Anticancer Medicinal Plants Used by the Natives in the Elgon Sub-region, Eastern Uganda

Ali Kudamba (alikudamba@gmail.com)
Makerere University https://orcid.org/0000-0002-6669-4039
Josephine N Kasolo
Makerere University
Godfery S Bbosa
Makerere University
Allan Lugaajju
Makerere University
Henry Wabinga
Makerere University
Nixon Niyonzima
Uganda Cancer Institute(UCI)
Moses Ocan
Makerere University
Ali M Damani
Makerere University
Hussein M Kafeero
Islamic University in Uganda
Abdul Walusansa
Islamic University in Uganda
Jamilu E Ssenku
Islamic University in Uganda
Shaban O Alemu
Islamic University in Uganda
Muhammad Lubowa
Islamic University in Uganda
Haruna Muwonge
Makerere University

Research Article

Keywords: Prostate cancer, Ethnobotanical survey, herbalists, Elgon sub-region, medicinal plants

Posted Date: July 26th, 2023

DOI: https://doi.org/10.21203/rs.3.rs-3147051/v1

Abstract

Introduction: Medicinal plants have been used to treat several diseases, including cancer in Uganda. However, very few studies have been reported on the anticancer medicinal plants used in the Elgon sub-region. The main aim of this study was to describe the anticancer medicinal plants used to treat cancer, with an emphasis on prostate cancer, in the Elgon sub-region of Eastern Uganda.

Methods: Information was gathered using a semi-structured, researcher-administered questionnaire, interview guides, and guided field walks. Quantitative indices such as fidelity level (FL), preference ranking, and informant consensus factor (ICF) were evaluated. To summarize ethnobotanical data, a descriptive statistical analysis and graphs were created by SPSS version 21.0 and GraphPad Prism version 8.125, respectively, and narratives were explained using theories and major hypotheses in ethnobotany.

Results: A total of 50 plant species from 36 families were described; of them, 45% were herbs and 10% were parasites. Additionally, 60% of plants were gathered from forest reserves, and 86% of the materials used by herbalists were leaves. *The most effective treatment for cancer overall was Tylosema fassoglensis due to its versatility. Hydnora abyssinica A. Br., Hydnora africana, Rhoicissus tridentata (L.f.) Wild & R.B. Drumm., Prunus africana, and Kigelia africana, respectively, are used to cure prostate cancer. Herbs make up 45% of all medical plant use, with the fidelity level (FL) for Hydnora abyssinica A. Br being 93.9%, Rhoicissus tridentata (L.f.) Wild & R.B. Drumm (89.7%), Hydnora africana (84.8%), and Prunus africana (82.4%).* Herbalists predominantly used leaves (86%), and 60% of the plants used as medicines were gathered from peripheral forest areas, according to their preferred ranking. The most popular methods of preparation and administration (86%) were oral routes and concoctions. *Hydnora abyssinica* A. Br. was the herb that was most sought after for treating prostate cancer. ICF values larger than 0.5 were only attained by plant species used to treat cervical and prostate cancer, indicating that herbalists often lack awareness of herbs used in cancer treatment.

Conclusions and recommendation: All the first ten frequently used plants in the treatment of cancer received faithfulness levels more than 50%, suggesting that herbalists have faith in the ability of these plants to treat cancer. Therefore, it is crucial to conduct additional research into their phytochemistry, toxicity, efficacy, and effectively enforced conservation.

Introduction

Cancer is the world's most serious public health problem [1]. Over the previous decades, it was responsible for 18.1 million cases 9.6 million deaths[1]. Cancer cases will more than double over the next two decades from 2018, reaching 43.5 million in the next 5 years as per GLOBOCAN[2]. In 2015, a global report by GLOBOCAN, found increase in the number of cases and fatalities from lung, cervical, uterine, liver, colorectal, and other cancers[3]. According to African Cancer Statistics, despite having the lowest incidences, Africa has the highest cancer mortality rate, which is attributed to poor diagnostics, exorbitant costs, and most importantly, cancer care is not easily accessible[4]. In 2020, the Global Cancer Observatory recorded 1,414,259 new cases of prostate cancer and 375,305 deaths[5]. Prostate cancer cases increased from 10200 in 1990 to 21900 in 2010 instances, with fatalities ranging from 5600 to 12300 during the same period[6], and in 2020, a total 77,300 cases were reported in Sub-Sahara Africa[7]. Around 1329 deaths from prostate cancer-related causes and over 2375 new cases were reported in Uganda in 2017[8], and this number is anticipated to climb to 33.4% by 2030[9]. Due to Uganda's lack of adequate cancer diagnostic resources, the reported number of cancer cases is understated [7 &8]. Given the absence of a cancer registry and the area's

isolation, it is likely that the diagnostic and treatment options are insufficient. Health professionals at Mbale Regional Referral Hospital report an upsurge in prostate cancer cases in the Elgon sub-region.

On the global scale, several cancer treatment modalities exist, including chemotherapy, radiotherapy, surgery, hormonal and gene therapies[3]. However, these modalities are expensive, have severe side effects on patients, are limited in availability due to the country's limited specialized clinics, and have shown ineffectiveness for advanced cancer stages. Due to these constraints, the local natives in the Elgon sub-region have turned to medicinal plants as alternative cancer therapy. Medicinal plants are major sources of cancer drugs, accounting for approximately 91 of licensed and approved cancer drugs. Elgon sub-region is thought to contain a diverse range of plant species that could supplement the already existing basket[2&11]. The global increase in the use of medicinal plants is attributed to cultural acceptance, safety, ready availability, and most importantly requiring less technical expertise [7]. In Africa, more than 80% of the population, particularly in developing countries, relies on herbs directly to meet their primary healthcare needs. More than 80% of East African countries natives in rural areas, including Uganda, Burundi and Tanzania, use medicinal plants to meet their needs, including cancer treatment[13].

According to a report[14] Uganda is home to more than 6,000 different species of medicinal plants. Tugume et al.'s earlier research[15] demonstrated that medicinal plants were growing in importance as a part of the ethnobotanical approach to treating a variety of ailments, including cancer. There are more than 3000 anticancer medicinal plants, and these plants contain over 5000 phytochemicals, including phenolics, carotenoids, glucosinolates, terpenoids, and alkaloids, which are important players in cancer therapy. Additionally, a research by Omara et al[11] presented anecdotal evidence pointing to the usage of regional plants in Uganda to cure cancer. One of the world's richest plant species, some of which are known to have anticancer characteristics, is found in the Elgon sub-region [16]. The indigenous knowledge of the plants used to treat cancer is not extensively documented, despite the widespread use of medicinal plants in the Elgon sub-region. This led to the creation of this specific ethnobotanic survey in an effort to close that gap. Traditional medical knowledge is preserved through documentation, which ultimately results in its conservation. It also makes it simpler for other later research to test the claimed activity of the identified plant. Based on this, the current study identified the typical anticancer plant species utilized by Elgon's locals in the treatment of cancer, with a focus on prostate cancer.

Materials and Methods

Design of the Study

A cross-sectional ethnobotanical survey that employed a qualitative method of data collection was conducted between September and November 2021. To collect data, the investigators used semi-structured interview guides, guided field walks, and observations. Twenty (20) herbalists were recruited for the study, and twenty-five (25) households reported using herbal medicine to meet their primary healthcare needs. Key informants were interviewed in their native language (Lumasaba) with a pre-tested interview guide. Respondents were asked to provide information on the plant's local name, the type of cancer it treats and other ailments, the parts used, the mode of preparation and route of administration, the daily dosage, and the duration of treatment. Key informants selected the non-generic names, which were written in Lumasaba; standard protocols were followed in the collection and preparation of vouchers for each of the medicinal plant species described[17]. The medicinal plant species were identified at the Makerere University Herbarium Laboratory, and the scientific name was confirmed and deposited in a comprehensive plant database at plantlist.org.

Study area

The Sironko and Bulambuli districts, which are rural districts in the Elgon sub-region in eastern Uganda and are believed to feature a variety of plant species, were the sites of the research study. According to Google Maps, 2020, Kampala, the capital of Uganda, is located respectively 275.9 km and 306.8 km from Sironko and Bulambuli districts, which are 24.7 km and 55.4 km from Mbale city. This region is far from Kampala, the capital city of Uganda, where the Uganda Cancer Institute is situated and where the majority of patients are referred for treatment, according to the distance. Bulambuli district lies to the north, Kapchorwa and Kween districts to the northeast, Kenya to the east, Bududa district to the southeast, and Mbale and Bukedea districts to the southwest border the Sironko district. Nakapiripirit district, Kapchorwa district, and Bukedea district all about Bulambuli district to the north, east, and west, respectively These districts are located at 1'17 and 1'24 North latitude, 1'15 ° E and 1'45 ° E East longitude, with an average elevation of 3996 feet (1,218 meters) (Google Map, 2020). The average annual temperature is 24.4 º C[18]. while the average annual rainfall is between 920 and 1650 mm [18]. Due to ideal environmental circumstances, a wide variety of plants are available all year round, some of which may have anticancer properties. It is unknown exactly what medicinal plants are used in this area to manage and treat malignant conditions like prostate cancer. Due to the majority of its custodians being elderly and the fact that it has not been well communicated, there is a risk of losing this important information.[19]. The study was therefore carried out in seven villages between September and November 2021, including Zema, Suguta, and Jewa in the Bulambuli district and Nakidoba, Bulwala, Miwu, and Madaya in the Sironko district.

