, consequently dominating the field of TH practices (Tugume *et al.*, 2016). Additionally, this study shows that over 50% of traditional healers are between the ages of 41 and 60. A significant number of healers within this age group have been reported in South Africa, including Bapedi (Semenya and Potgieter, 2014), Zulu (Ndawonde, 2006), and Xhosa healers (Nzue, 2009). This age group likely dominates because they are generally seen as responsible and often need income to fund their children's education and support essential living needs (Ndawonde, 2006; Semenya and Potgieter, 2014). In contrast, the prevalence of older traditional healers suggests

that younger generations may be reluctant to embrace and adopt this traditional healing culture. This is potentially influenced by exposure to modern knowledge and a subsequent loss of interest in traditional healing and cultural practices (Tugume *et al.,* 2016). Furthermore, it signifies that the transfer of this knowledge to younger generations is not adequately taking place (Kamau *et al.,* 2016). The resultant implication is that should traditional knowledge not be expeditiously researched and documented, there exists a perilous likelihood of its demise for subsequent generations (Maroyi, 2013).

In terms of educational background, our findings align with the research conducted by Abubakar and colleagues (Abubakar *et al.,* 2017) in Nigeria, which reported a similar prevalence of basic education level among traditional healers. However, our study diverges from the findings of Mrabti and colleagues (Mrabti *et al.,* 2021) in Morocco, where the majority of healers were found to be illiterate, with only 12% having completed primary education. Basic educational skills are increasingly essential for traditional healers, enabling them to enhance their practices through competencies like literacy, which support better counseling and an understanding of conservation (Semenya and Potgieter, 2014). Providing foundational training can play a crucial role in sustaining their knowledge, practices, and the responsible use of natural resources.

In the realm of traditional healing and its intersection with gender, our research aligns with other investigations, such as the ones conducted in Morocco, that revealed that a significant majority of THs or users were females (Jouad *et al.,* 2001; Eddouks *et al.,* 2002; Bousta *et al.,* 2014; Mrabti *et al.,* 2021). However, our findings are in contrast with other research, including studies conducted in Nigeria (Abo *et al.,* 2008; Abubakar *et al.,* 2017), which indicated a predominant presence of male traditional healers. The predominance of female healers can be attributed to several factors including; analphabetism, the ease of information transmission among women, and their strong attachment to traditional knowledge (Jouad *et al.,* 2001; Eddouks *et al.,* 2002). Additionally, the responsibility that falls on women for the overall health care of their families is a significant contributing factor, as emphasized by Mrabti and colleagues (Mrabti *et al.,* 2021).

Regarding marital status among respondents, the majority were married, with single individuals making up the next largest group. This trend may be attributed to married individuals' greater attention to personal and family health, particularly in rural settings, where they also tend to be more mindful of medical and pharmacy expenses (Belhaj *et al.,* 2021). Similar trends have been also reported in other studies (Belhaj *et al.,* 2021).

Most of the healers practiced healing as a primary and agriculture as a secondary occupation. This pattern was also observed in other similar studies such as in Togo (Karou *et al.,* 2011). Most healers engage in agriculture as a secondary economic activity because it provides a reliable source of income and food security, supplementing their earnings from healing practices, which may fluctuate. Agriculture allows them to cultivate crops that are integral to their sustenance, especially in rural areas where access to diverse income sources may be limited**.**

***Symptoms and diagnosis methods for diabetes and hypertension***

The results of the current study revealed that herbalists were able to clearly identify and observe the key symptoms, and diagnostic methods employed for the two targeted diseases. Similar studies conducted in different regions, such as Togo (Karou *et al.,* 2011), as well as in Kenya (Kamau *et al.,* 2017), also revealed that traditional healers could identify crucial symptoms. Moreover, the identified symptoms were congruent with those delineated by the World Health Organization (World Health Organization, 2016). The use of traditional diagnosis methods has been also reported in other studies, for instance, the presence of insects congregating around a urine spot subsequent to urination has emerged as a reliable diagnostic indicator for diabetes (Karou *et al.,* 2011; Zain-ul-Abidin *et al.,* 2018). Although traditional methods were also used for diagnosis, most herbalists in this study relied on laboratory results to confirm illnesses before providing treatment. By combining traditional diagnostic approaches with lab results, herbalists can achieve a more

precise understanding of a patient's condition, which enhances the effectiveness of their treatments. This trend has been noted in other studies as well, where herbalists often refer patients for follow-up checks to confirm that the illness has been successfully treated by the end of their therapy (Hu *et al.,* 2020).