Sites selection for research

On the recommendation of local leaders and elders, a reconnaissance survey was carried out in this area between September and November 2021 in order to choose the study site. Seven villages have multiple herbalists, according to preliminary data. These villages include Zema, Suguta, and Jewa in the Bulambuli district and Nakidoba, Bulwala, Miwu, and Madaya in the Sironko region.

Study Population Demographic Characteristics

The bulk of the inhabitants, who are primarily peasants and belong to the seventh-largest ethnic group in Uganda, the Bagisu, speak Lumasaba as their primary language [22]. The Elgon sub-region's residents, who are largely peasants with poor literacy levels and live in rural areas with only a few peri-urban districts, cannot afford the high costs of prostate cancer treatment. Therefore, one of the most practical solutions for meeting their basic healthcare demands is the usage of plant extracts.

Participants Selection, Sample Size, and Sampling Techniques

Local leaders (LCI chairpersons), who serve as the communities' gatekeepers, assisted in the selection of 45 participants (38 men and 7 women). The redundancy criterion technique (response saturation point) was used to calculate the sample size, and the snowball sampling technique was utilized to sample the eligible participants.

Inclusion and exclusion criteria

The study included all herbalists over the age of 25, since earlier data indicated that most herbalists venture into this industry as early as 15 years of age, and at this age, they will have acquired 10 years' experience, the minimum required for a good herbalist[20], and no communication barriers (they were fluent in Lumasaba). The herbalists who did not meet any one of the above criteria were barred from participating in the present study.

Ethnobotanical Data Collection, Plant Identification, and Authentication

We created a researcher-administered questionnaire using semi-structured forms of question items, interviews, and observation guides. Before collecting data, the question items were pretested with the non-targeted groups in a different area other than the study area. As a result, all ambiguities that arose during the process of data collection were either corrected or removed. During data collection, the researcher immediately captured, recorded all the responses from participants. Furthermore, the researcher interviewed and recorded responses all of the key informants and recorded their responses. For in-site plants identification, the expert used plant based-field manual. The plant part was further identified by either detaching the plant part or thoroughly uprooting and wrapping it in old newspapers, before placing it in the plant placement and transporting it to Makerere University Herbarium Laboratory for further examination. Finally, the correctness of the plant name was confirmed by extensive plant databases, plant lists.org[21].

Qualitative Data Analysis

Simple descriptive statistics (frequency and percentage) were implemented using Statistical Packages for Social Scientists (SPSS) version 21, and graphs were produced using GraphPad Prism version 8.0. To quantify sociodemographic data, tables were made. In SPSS, which generated frequencies and percentages, plant sections used, growth patterns, technique of preparation, and route of administration were all quantified and categorized. Participants' personal narratives were used to record the information gathered through interviews. These narratives were then subjected to narrative analysis, and the participants' justifications were supported by main hypotheses and ethnobotany theories. Utilizing pre-existing formulas, the fidelity levels, informant consensus factor, and preference ranking were determined.

Preference Ranking

The first ten (10) medicinal plant species were prioritized based on Martin's description[22], with modifications. The ten most valuable anticancer medicinal plant species were ranked by 10 key informants based on their importance, frequency of use, and effectiveness (number of days required to heal after successfully treating specific cancer). To obtain, an overall ranking, the values assigned to each species were added together. For each informant the value assigned were totaled. After that the species were ranked beginning with the species with the highest preference.

Informants Consensus Factor (ICF)

The informant consensus factor was calculated using the formula established by Hu, et al [23] and indicates the homogeneity of the information[24].

$$Fc = \frac{Nur - Ntaxa}{Nur - 1}$$

where N_{ur} denotes the total number of plant-use reports (citations) for a particular disease category. It computes the relationship between the number of plants used (N_{ur}) minus the number of taxa (Nt_{axa}) and the number of use reports for each category minus one. When the plants are chosen at random, when informants do not exchange information about their use or when they disagree about the species used in specific cancer categories, ICF is low. If the species is used by a large proportion of the informant, there is a well-designed criterion in the community, and information is exchanged between informants, then ICF is high (close to 1). As a result, a medicinal plant with high informant consensus value is thought to be effective in treating specific cancers and other ailments.

Fidelity Level (FL) or Level of Trust

The formula was used to calculate fidelity level (FL) $FL = \frac{Lpx100\%}{Iu}$ Where Lp represents the number of informants who suggested using a specific species for the same major use (prostate and other cancers), and lu represents the total number of informants who mentioned using the same species for any other use.

RESULTS

The present study enlisted 45 participants of which males (38, 84%) were significantly more than female (7, 16%) in our study (X^2 = 48.0909, 95% CI = 4.1876–6.4999%, P < 0.0001). They were mostly Ugandan (40, 89%) (X^2 = 60.84, 95% CI = 6.4977–9.9566%, P < 0.0001), and married (34, 76%) (X^2 = (X^2 = 57.3614, 95% CI = 8.554–13.589%, P < 0.0001). Furthermore, the vast majority of the participants had only completed primary school (35, 78%) (X^2 = 66.7805, 95% CI = 71.474–109.522%, P < 0.0001), and generally of low literacy class. Most participants (15, 33.3%) ranged in age from 51 to 55(X^2 = 16.900, 95%CI = 3.2451–6.6206%, P < 0.0001) and were mostly peasants (X^2 = 16.900, 95%CI = 3.2451–6.6206%, P < 0.0001).

Table 1
Demographic Characteristics of Herbalists in the Elgon sub-region

Characteristics	Frequency	Percentage (%)	P value
Gender			
Male	38	84.4	P < 0.0001
Female	07	15.6	
Age			P < 0.0001
25–30	04	8.88	
31–36	03	6.67	
36–40	03	6.67	
41–45	03	6.67	
46–50	05	11.11	
51–55	15	33.33	
56–60	10	22.22	
61 above	02	4.45	
Nationality			P < 0.0001
Ugandan	40	88.89	
Non-Ugandan	05	11.11	
Marital status			P < 0.0001
Married	34	75.56	
Single	05	11.11	
Divorced	03	6.67	
Widowed	03	6.67	
Education			P < 0.0001
Informal	02	4.45	
Primary	35	77.78	
Secondary	06	13.33	
Tertiary	02	4.45	
Occupation			P < 0.0001
Teacher	03	6.7	
Business	04	8.9	
Peasant	34	75.6	
Others	04	8.9	

Our findings showed herbalists attained their knowledge from a variety of sources, the most common of which were grandparents and parents (67%) and the remaining (33%) claimed to have learned from spiritual guidance, friends, and peers.

Table 2
Medicinal Plants, their habits, Cancer Types, and Methods of Preparation and Administration.

Local Name	Plant Family, Scientific Name & Voucher No.	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of preparation & Application
Kachuum	Alliaceae, *Allium sativa*, -KA 006	Herb	bulb	Cervical, colon, prostate & skin	Boiled and drunk (decoction) & burn and applied infected skin part (topical medication)
Kitungulu	Amaryllidaceae, *Allium sepa* L -KA 007	Herb	Bulb	Stomach	Mixed with other plants and drunk (Concoction)
Kitondwani	Apocynance, *Rouvoflavia vomitoria Afzel* -KA 008	Shrub	All parts	Colon & cervical cancer	Boiled and drunks (decoction
Kiyembe	Anarcardiaceae, *Mangifera indica* – KA 009	Tree	Leaves	All listed cancer	Boiled and drunk (decoction) & burn and applied infected skin part (topical medication)
Kigadi	Asphodelaceae, *Aloe vera* – KA 010	Herb	Leaves	All listed cancers	Boiled and drunk (decoction) & burn and applied infected skin part (topical medication)
Kyikhamama (Tabululu)	Asteraceae, *Biden Pilosa* L – KA 011	Herb	Whole plant	All listed cancers	Boiled and drunk (decoction) & burn and applied infected skin part (topical medication)
Nandwasis	Acanthaceae, *Amelia caurrhiza* Del – KA 012	Herb	Leaves	All listed cancers	Boiled and drunk (decoction) & burnt and applied infected skin part (topical medication)
Namagoye	Asteraceae, *Conyza sumatrensis KA* 013	Herb	Leaves	All listed cancers	Boiled and drunk (concoction) & burnt and applied infected skin part (topical medication)
Lunyabakana	Asteraceae, *Dicrocephala integrifolia* -KA 014	Herb	Leaves	All listed cancers	Boiled and drunk (concoction) & burnt and applied infected skin part (topical medication)
Local Name	**Plant Family, Scientific Name & Voucher No.**	**Plant Habits**	**Plant Part(s) Used**	**Type of Cancer**	**Method of Application**
Kisola	*Vernonia adonsis, Vernonia adonsis* Walp – KA 015	Tree	Leaves	All listed cancers	Boiled and drunk (concoction) & burnt and applied infected skin part (topical medication)

Local Name	Plant Family, Scientific Name & Voucher No.	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of preparation & Application
Gufungo/Kifungo	Bignoniaceae, *Kigelia africana* – KA 016	Tree	All parts	Prostate and breast cancer	Concoction & topical medication
Nadanga	Bromeliaceae, *Ananasi sativa* (Retz) Walker – KA 017		All parts	Oesophageal cancer	Boiled and mixed with other plants, drunk as decoction & concoction
Kikonje	Celastraceae, *Maytnus senegalensis* -KA 018	Shrub	All parts	Cervical cancer	Boiled and mixed with other plants, drunk as decoction & concoction
Kikameli	Clusiaceae, *Garcinai Buchananii* Baker – KA 019	Tree	Leaves & stem	All listed cancers	Boiled and mixed with other plants, drunk as decoction & concoction
Nabakwana	Curcubitaceae, *Mormordica foetida* K schum -KA 020	Herb	All parts	Cervical & colon cancer	Boiled and mixed with other plants, drunk as decoction & concoction
Mukakale	Euphorbiaceae, *Rinus communis* L -K 021	Herb	All parts	Uterine fibroids	Boiled and mixed with other plants, drunk as decoction & concoction
Liakunyu	Dioscoreaceae, *Dioscaena bulbifera.* Linn -KA022	Herb	Leaves & tubers	Cervical, breast & prostate cancers	Boiled and mixed with other plants, drunk as decoction & concoction
Linzi	Draceananceae, *Dioscaena fragrans* (L.) Ker-Gawl - KA 023	Shrub	Leaves	Cervical & colon	Boiled and mixed with other plants, drunk as decoction & concoction.
Coboliwomutka	Hydnoraceae, *Hydnora abyssinca* A. Br – KA 024	Parasite	Roots	Prostate & cervical cancer	Boiled and mixed with other plants, drunk as decoction & concoction
Local Name	**Plant Family, Scientific Name & Voucher No.**	**Plant Habits**	**Plant Part(s) Used**	**Type of Cancer**	**Method of Application**
Mwoyogwemutaka	Hydnoraceae, *Hydnora africana* 025	Parasite	Roots	Prostate & cervical cancer	Boiled and mixed with other plants and drunk (decoction & concoction)
Zikolimbo	Fabaceae, *Cajanus Cajan* -KA 026	Herb	Whole plant	Breast	Burnt and applied at the infected part as ash (topical medication)
Kitugutu	Fabaceae, *Erythrina abyssinica* Lam. Ex. DC – KA 027	Tree	Stem & root bark	Cervical & oesophageal cancers	Eaten raw, Boiled, and mixed with other plants, drunk (decoction & concoction)

Local Name	Plant Family, Scientific Name & Voucher No.	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of preparation & Application
Nakikofira	Fabaceae, *Pseudarthria hookeri* Wight & Arn KA 028	Herb		Breast	Boiled and drunk (decoction)
Kikayi	Fabaceae, *Tylosema fassoglensis* (Schweinf) Torre -KA 029	Shrub	Roots	All listed cancers	Boiled and drunk (decoction) & burn and applied infected skin part (topical medication)
Kiluku	Fabaceae, *Albizia coriaria*. Welwe. ex Oliv KA 030	Tree	Root back	All listed cancers	Boiled and drunk (decoction)
Kishembe	Fabaceae, *Entada abyssinica* stued – KA 031	Herb	Whole plant	GIT & prostate	Boiled and drunk (decoction)
Mukuwe	Fabaceae, *Tamarindus indica* L - KA 032	Tree	Fruit	GIT & prostate	Crushed and taken raw (infusion) or boiled and drunk (decoction)
Wobulaka (Tuliguuye)	Lamiaceae, *Plectranthus cyanneus* -KA 033	Herb	Whole plants	Skin cancer	Crushed and taken (infusion) or boiled and drunk (decoction)
Namusiriri	Lamiaceae, *Leonotis nepetifolia* (L) R -KA 034	Herb	Whole plant	All listed cancers	Crushed and taken (infusion)
Local Name	**Plant Family**, **Scientific Name & Voucher No.**	**Plant Habits**	**Plant Part(s) Used**	**Type of Cancer**	**Method of Application**
Pekedo	Lauraceae, *Persea Americana* -KA 035	Tree	Leaves & seeds	Skin cancer	Boiled and drunk (decoction)
Murabaine	Meliaceae, *Azedaracta indica* – KA 036	Tree	All parts	All listed cancers	Boiled and drunk (decoction)
Kinywabanji	Primulaceae, *Maesa lanceolata* Forrsk -KA 037	shrub	All parts	Skin cancer	Boiled and drunk (decoction)
Jambula	Myrtaceae – *Syzygium cumini* (L) Skeels- KA 038	Tree	All parts	All cancers	Boiled and drunk (concoction) & burnt and applied infected skin part (topical medication)
Nankombi	Polygonanceae, *Rumex usambarensis* - KA 039	Herb	Whole plant	All listed cancers	Boiled and drunk (decoction)

Local Name	Plant Family, Scientific Name & Voucher No.	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of preparation & Application
Gusasa (Kilumati)	Rosaceae, *Prunus africana* (Hook.f). kalk -KA- 040	Tree	All parts	All listed cancers	Mixed with plants boiled and drunk (Concoction)
Kizambazambe	Rubiaceae, *Ribia cordifera*. Linn -KA 041	Herb	Whole parts	Lung & skin cancer	Mixed with plants boiled and drunk (Concoction)
Namayendeyende	Rhmanceae, *Gouania longispicata* Engl. (Ait) -KA 042	Shrub	Leaves	Skin cancer	Boiled and drunk (decoction) & burn and applied infected skin part (topical medication)
Zipelele	Sapindaceae, *Allophylus abyssinicus* P. Beauv – KA 043	Shrub	Whole plant	Lung cancer	Boiled and drunk (decoction)
Njetu (Nasambu Or Nefulo	Simaroubaceae, *Harrisonia abyssinca* Olivia - KA 044	Tree	All parts	All listed cancers	Mixed with plants boiled and drunk
Namuserera	Verbenanceae, *Lantana trifolia* - KA 045	Shrub	All parts	Cervical cancer	Boiled and drunk (decoction)
Nettle	Urticaceae, *Urtica dioica* L – KA 046	Herb	Root tuber	Skin cancer	Crushed and taken raw (infusion) or boiled and drunk (decoction
Local Name	**Plant Family, Scientific Name & Voucher No.**	**Plant Habits**	**Plant Part(s) Used**	**Type of Cancer**	**Method of Application**
Namakajo	Vitaceae, *Cyphosteman adenocaule* (A. Rich - KA 047	Herb	Leaves & roots	Skin cancer	Mixed with plants boiled and drunk (Concoction)
Tangawunzi	Zingiberaceae, *Zingiber officinale* -KA 048	Herb	Rhizome	Oesophageal cancer	Eaten raw or mixed with other plants boiled and drunk (Concoction)
Mabondi Gemukyigona	Hypoxidaceae. Hypoxis hemerocallidea Fish C. A. Mey. &Ave-Lall - KA 049	Shrub	Tuber	All cancer	Boiled and drunk (decoction) and topically applied

Local Name	Plant Family, Scientific Name & Voucher No.	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of preparation & Application
Lipella	Myrtaceae, *Psidium guajava* L. KA 050	Tree	Leaves	All cancer	Mixed with othe plants boiled and drunk (Concoction)
Nakibondi	Vitaceae, *Rhoicisuss tridentata* (L.f) Wild & R.B Drumm- KA 050	Shrub	Leaves & tubers	Prostate and breast	Crushed, boiled and drunk (Decoction)
Gulumati/Kilumati	Euphorbiaceae, *Margaritria discoidea* (Baill) Muell. Arg. -KA 051	Tree	Leaves and stem bark	Prostate, colon and cervical and breast	Boiled and drunk (decoction) and topically applied
Kifuti	Sapindaceae, Deinbollia fulva - fomentalla Bak.f	Tree	Fruits, and leaves	All cancer	Boiled and drunk (decoction) and topically applied
Kigakala	Phyllanthaceae, *Bridilia micrantha* (Hochst.) Bail-KA-052	Tree	All parts	Skin, prostate and cervical cancer	Boiled and drunk (decoction) and topically applied
Kimwanyimwayi	Combretaceae, Combretum mole G-don- KA 053	Shrub	Leaves	Skin, prostate and cervical cancer	Boiled and drunk (decoction) and topically applied

The herbalists shortlisted a total of 50 plant species from 36 families to have cancer-healing potential. Fabaceae and Asteraceae, with eight (8) and three (3) species, were the most pronounced, and the rest of the families had either two or one. The majority of the plant species in this study (23 species) were herbs (23, 45%) followed by trees (14, 27%) species), and only two species were parasitic plants. The findings also suggest that herbalists in these settings use a variety of different modes of herbal preparation and administration. The majority of herbs were prepared as concoctions and decoctions, with the oral administration route being the most common. However, other modes of administration, such as a topical application on the affected areas and, at times, raw consumption of the herb, were also used in herbal administration. Furthermore, we also discovered that prostate, breast, skin, gastrointestinal (GIT), and cervical cancers appeared to be most commonly cancers treated in this region by plant extracts.