In the context of diabetes and hypertension patients, the majority were females, a finding that diverges from a study conducted in Kenya by Kamau and colleagues (Kamau *et al.,* 2017), where the prevalence was reported to be higher among males. In Uganda, this variance could be attributed to two main factors. Firstly, women are identified as primary dependents and users of medicinal plants, as observed in prior studies (Kamatenesi-Mugisha and Oryem-Origa, 2006). Secondly, according to the National Household Survey by the Uganda Bureau of Statistics (UBOS, 2010), the incidences of NCD diseases were reported to be higher in women (5%) than in males (2% and 3%). This may offer an additional explanation for the observed gender distribution as reported by respondents. Furthermore, it has also been shown that women exhibit a higher susceptibility to diabetes compared to men, a susceptibility attributed to hormonal shifts induced by menopause, as well as the onset of gestational diabetes during pregnancy (Hoda *et al.,* 2019).

***Medicinal plants used to treat diabetes and hypertension***

This study identified 120 plants used in the management of diabetes and hypertension diseases in the Mpigi district, Uganda (Table 3). In the case of diabetes, a previous study conducted in selected districts in central Uganda identified eighteen plants used to treat Type II diabetes (Ssenyange *et al.,* 2015), with eight of these plants also being referenced in our current study. In the review paper authored by Gang and colleagues (Gang *et al.,* 2023), which synthesized information from previous studies in Uganda, a compilation of plants used for the treatment of diabetes was presented which identified 46 plant species, and notably, 23 of these plants overlap with those mentioned in the current study.

Some of the plants that were highlighted in this study for their potential benefits in managing diabetes have also been cited in other regions worldwide, although some were similar by genera names but with different species names. For example, in Morocco, *Ficus, Citrus, Eurphobia, Artemisia, Eucalyptus, Aloe*, and *Allium sativum, Allium cepa L*, *Persea americana* Mill., were prominently genera and species featured for their relevance to diabetes, a correlation that aligns with the findings of this study (Eddouks *et al.,* 2002; Bousta *et al.,* 2014). In India, research has been conducted on plants with anti-diabetic properties, some plants are also cited in this study including *Mangifera indica* L., *Allium cepa* L., *Allium sativum* L., *Azadirachta indica* A. Juss., *Catharanthus roseus* (L.) G. Don., *Lantana camara* L., *Moringa oleifera* Lam., *Aloe vera* (L.) Burm.f, and *Centella asiatica* (L.) Urban. Other genera were also important such as *Cucumis, Ficus, Annona, Albizia, and Clerodendrum* (Chakravarty and Kalita, 2012; Kumar *et al.,* 2019).

In Togo, *Catharanthus roseus* (L.) G. Don., *Vernonia amygdalina* Del, *Persea americana* Mill, *Allium cepa* L. *Allium sativum* L. *Aloe vera* (L.) Burm.f., *Moringa oleifera* Lam., *Stachytarpheta angustifolia* (Mill.) Vahl, have been recognized for their potential as antidiabetic plants (Karou *et al.,* 2011). These plants are also mentioned in this study. In Pakistan *Azadirachta indica* A. Juss, *Syzygium cumini* were mentioned plants, and *Datura, Solanum, Ficus, Momordica*, and *Artemisia* were among the genera with species also identified in this study (Zain-ul-Abidin *et al.,* 2018). In Kenya *Allium cepa* L., *and Warbugia ugandensis* were also mentioned to treat diabetes (Kamau *et al.,* 2017). The shared utilization of traditional plant remedies across different cultures and countries strongly suggests the bioactive potential inherent in the documented plant species (Maroyi, 2013).