Preferred Medicinal Plant Species

Table 3
Rank Values by each informant to the Preferred Medicinal Plants

MPS	PPU	KCT	KI (n = 10)									PV/100		PR
			A	B	C	D	E	F	H	I	J	K		
Tylosema fassoglensis	Tuber	All cancers,	10	10	10	10	10	10	10	10	10	10	100	1st
Hydnora abyssinica.A. Br	Tuber	Prostate, cervical & breast cancer	9	9	8	8	9	9	9	7	8	8	84	2nd
Hydnora africana	Tuber	Prostate, cervical, & breast cancer	9	9	8	8	8	9	9	7	8	7	82	3rd
Rhoicissus tridentata (L.f.) Wild & R.B. Drumm	Whole plant	Prostate, Colon & GIT cancers	6	9	8	8	8	7	7	7	7	7	81	4th
Albizia coriaria	Tuber	Skin & colon cancer	8	8	8	9	8	8	8	8	7	7	79	5th
Azadirachta indica		Lung cancer	8	8	8	8	7	8	8	8	7	7	77	6th
Prunus africana	Bark and leaves	Prostate & cervical,	8	7	8	8	7	8	8	8	7	7	76	7th
Kigelia africana	Fruit	Prostate & esophageal,	8	7	8	8	7	7	8	8	7	7	75	9th
Myrtaceae – *Syzygium cumini* (L)Skeel	Leaves	Colon & GIT cancers	8	7	8	8	6	7	8	8	7	7	74	9th
Erthrina abyssnica Lam. Ex. Dc	Stem & root barks	Colon	6	7	8	8	6	7	8	8	7	7	72	10th

Where MPS = Medicinal Plant Species, PPU = Plant Part Used, KI = key informant, PV = Plant Value and PR = Plant Rank)

A total of ten (10) of the most commonly used medicinal plants were identified and ranked based on the preferences of herbalists in treating specific cancers, including prostate cancer. *Tylosema fassoglensis* is highly ranked for its multipurpose role in treating all cancers known to the residents of this area. In terms of prostate cancer, *Hydnora abyssinica* A Br received the highest ranking, and *Hydnora africana* received the second-highest rank, then *Hypoxis hemerocallidea*. Fisch. C.A. Mey & Ave-Lall third, prunus *africana* fourth and finally *Kigelia africana* fifth.

Informant Consensus Factor (ICF)

This method was used to demonstrate the potential of plant species in treating a specific type of cancer and other ailments. The study's informant agreement was based on the treatment of prostate cancer as the central focus, with other types of cancer and other ailments managed by the same plants.

Table 4
Informant Consensus Factor (ICF or Fic)

Cancer Type	N_{taxa}	N_{ur}	F_{ic}
Prostate cancer	34	12	0.67
Cervical cancer,	33	14	0.59
Breast cancer	28	18	0.37
Colon cancer	25	24	0.04
Lung cancer	22	20	0.09
Skin cancer	19	18	0.05
Intestinal cancer	16	15	0.05
Uterine cancer	12	11	0.05
Esophageal cancer	10	08	0.22
Bone cancer	09	09	0.00
Gastrointestinal cancers	10	10	0.00

Of all cancers, prostate cancer had the highest informant consensus value (Fic = 0.67). The high ICF of prostate cancer indicated that the majority of key informants had agreed with the use of those specific species to treat specific disorders and were using them in large quantities. Apart from prostate and cervical cancer, all the other types of cancer scored less than 0.5, indicating that either herbalists partially disagreed, the plant species were less used in the treatment of specific cancer, or that there was limited knowledge exchange on the use of the plant for that particular cancer treatment. The Fic for bone and gastro-intestinal cancer scored at zero (0.0), indicating that herbalists either completely disagreed or had not used or shared knowledge of those plant species on the plant's species in the treatment of these cancers.

Table 5
Fidelity Level (FL) of Most Commonly Used Plants in Cancer and any other use by key informants

Plant species	Therapeutic use	Lp	Lu	FL (%)
Tylosema fassoglensis	All cancers	32	36	88.9
Hydnora abyssinica A. Br	Prostate cancer	31	33	93.9
Hydnora africana	Prostate	28	33	84.8
Rhoicissus tridentata (L.f.) Wild & R.B Drumm	Prostate and Colon	35	39	89.7
Azidarachata indica	Lung cancer	35	38	92.1
Prunus africana	Prostate	28	34	82.4
Kigelia africana	Prostate & oesopahagel cancer	27	34	79.4
Albizia coriaria	Skin cancer	35	40	87.5
Syzygium cumini (L) Skeels	Gastrointestinal cancer	12	16	75.0
Plectranthus cuanneus	Gastrointestinal cancer	05	07	71.4

Our findings revealed that all 10 key plants had fidelity levels was above 50%, indicating that the plants were preferred by the herbalists, particularly in cancer treatment. The fidelity level (FL) for *Hydnora abyssinica* A. Br is 93.9%, 84.8% *Hydnora africana*, *Hypoxis hemerocallidea*. Fisch. C.A. Mey & Ave-Lall (89.7%) *Prunus africana* (82.4%) and *Kigelia africana* (79.4%) for prostate cancer management.

The most commonly used plant part was the leaves (86%), followed by stem bark (63%), roots and fruits (44%), and whole plants (25%). When compared to other plant parts, the high utilization of leaves could be attributed to the ease with which they can be obtained and the presence of highly pharmacologically active compounds such as tannins and alkaloids compared.

Herbs were discovered to be the most common plant growth habit (45%), followed by trees (27%), and parasites scored the lowest (9%). Herbs' popularity as alternative cancer therapies may be partly due availability all year-round and also highly enriched content of pharmacologically active ingredients when compared to other plant habits.

The current study found that the majority of medicinal plants were collected from the outskirt of forest reserves. For example, 60 percent of the recorded medicinal plants were collected from the Elgon Mountain Forest Reserve's periphery. The rest was gathered from nearby grasslands (25%), nearby homestead gardens (15%), or both cultivated and collected from a nearby forest reserve (7%).

The herbalists demonstrated the use of various methods for preparing herbal extracts and administering herbs to their clients. The methods used differed depending on the plant and the type of cancer in question. Most (86%) herbalists could combine more than one plant, and boil (make a concoction) to administer orally (drink). The findings further indicate that 15% of herbalists believe that boiling a single herb can treat some cancer (decoction). Depending on the type of cancer, drying, crushing, and mixing with cold water (cold infusion), eating raw or burnt ash, and either applying to the infected or taking it orally, depending on the type of cancer, were also revealed.

DISCUSSION

We conducted a descriptive cross-sectional ethnobotanical survey in districts of Sironko and Bulambuli, which located 275.9 km and 306.8 km east of Kampala, Uganda's, Capital City respectively indicating the remoteness of the areas.

According to the findings, the majority of the participants were male (38, 84%), Ugandan, married and had only had attained primary education. A total of fifty (50) medicinal plants from 36 families were shortlisted to have several anticancer properties. The majority of medicinal plants grew herbaceously and plant were mostly collected from peripheral forest reserves. The leaves were the most commonly used parts were, which were prepared as concoction administered orally. The acquisition of herbal knowledge across generations depended heavily on family history. According to the informant consensus factor, *Tylosema fassoglensis* was favored for its versatility in cancer treatment. The majority of herbalists favor and believe in Hydnora abyssinica A. Br. as a treatment for prostate cancer.

Socio-demographic Profiles of the Respondents

Males outnumbered females in our study (X^2 = 48.0909, 95% Cl = 4.1876–6.4999%, P < 0.0001) (Table 1). Ssenku et al[25], Heinrich [26] &. Hassan et a [27] also discovered that men outnumbered women in the herbal industry in rural areas of Uganda, Mexico and Ethiopia respectively. These findings support the African belief that herbalists are a male dominated profession. In contrast, Septiani [28] revealed that majority of herbalists in Indonesia were female and this was attributed to differences in cultural environment of the study area as well as the purpose type of herbs under investigation. For example, the current study was carried out in a rural setting of Sironko and Bulambuli districts as opposed to the previous study which was conducted in Jakarta city, Indonesia with different cultural set-up and developmental level and specifically focuses on herbs for the toothpaste, a hygienic practice which is inclined to females over males. Most participants (33.3%) were aged between 51 and 55 (Table 1). The majority of herbalists in the current study were between the ages of 51 and 55 (X2 = 16.900, 95%CL = 3.2451–6.6206%, P 0.0001), which falls outside the desirable age range of 31–45 for the continuation, expansion, and sustainability of the herbal industry[29]. Additionally, in Kampala and Kaduna State in Nigeria, respectively, Walusansa *et al* [30] and Onwudinjo *et al* [31] noted that the majority of herbalists were older than the desirable age range of 31–45 years, emphasizing this potential risk factor for this industry's demise. In addition, most of the participants had just finished elementary school (X^2 = 66.7805, 95% Cl = 71.474–109.522%, P < 0.0001) and were of low literacy class. This is consistent with our previous study, which discovered that most herbalists in the Sironko district had limited knowledge and a poor perception of the concept of cancer due to high illiteracy [32]. This could be attributed to the fact that most herbalists spent their childhood learning about herbal medicine knowledge at the expense of secular education, implying that such an industry cannot be expanded to the next level of the pharmaceutical industry in the hands of such people.