***Plant parts used and life forms***

In traditional medicine, each part of a plant possesses therapeutic properties that vary according to the specific plant and the condition being treated. In this study, leaves emerged as the predominantly utilized plant parts, closely followed by the bark and whole plants (Figure 2). These findings align with similar studies conducted on diabetes, such as the one conducted in Nalbari District, Assam, India (Chakravarty and Kalita, 2012), as well as studies in Morocco (Mrabti *et al.,* 2021), Iran (Bahmani *et al.,* 2014),

and South-West Pakistan (Zain-ul-Abidin *et al.,* 2018). Another study in Guinea reported 97 plant species for hypertension with leaves as the highly used part (Traore *et al.,* 2022). The high utilization of leaves can be attributed to their easy accessibility and harvestability. Additionally, the abundance of phytochemicals in leaves enhances their therapeutic potential, further contributing to their high usage (Zain-ul-Abidin *et al.,* 2018). The extensive utilization of leaves, on the other hand, holds significant importance as it is less destructive (Tugume *et al.,* 2016). This practice plays a crucial role in preserving and ensuring the long-term survival of these medicinal plants (Traore *et al.,* 2022). However, it's essential to be cautious about potential consequences, as excessive harvesting of leaves may impede the natural regeneration process, limiting the transformation from vegetative to reproductive states (Tugume *et al.,* 2016). In contrast to our study, other research findings diverged. For instance in South Africa, roots were identified as the most utilized parts, followed by the whole plant, while leaves were reported as the least used (Oyedemi *et al.,* 2009). In Kenya, a similar trend was observed, with roots being highly utilized, followed by leaves (Kamau *et al.,* 2017).

On plant life forms, herbs were the most used (Figure 3). In the herbal healthcare system, herbs are widely utilized because they are readily accessible, possess significant healing potential, and contain a diverse array of bioactive compounds. Previous studies have shown that herbs have a strong capacity to produce secondary metabolites, which may serve as the primary source of active compounds responsible for therapeutic effects against various diseases. Additionally, it has been noted that herbalists frequently rely on herbs for their formulations, primarily due to their ease of collection and natural abundance (Ahmad *et al.,* 2015). For example, herbs are more commonly found across diverse environments—such as roadsides, home gardens, farmlands, and natural habitats—compared to plants with other growth forms (Hu *et al.,* 2020). The majority of lifeforms being herbs and trees have been also reported in other studies (Ahmad *et al.,* 2015; Singh *et al.,* 2020).

Asteraceae was also mentioned as one of a family with many plant species in treating diabetes in South-West Pakistan having 8 species similar to this study followed by Solanaceae (Zain-ul-abidin *et al.,* 2018). Asteraceae was also the second most cited family in treating DM in Morocco (Belhaj *et al.,* 2021; Mrabti *et al.,* 2021). The high usage of Asteraceae and Solanaceae could be attributed to their importance in the medicinal flora.

***Herbs preparation and dosage administration***

The primary method of administering dosage to patients involved orally ingesting a liquid derived from boiling or extracting the leaves. The high usage of the oral method can be attributed to the practicality and simplicity of this method, which enhances the absorption of active compounds from medicinal plants, allowing for easier distribution throughout the body and thus aiding in the treatment of diabetes and hypertension (Belhaj *et al.,* 2021). This mode of application was consistent with findings from other research conducted in Nigeria (Abubakar *et al.,* 2017) and Morocco (Mrabti *et al.,* 2021).

The duration of dosage ranged from one week to three months, aligning somewhat with the doses documented in the study from Pakistan (Ahmad *et al.,* 2015). In certain instances, patients were instructed to continue using the provided plants until they observed favourable outcomes. However, there were dissimilarities compared to the study conducted in South Africa, where the dosage duration spanned from six to twelve months (Oyedemi *et al.,* 2009), and in Morocco where the duration ranged from three weeks to four years (Belhaj *et al.,* 2021). Herbalists also administered dosages to patients using locally available measurements. In this study, doses were measured with cups for decoctions and spoons for powdered plants, a practice similarly observed in a study conducted in Morocco (Belhaj *et al.,* 2021). A major challenge in traditional medicine is the absence of standardized dosage measurements and treatment durations, which can be particularly risky when plants with dose-dependent toxicity are used.

A significant portion of the plants cited by herbalists underwent a monotherapy preparation, although a few were combined with other plants during the decoction process.

Utilizing more than one plant in dosage preparation is associated with the potential additive or synergistic effects they may offer in treating ailments. Additionally, research has indicated that employing multiple plants enhances efficacy (Maroyi, 2013).