"Culturally, we in Nakidobo and Zema village, *herbal practice is more of a responsibility for males, so females are rarely involved, except under special circumstances like maternity services and hygiene practices, and these are especially encouraged only for older women"* said one of the senior herbalists from *Nakidobo*." *"I became involved in herbal treatment when I was 10 years old; we could not go far with formal education" One important herbalist from* Makogati village. The age, gender, and dynamic knowledge best explain these narratives, claiming the socio-cultural and demographic traits such as age, gender, literacy or formal education are all dynamic knowledge hypotheses Orou et al [32] which suggests that "socio-cultural and demographic traits such as gender, age, and literacy or formal education are all correlated with an individual's level of knowledge." Older women have a better understanding of the local medicinal flora. Higher literacy and formal education are frequently inversely related to medicinal plant knowledge. All the above responses support this hypothesis, with exception of women because cultural norms in Elgon limit women's involvement in the herbal industry, and women are only involved to a lesser extent under special circumstances.

Source of Knowledge of Medicinal Plants

The research revealed that 67% of herbalists in this profession claimed to have acquired this knowledge from their parents or grandparents, with the remaining 33% saying they learned it via acquaintances, peers, or spiritual guidance (Fig. 2). This suggested that the sub-region's herbal sector is strongly dependent on family history and informal education, both of which have a negligible impact on attainment and led to illiteracy among herbalists [34]. Similar findings were made in the Buteleja district by Ssenku *et al* [25], who found that due to inherited survival instincts, knowledge from parents and grandparents was the most crucial source of information for herbalists in this region. In Saudi Arabia, Ghamdi[33] found that the majority of herbalists claimed to have learned about herbs via friends, which is less frequently cited in the current study, while neighbors were almost never mentioned.

In addition to the foregoing, the following are some of the key responses obtained from interviews: *"My father and a grandfather both of whom lived in Jewa village, used to take me to a senior herbalist, who began showing me the*" *plant he used to treat various ailments, I began treating patients with specific ailments between the age 10 and 15 years ago*, according to the senior herbalist in Bulaba village.*" "I learned to treat various diseases including cancer from my family, friends, and peers."* Said and an elderly herbalist who claimed to be 70 years old. The above hypothesis of social networks as a driver of knowledge dynamics Orou *et al* [34], proposes that "peer influence and how this influences the transmission of knowledge will also depend on family background, age, gender, and whether a given community is rural or urban." As a result, societal practices, behaviors, and levels of development are important motivators for acquiring any knowledge, about the use of plant medicine.

Source of Medicinal Plants

The majority of therapeutic plants were shown to have been harvested close to forest reserves, according to the current study. For instance, 61% of the therapeutic plants that were reported came from the periphery, with 33% coming from other sources (Fig. 5). The reason why there aren't many medicinal plant gardens is likely due to their survival urge to keep information to themselves. The herbalists who lived in the vicinity of the Mabira forest primarily collected their herbs from the wild rather than domesticating them, according to a prior study by Tugume et al[35] his was caused in part by the requirement for concealment as well as the fact that certain plants were more prevalent in the wild.

Respondents stated in their interviews with local leaders in Sigma and Zema that "though we have *plans to create a garden we have not domesticated plants for making herbal therapies because they are abundant in the wild and within walking distance." Domesticating of herbal plants according to an elderly person from Zema said that domesticating my herbal plants is something I don't want to do because it would mean giving up my source of income. According to a local leader "they are no enough land to domesticate these medicinal plants, and so are collected when need arise."* In line with this, the "resource availability hypothesis" investigates the location where people collect plants and more broadly correlates the local abundance or dominance of plants with plant uses. Domestication of the plant according to this theory is governed by the availability of the plants in the wild, their accessibility, and their intended use. In such cases, herbalists are hesitant to domesticate herbal plants to keep their use a secret, especially if there is the certainty of a constant supply from the wild

Medicinal Plants Used in the Treatment and Management of Cancer

The results of our study were quite intriguing and unexpected because herbalists had reduced down a large number of plant species to 45 species from 33 families that were supposed to have anticancer properties. The Fabaceae family encompassed the majority of the species (7 species) with anticancer therapeutic advantages (Table 2). The

availability of these plant species in this region relative to other species was a factor in their use[36]. The Fabaceae family is widely used since the majority of its members are either herbs or shrubs, which grow and reproduce quickly. The Fabaceae family is widely used since the majority of its members are either herbs or shrubs, which grow and reproduce quickly. Additionally, they are widely dispersed in this region, which makes them readily available and reasonably priced all year round. In terms of species, Hydnora abyssinica (19) was the most favored and relied upon species for treating prostate cancer, while Tylosema fassoglensis (Schweinf.) and Torre & I (22) had the highest frequency in their multipurpose role in cancer treatment. The use of plant extracts in the treatment of cancer can be explained by the fact that these plants are widely available, inexpensive, culturally acceptable, and, most importantly, thought to be safe for human consumption. A similar observation was made by Tugume et al[37], but with more species in the vicinity of Mabira for using plants to heal various illnesses. Their study explored a wider range of plant species for the treatment of numerous ailments, in contrast to current research, which concentrated on plant species for cancer treatment, which may account for the study's increased species diversity[36]. [38, 39, 40, 41,& 42].

Plant Growth Habits

Herbs were found to have the most common growth behaviors (45%), while parasitic plant species had the fewest (9%) (Fig. 4). Herbs are the most widely used medicinal growth habit, according to earlier studies by Abera[43], Tugume *et al*[44] &, Omara *et al*[36] his is due in part to their year-round availability as well as the fact that they contain high concentrations of a number of active secondary metabolites, including flavonoids, alkaloids, phenol, tannin, and anthraquinones. The results also agree with the Uprety et al[43] assessment on the prevalence of herb cultivation and their main application. n contrast to the study in question, which was done in forest settings where trees are more frequent, Maroyi[45] found that trees and shrubs were the most regularly used plant habits.

Some local leaders and elders in villages of Nakidobo, Makogati, Jewa, and Bulaba villages during interview with herbalist stated that "*we normally use small weeds as herbs in this area because they are abundant and available almost through the year and have also cured our patients after use." "However, they also stated they I also use some parts of the plant, such as stems, barks, and roots, despite the fact the they are sometimes far from our homes." "In deed according to the senior herbalist in Sigma village said that some the key plants are collected as far as 30 kilometers from my home because they are very important*. "The findings support the availability hypothesis as well as the theory of non-random medicinal selection According to the resource availability hypothesis "plant species adapted to high resource environments (e.g., high light, nutrient-rich habitats) are more likely to grow quickly and employ qualitative defenses, whereas species in low resource environments (e.g., low light, nutrient-poor habitats) are likely to grow slowly and employ a high level of defenses, primarily quantitative but also qualitative." The Journal titled Theories and Major Hypotheses in Ethnobotany, it explains why some plant species in a given habitat are used more than others, based on their medicinal importance, accessibility, and affordability." The theory of non-random selection predicts that the selection of medicinal plants is not random. The number of medicinal plant families in a given region area would be a factor.

Plant Parts Used

The most frequently utilized plant parts in the Elgon sub-region for the treatment of cancer were leaves (86%), followed by stem bark (63%), and rhizome-like (25%; Fig. 3). Peripheral portions are employed often, which has been linked to their accessibility and the fact that they serve primarily as storage sites for active secondary metabolites. Since leaves had the largest quantities of phytochemicals with anticancer potential, it was once again proven that they were the portions most frequently employed in cancer treatment [35]. Although at varying frequency, earlier observations on the predominance of ancillary parts such leaves, stem barks, roots, and fruits in cancer treatment have been published [38&39]. Because their removal offers little harm to the plant's existence and so improves

conservation and sustainability, the major usage of leaves may also be related to the survival rates of medicinal plants [34]. In other publications on the medicinal plant parts employed, it was also mentioned that leaves were extremely concentrated and diverse with potent secondary metabolites as compared to other plant parts. This was demonstrated by their extensive use in illness management by international communities The high concentration of active secondary metabolites found in the roots of the plant species used was attributed to the widespread use of roots in disease treatments and management by traditional practitioners among the Market community in Kenya and Ethiopia's Berbere district, as revealed by the research by Jima & Megersa[48] & Wanjohi *et al* [49]. The restricted use might have been influenced by the fact that Hydnora species are thought to be hardly dispersed broadly.

In response to an in-depth interview with key informant, *one of elderly from Zema village stated, " we normally use leaves to prepare herbal therapies because they are readily available and effective." Some leaves have more medicinal properties than to the stem and root barks, which are very promising. "I uproot a small plant, boil it, and give it to my patients, who are cured after a while depending on the type of disease."* The responses can be best understood based on the resource availability hypothesis [34], which tends to propose "that the distribution of secondary chemistry within a given plant drives the selection of plant organs for medicinal purposes." The optimal defense theory provides a framework to understand why people would select roots instead of leaves from the same plant for medicinal plants.