***Sources and practices for harvesting medicinal plants***

This study found that most herbalists gathered medicinal plants primarily from areas near their home gardens, with wild areas being the next most common source. This may be because the Mpigi district, rich in natural habitats, allows for the easy availability of medicinal plants around home settings. Collecting plants close to home has several advantages: it provides a steady, convenient supply, is easier and less time-consuming than traveling to wild areas, and helps reduce the pressure on wild plant populations, thereby supporting the conservation of potentially at-risk species in natural habitats.

Regarding harvesting times, most herbalists in this study collected plants from morning to mid-morning, citing enhanced healing effectiveness at this time. This finding contrasts with a study in China, where herbalists typically gathered medicinal plants from noon to evening during autumn or winter, believing that many plants, entering dormancy, reach their highest efficacy when harvested dry (Hu *et al.,* 2020). These studies illustrate how harvesting times are often shaped by cultural beliefs and traditions specific to each region. In many cultures, traditional knowledge passed down through generations determines the optimal times for gathering medicinal plants to ensure maximum potency.

***Preference for medicinal plants***

This study explored the herbalist's perception of the reasons for the high usage of plants for medicinal purposes (Table 4). The affordability of plants because they were either cheap or free of charge, their ease of availability and accessibility, healing efficiency, and less side effects stood out as the major reasons. Other studies have reported similar factors from herbalists and patients. In Morocco, medicinal plants being cheaper, more effective, and better than modern medicine stood out as the main factors (Eddouks *et al.,* 2002; Belhaj *et al.,* 2021). In Guinea belief in the efficacy of plants, better accessibility, and lower cost were also among the key reasons for their preference (Baldé *et al.,* 2006). Herbalists attribute the high usage of plants for medicinal purposes to their accessibility, effectiveness, cultural significance, and sustainability. These factors, combined with traditional knowledge passed down through generations, make plant-based treatments a trusted and integral part of healthcare.

***Threats facing medicinal plants and conservation aspects***

This study identified key threats facing documented medicinal plants in the study area. The threats to medicinal plants identified in this study are reiterated in other studies, encompassing issues such as charcoal burning, overexploitation, and deforestation observed in Amboseli, Thika, and Nairobi in Kenya (Kiringe, 2005; Njoroge, 2012). Unresponsive harvesting strategies were noted in Simanjiro, northern Tanzania (Mbinile *et al.,* 2020), while overexploitation was observed in the cold desert of Ladakh (Chauhan *et al.,* 2020), as well as in Morocco (Bouiamrine *et al.,* 2017). Overharvesting, overexploitation, deforestation, and human activities were also reported as concerns in natural areas, specifically in Kashmir Himalaya in India (Ganie *et al.,* 2019). The global surge in demand for herbal products and plant-based drugs has led to significant exploitation of medicinal plants, primarily due to habitat degradation, unsustainable harvesting, and overexploitation, posing significant threats to their survival (Bhat *et al.,* 2013). In general, these threats can result in significant consequences, including the local and global extinction of medicinal plant species, a reduction in the genetic pool due to the impact on genetic diversity, diminished regeneration potential, and the complete eradication of medicinal plants in various locations (IUCN, 2006). Therefore, ensuring sustainable harvesting practices and implementing conservation measures becomes crucial for the survival of these plants and for the well-being of present and future generations.

**Conclusion**

Interviews with traditional herbalists resulted in the identification of 120 plants used for the management of these two targeted diseases. This

study has shown that plants and traditional knowledge still play a key role in the management of human diseases in this century. THs were very knowledgeable of the diseases' causes and symptoms although the majority relied on laboratory results. Some of the mentioned plants are also used in other parts of the world to manage the same ailments. This research suggests the undertaking of comparable studies in diverse regions of the country to document the use of plants within different communities and cultures. Additionally, the findings of this study underscore the significance of traditional healing practices in managing human ailments. This highlights the necessity for government strategies to incorporate traditional healing into the national healthcare system. Furthermore, this study advocates for additional scientific investigations into the plants identified in this study to explore their pharmacological potentials, efficacy, phytochemical compositions, antioxidants, toxicity profiles, and other essential categories that remain unstudied. This will be a key step in providing scientific proof of treatment potentials, discovery of drugs, and the safety of these plants for human health.

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