Preparation and administration Mode

Different methods of preparation and administration were used by the herbalists in this area; depending on the type of cancer and the plant in question (Fig. 6). The majority of the herbalists used concoctions (86%) because most herbalists believed that no single plant could be effective in the management of a specific type of cancer. Rick-Leonid Ngoua-Meye-Mis *et al.* opined that combination therapies enhanced the effectiveness of medicinal plants as compared to using a single plant species used alone[50]. Furthermore, Calzada & Bautista [51] demonstrated that to effectively cure GIT cancers and other digestive disorders, a combination of therapies of up to 32 plant species are required. On the contrary, a study in Indonesia Alemayehu *et al*[26] found that decoction was widely used in therapies for the treatment of several diseases, not only due to its simplicity, ease of handling and preparation, and affordability but because of its increased efficiency and effectiveness in cancer management[47&48]. The findings also revealed that some herbal plants such *Zingiber officinale* (Tangawuzi) and *Allium sativa* (Kachuum and Kitungulu) could be consumed raw and were more effective in this regard.

“We *normally use a mixture of plants and instruct our patients to drink them in the morning and at night because I believe that is the most effective means of treatment, and it can take half a nice cup for two to three months to cure." The herbalist in* Zema, Nakidobo, and Makogati said during the interview. *"an herbalist from Jewa said “in most cases, I don’t trust the use of a single plant to boil to treat a given disease, which is why I mix three or more, but every now and then, I can use one, which I believe is the strongest, for just a month." An elderly man among herbalist said “treatment of patients with herbs is determined by the type of cancer I have “. For all other cancers, I boil various plants and patients, but for not skin cancer”, A local leader and senior herbalist advised me to burn into ash and apply it topically to the affected area, while also drinking the same plants for three months*." The optimal foraging theory borrowed from ecology and applied to ethnobotany can explain these responses [34]. According to this theory, "a person will place a higher value on a plant that yields more benefit per unit of foraging or processing time." As the abundance of plants with higher values increases, plants with lower values will no longer be used, and the individual will have a quantitative threshold for when the specific plants should be included or excluded. In this way, the plant has been adopted in ethnobotany to select a plant for food, medicine, and construction, among others.

Different Types of Cancer Treated by Medicinal Plants

Our research also showed that *Tylosema fassoglensis* is preferred by the majority of herbalists for use in treating cancer. Other plant species, however, were investigated for a variety of malignancies. Most herbalists in this field favor and rely on plants like *Prunus africana, Kigelia africana*, *Hydnora abyssinica* A. Br., *Hydnora africana*, Hemerocalliadea Fisch, C.A. Mey & Ave-Lall, and *Hydnora abyssinica* for treating prostate cancer. Most commonly used to treat malignancies like lung, skin, colon, and gastrointestinal cancers are other plant species include *Azadirachta indica*, *Albizia coriaria, Syzygium cumini* (L) Skeels, and *Plectranthus cuanneus*. According to Omara et al[36] plant species from the Malvaceae and Molingaceae families have a strong potential for curing a number of cancers. This was explained by the presence of several anticancer phytochemicals, including alkaloids, phenols, flavonoids, tannins, and others.

Informant Consensus Factor (ICF)

We also found that, with the exception of prostate and cervical cancers, every other cancer scored ICF below 0.5, showing that herbalists are less familiar with other plant species in the treatment of particular malignancies (Table 4). The low ICF suggested that the plant species were many or unreliable among herbalists, or that there were few plants now recognized to be employed in cancer treatment in this region. Ssenku et al [19] discovery of low ICF in the Buteleja district of Uganda was also explained by the study's location in a remote area with little diagnostic resources. Even so, cancer signs and symptoms (such as headache, urinary tract issues, diarrhea, vomiting, lethargy, and headache) can be readily misdiagnosed. The contrasts between the current study's findings and those of earlier ones [34, 35, 36], which showed that China, Indonesia, and Ethiopia had extremely high ICF levels, could be ascribed to variations in the study's geographical setting, the educational backgrounds of its participants, and the diseases that were being studied. For instance, in contrast to the current study, their research focused on a number of diseases and was conducted among persons with greater literacy levels.

Fidelity Level of the Most Preferred Plants

The fidelity level (FL) of the top 10 anticancer plants was better than 50% in every case, showing that local herbalists were comfortable employing these plant species to treat cancer (Table 5). In this region, Tylosema fassoglensis achieved a 100% success rate in treating all of the prevalent cancer types. For the treatment of prostate cancer, Hydnora abyssinica A. Br. worked better (84%) than other often mentioned plant species. Their widespread usage in the prevention or treatment of cancer is due to the presence of bioactive chemicals. The anticancer plants *Tylosema fassoglensis* A. Br., *Azadirachta indica*, and *Albizzia coriaria* showed higher quantities of tannin, alkaloids, polyphenols, and flavonoids than those gathered in other parts of Uganda, according to a previous study.[53] [36]. Previous research by Onwudinjo, Onwudinjo & Ilo [31], Kudamba et al [32], and Welz, Emberger-Klein &Menrad,[54] previously conducted studies and found that the most popular anticancer plants contain phytochemical properties like alkaloids, steroidal saponins, polyphenolics, rosmarinic acid, artemisinin, diterpenes, flavonoids, phenolics, B-sito One of the elements that affects the anticancer potential, which is governed by dosage and duration directly related to phytochemical concentration, which is determined by plant habitat conditions, has also been named as habitat condition[36].

An in-depth interview with key informant among males aged 51–60 from *Sigma, Jews, and Bulaba villages*, yielded the following responses: *"We normally use a certain plant that is nearby my homestead as prescribed by our grandparents; some plants are very effective in treating cancer, but some are, honestly speaking, far away, and some are in protected areas of the forest and cannot be easily accessed." "*Another elder from *Bulaba* village claimed to treat his treat my cancer patient with plants that are readily available and accessible throughout the year". These responses

are best understood by applying the "Plant Values Hypothesis" Orou *et al*[34], which proposes that "the use of plants by a given community as medicine, food, or construction is directly related to the botanic family, life form, and local abundance." According to the availability hypothesis of plant use, the use of the plant by a given community is largely governed by its accessibility and affordability.

Conclusions and Recommendations

The study revealed that local populations in the Elgon sub-region frequently use herbal treatments made from a range of plant species to treat various malignancies. When using plant treatments, the indigenous knowledge showed substantial increases with age but not with education level. The study revealed that local populations in the Elgon sub-region frequently use herbal treatments made from a range of plant species to treat various malignancies. When using plant treatments, indigenous knowledge showed substantial increases with age but not with education level. A total of 50 plant species have been reported to treat 10 different malignancies, with the therapy of prostate cancer being most strongly associated with Hydnora abyssinica A. Br., *Hydnora africana, Rhoicissus tridentata* (L.f.) Wild, and R. B. Drumm. The bulk of the plants identified in our study have been documented as being utilized in the same region as well as in other parts of the country to treat other illnesses, demonstrating their potential efficacy. Herbs make up the majority of species, followed by trees, and parasites make up the least number. Despite the fact that many remedies are prepared by decoction and are often taken orally after being applied topically to cure skin cancer, leaves and stem barks are the most frequently employed plant parts in making remedies. There is scant ethnobotanical evidence of these plants in the Elgon subregion, despite the fact that Ugandans continue to extensively rely on some plant species for cancer treatment. Therefore, the plant with the highest informant consensus factor, loyalty rating, and preference rating could be useful in future pharmaceutical and conservation operations. To profile their phytochemistry, toxicology, and efficacy assessments, more research is needed.

Declarations

Ethical approval and Consent to participate

The School of Biomedical Sciences Research Ethics Committee at Makerere University approved this study (SBS-2023-320). The Uganda National Council of Science and Technology, also registered this study (UNCST). Local officials from the Sironko and Bulambuli, including the LC1 chairpersons granted permission to visit these settlements. The investigators gave the respondents explanation on the purpose of the study and received their informed consents and thumbprints-registered. Participants also, orally agreed to the auto-recording of the discussion and shooting pictures during the study. In order to protect the privacy of the date, the participants were not required to submit their names in any ways.

Consent for Publication

The participants provided voluntary informed consent for publication of the study findings. Codes were used instead of participants identifiers to maintain anonymity.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Competing Interests

The authors declare that there is no conflict of interest.

Funding

This research was fully funded under the research and innovation grant awarded to the Islamic University of Uganda (IUIU) by the Islamic Development Bank (IsDB).

Authors' Contribution

AK, JNK, HM, GSB, AMD & MO contributed to the conceptualization of the study and revision of manuscript. AK, JES, SOA, HMK, AW & ML gathered and analyzed the data, and wrote the draft manuscript. JNK, HM, GSB, HW, AL & NN were supervisors and senior advisors in the study. They reviewed, read and approved the final manuscript. All the authors read and approved the final manuscript.

Acknowledgment

Sincere thanks go to local leaders and elders in Elgon sub-region who served as gatekeeper to community access in this area; without them this work would not has been possible. We are grateful to the administration of the Islamic University in Uganda (IUIU) in partnership with the Islamic Development Bank (IDB) for their financial and moral support in making this work a success of this work. We also thank Dr. Robert Kalyesubula, the Head of the Department of Physiology at Makerere University and other departmental staff for on-going guidance, physical and moral support throughout the article writing process. We also acknowledge Dr. Freddie Bwanga, a senior lecturer in the Department of Microbiology for his financial and technical advice rendered to us during the shaping of this study.

References

1. R. M. Feng, Y. N. Zong, S. M. Cao, and R. H. Xu, "Current cancer situation in China: Good or bad news from the 2018 Global Cancer Statistics?," *Cancer Commun.*, vol. 39, no. 1, Apr. 2019, doi: 10.1186/s40880-019-0368-6.
2. F. Bray, J. Ferlay, I. Soerjomataram, R. L. Siegel, L. A. Torre, and A. Jemal, "Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries," *CA. Cancer J. Clin.*, vol. 68, no. 6, pp. 394–424, 2018, doi: 10.3322/caac.21492.
3. W. . London, J. . Petrick, K. . McGlynn, and A. . Lindsey, *Cancer Epidemiology and Prevention.* Oxford: Oxford University Press, 2018.
4. B. Benarba, "Medicinal plants used by traditional healers from South-West Algeria: An ethnobotanical study," *J. Intercult. Ethnopharmacol.*, vol. 5, no. 4, p. 320, 2016.
5. D. Singh, S. Vaccarella, A. Gini, N. De Paula Silva, E. Steliarova-Foucher, and F. Bray, "Global patterns of Hodgkin lymphoma incidence and mortality in 2020 and a prediction of the future burden in 2040," *Int. J. Cancer*, vol. 150, no. 12, pp. 1941–1947, 2022.
6. D. Adeloye *et al.*, "An estimate of the incidence of prostate cancer in Africa: a systematic review and meta-analysis," *PLoS One*, vol. 11, no. 4, p. e0153496, 2016.
7. F. Bray *et al.*, "Cancer in sub-Saharan Africa in 2020: a review of current estimates of the national burden, data gaps, and future needs," *Lancet Oncol.*, vol. 23, no. 6, pp. 719–728, 2022, doi: https://doi.org/10.1016/S1470-2045(22)00270-4.
8. P. Katongole, O. J. Sande, M. Joloba, S. J. Reynolds, and N. Niyonzima, "The human microbiome and its link in prostate cancer risk and pathogenesis," *Infect. Agent. Cancer*, vol. 15, pp. 1–8, 2020.
9. J. Asasira *et al.*, "Infection-related and lifestyle-related cancer burden in Kampala, Uganda: projection of the future cancer incidence up to 2030," *BMJ Open*, vol. 12, no. 3, p. e056722, 2022.

10. et al. Mohammed, Hamdoon A., "'Bio-Evaluation of the Wound Healing Activity of Artemisia judaica L. as Part of the Plant's Use in Traditional Medicine; Phytochemical, Antioxidant, Anti-Inflammatory, and Antibiofilm Properties of the Plant's Essential Oils.,'" *Antioxidants*, vol. 11, no. 2, p. 332, 2022.
11. T. Omara *et al.*, "Antivenin plants used for treatment of snakebites in Uganda: ethnobotanical reports and pharmacological evidences," *Trop. Med. Health*, vol. 48, no. 1, pp. 1–16, 2020.
12. N. R. Farnsworth and D. D. Soejarto, "Global importance of medicinal plants," *Conserv. Med. plants*, vol. 26, pp. 25–51, 1991.
13. J. Friedman, Z. Yaniv, A. Dafni, and D. Palewitch, "A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel," *J. Ethnopharmacol.*, vol. 16, no. 2–3, pp. 275–287, 1986.
14. S. B. Obakiro *et al.*, "Ethnobotany, ethnopharmacology, and phytochemistry of traditional medicinal plants used in the management of symptoms of tuberculosis in East Africa: a systematic review," *Trop. Med. Health*, vol. 48, no. 1, pp. 1–21, 2020.
15. P. Tugume *et al.*, "Ethnobotanical survey of medicinal plant species used by communities around Mabira Central Forest Reserve, Uganda," *J. Ethnobiol. Ethnomed.*, vol. 12, no. 1, pp. 1–28, 2016.
16. F. B. Kyazze, N. Mubangizi, P. I. Mukwaya, and S. Kyamanywa, "Using indigenous knowledge to enhance rainfall forecasts among smallholder farmers in Mt. Elgon Region, Eastern Uganda," *Agric. Ecosyst. Resil. Sub Sahar. Africa Livelihood Pathways Under Chang. Clim.*, pp. 691–713, 2019.
17. G. J. Martin, "Ethnobotany: a methods manual," 1995.
18. B. Allan, N. Gorettie, J. J.N, G. . Michael, and A. Banana, "Perceptions of Climate Variability in the Mt. Elgon sub-region, Eastern Uganda. Cogent Environmental Science.," 2016.
19. J. E. Ssenku *et al.*, "Medicinal plant use, conservation, and the associated traditional knowledge in rural communities in Eastern Uganda," *Trop. Med. Health*, vol. 50, no. 1, pp. 1–10, 2022.
20. T. Deeb, K. Knio, Z. K. Shinwari, S. Kreydiyyeh, and E. Baydoun, "Survey of medicinal plants currently used by herbalists in Lebanon," *Pak. J. Bot*, vol. 45, no. 2, pp. 543–555, 2013.
21. D. Kipiro and K. . Robert, ""Laboratory Manual For Collecting and Processing of plant species & Processing of Plant Samples 2017," 2017.
22. G. J. Martin, "Ethnobotany: a methods manual, Chapman y Hall," *Nowy Jork*, 1995.
23. R. Hu, C. Lin, W. Xu, Y. Liu, C. Long, and ., "Ethnobotanical study on medicinal plants used by Mulam people in Guangxi, China.," *J Ethnobiol Ethnomed.*, vol. 16, no. 1, p. 40, 2020.
24. M. Heinrich, A. Ankli, B. Frei, C. Weimann, and O. M. Sticher, "edicinal plants Med., in Mexico: healers' consensus and cultural importance.," *Soc Sci*, vol. 47, no. 11, pp. 1859–71. P, 29., 1998.
25. J. E. Ssenku *et al.*, "Medicinal plant use, conservation, and the associated traditional knowledge in rural communities in Eastern Uganda," *Trop. Med. Health*, vol. 50, no. 1, pp. 1–10, 2022, doi: 10.1186/s41182-022-00428-1.
26. A. Farooq, M. S. Amjad, K. Ahmad, M. Altaf, M. Umair, and A. M. Abbasi, "Ethnomedicinal knowledge of the rural communities of Dhirkot, Azad Jammu and Kashmir, Pakistan," *J. Ethnobiol. Ethnomed.*, vol. 15, no. 1, 2019, doi: 10.1186/s13002-019-0323-2.
27. D. Hassan, B. Omer, F. Salih, and M. D. Abdulrahman, "Medicinal Plants Used for Immune Booster in The Kurdistan Region, Iraq," *NAYREC-2022*, p. 39, 2022.
28. S. Septiani *et al.*, "Choosing Herbal Toothpaste: Study on Consumer Behavior and Preferences in The Greater Jakarta Area," *J. Apl. Bisnis dan Manaj.*, vol. 8, no. 3, p. 758, 2022.

29. C. A. Monteiro, G. Cannon, J.-C. Moubarac, R. B. Levy, M. L. C. Louzada, and P. C. Jaime, “The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing,” *Public Health Nutr.*, vol. 21, no. 1, pp. 5–17, 2018, doi: DOI: 10.1017/S1368980017000234.
30. A. Walusansa *et al.*, “Herbal medicine used for the treatment of diarrhea and cough in Kampala city, Uganda,” *Trop. Med. Health*, vol. 50, no. 1, pp. 1–21, 2022.
31. L. E. Onwudinjo, O. H. Onwudinjo, and W. N. Ilo, “Rural-rural migration in Sub-saharan Africa: A study of farmers and artisans in Ezeagu Local Gov-ernment Area of Enugu State, Nigeria.”
32. A. Kudamba *et al.*, “Assessment of Knowledge, Perception, Attitude, Risk Factors Prevention, and Treatment Options of Cancer among Natives in Elgon Sub-Region, Uganda. Fortune Journal of Health Sciences 5 (2022): 472-487.,” *Fortune J. Heal. Sci.*, vol. 5, no. 2022, pp. 472–487, 2022.
33. M. M. A. Akeel, W. M. A. Ghamdi, S. A. Habib, M. Koshm, and F. A. Otaibi, “Herbal medicines: Saudi population knowledge, attitude, and practice at a glance,” *J. Fam. Med. Prim. Care*, vol. 7, no. 5, p. 865.
34. G. . Orou, A. . Michael, B. Mathew, H. Georgia, C. . Barnabas, and M. Heather, “Theories and Major Hypotheses in Ethnobotany,” New York: New York Botanical Garden Press, Bronx, 2017.
35. P. Tugume *et al.*, “Ethnobotanical survey of medicinal plant species used by communities around Mabira Central Forest Reserve, Uganda,” *J. Ethnobiol. Ethnomed.*, vol. 12, no. 1, 2016, doi: 10.1186/s13002-015-0077-4.
36. T. Omara *et al.*, “Medicinal plants used in traditional management of cancer in Uganda: a review of ethnobotanical surveys, phytochemistry, and anticancer studies,” *Evidence-Based Complement. Altern. Med.*, vol. 2020, 2020.
37. A. Farooq, M. S. Amjad, K. Ahmad, M. Altaf, M. Umair, and A. M. Abbasi, “Ethnomedicinal knowledge of the rural communities of Dhirkot, Azad Jammu and Kashmir, Pakistan,” *J. Ethnobiol. Ethnomed.*, vol. 15, no. 1, Aug. 2019, doi: 10.1186/s13002-019-0323-2.
38. J. A. Oduma, “Medicinal plants used in treatment and management of cancer in Kakamega County, Kenya,” 2013.
39. F. Ocheng *et al.*, “Essential oils from Ugandan medicinal plants: in vitro cytotoxicity and effects on IL-1β-induced proinflammatory mediators by human gingival fibroblasts,” *Evidence-based Complement. Altern. Med.*, vol. 2016, 2016.
40. I. L. Jung, J. H. Lee, and S. C. Kang, “A potential oral anticancer drug candidate, Moringa oleifera leaf extract, induces the apoptosis of human hepatocellular carcinoma cells,” *Oncol. Lett.*, vol. 10, no. 3, pp. 1597–1604, 2015.
41. D. S. Vinay *et al.*, “Immune evasion in cancer: Mechanistic basis and therapeutic strategies,” in *Seminars in Cancer Biology*, 2015, vol. 35, pp. S185–S198, doi: 10.1016/j.semcancer.2015.03.004.
42. E. ELFRIDA, N. S. TARIGAN, and A. B. Suwardi, “Ethnobotanical study of medicinal plants used by community in Jambur Labu Village, East Aceh, Indonesia,” *Biodiversitas J. Biol. Divers.*, vol. 22, no. 7, 2021.
43. D. Rana, A. Bhatt, and B. Lal, “Ethnobotanical knowledge among the semi-pastoral Gujjar tribe in the high altitude (Adhwari’s) of Churah subdivision, district Chamba, Western Himalaya,” *J. Ethnobiol. Ethnomed.*, vol. 15, no. 1, 2019, doi: 10.1186/s13002-019-0286-3.
44. J. Tugume, P., Kakudidi, E. K., Buyinza, M., Namaalwa, J., Kamatenesi, M., Mucunguzi, P., & Kalema, “Ethnobotanical survey of medicinal plant species used by communities around Mabira Central Forest Reserve, Uganda.,” *J. Ethnobiol. Ethnomedicine,* vol. 12, no. 1, p. 5, 2016, doi: doi:10.1186/s13002-015-0077-4.
45. A. Maroyi, “A comparative study of medicinal plants used in rural areas of Namibia and Zimbabwe,” 2015.
46. S. S. Kankara, M. H. Ibrahim, M. Mustafa, and R. Go, “Ethnobotanical survey of medicinal plants used for traditional maternal healthcare in Katsina state, Nigeria,” *South African J. Bot.*, vol. 97, pp. 165–175, 2015.

47. M. I. SUPIANDI, S. MAHANAL, S. ZUBAIDAH, H. JULUNG, and B. Ege, “Ethnobotany of traditional medicinal plants used by Dayak desa Community in Sintang, West Kalimantan, Indonesia,” *Biodiversitas J. Biol. Divers.*, vol. 20, no. 5, 2019.
48. T. T. Jima and M. Megersa, “Ethnobotanical study of medicinal plants used to treat human diseases in Berbere District, Bale Zone of Oromia Regional State, South East Ethiopia,” *Evidence-Based Complement. Altern. Med.*, vol. 2018, 2018.
49. B. K. Wanjohi, V. Sudoi, E. W. Njenga, and W. K. Kipkore, “An ethnobotanical study of traditional knowledge and uses of medicinal wild plants among the Marakwet Community in Kenya,” *Evidence-Based Complement. Altern. Med.*, vol. 2020, 2020.
50. R.-L. .-M. Missoa, C. Sima-Obinga, J. D. L. . Ndonga, J. . Ondo, G. . Ndong-Atom, and et al. Abessolo, F.O, “Medcinal Plants Used in the Management of Cancer and Other Related Diseases in In Woleu-Ntem Provice, Gabon.,” *Eurpoen J. Integr. Med.*, vol. 29, p. 100924., 2019.
51. F. Calzada and E. Bautista, “Plants used for the treatment of diarrhoea from Mexican flora with amoebicidal and giadicidal activity, and their phytochemical constituents,” *J. Ethnopharmacol.*, vol. 253, p. 112676, 2020.
52. G. Komlaga *et al.*, “Medicinal plants and finished marketed herbal products used in the treatment of malaria in the Ashanti region, Ghana,” *J. Ethnopharmacol.*, vol. 172, pp. 333–346, 2015.
53. A. Kudamba *et al.*, “Phytochemical Profiles of Albizia coriaria, Azadirachta indica, and Tylosema fassoglensis Used in the Management of Cancers in Elgon Sub-Region,” *Fortune J. Heal. Sci.*, vol. 5, no. 3, pp. 461–471, 2022.
54. A. N. Welz, A. Emberger-Klein, and K. Menrad, “Why people use herbal medicine: insights from a focus-group study in Germany,” *BMC Complement. Altern. Med.*, vol. 18, no. 1, pp. 1–9, 2018.

Plates

Plates 1 and 2 are available in the Supplementary Files section.

Figures

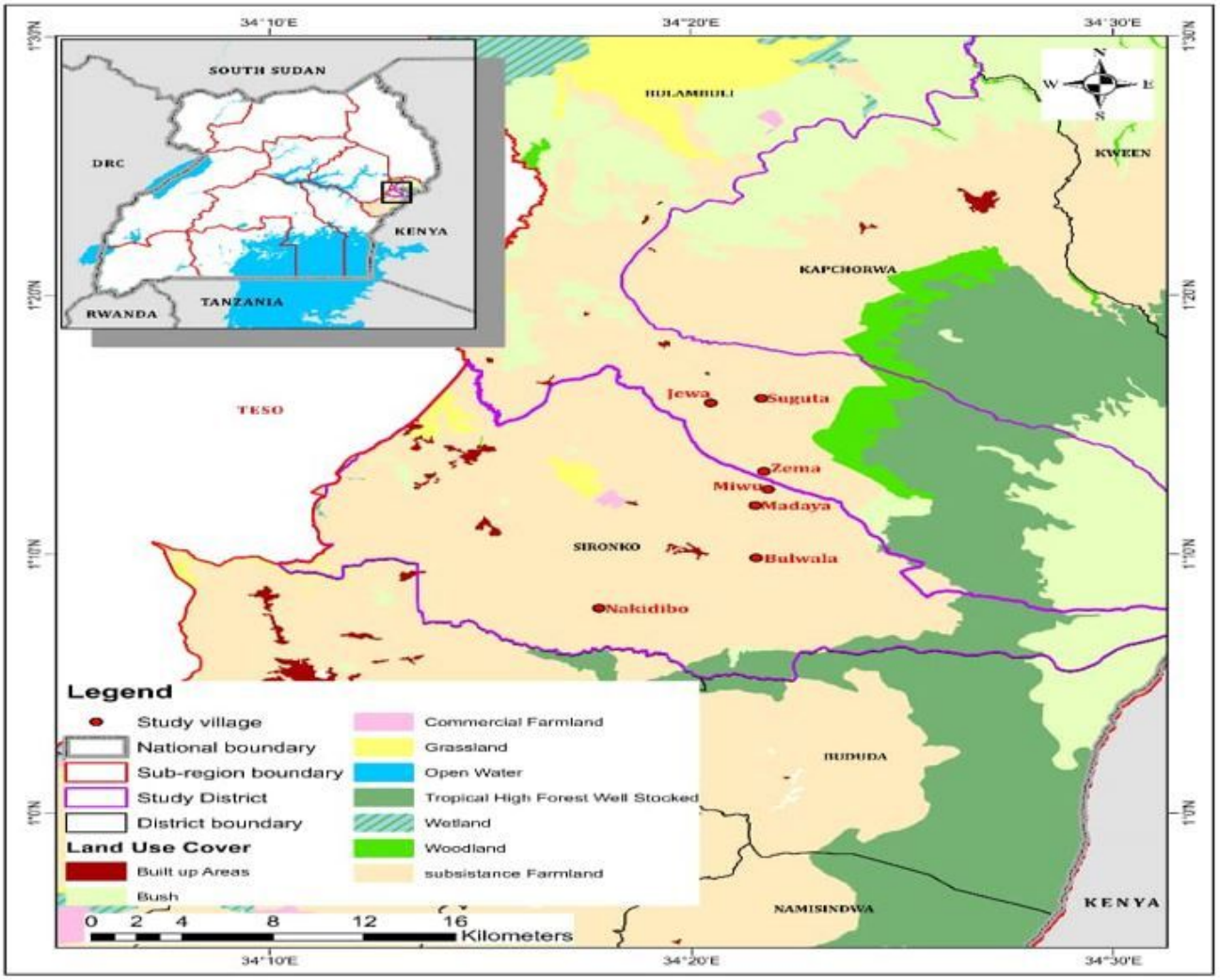

Figure 1

Map of Elgon Sub-region with Location of Sironko and Bulambuli districts

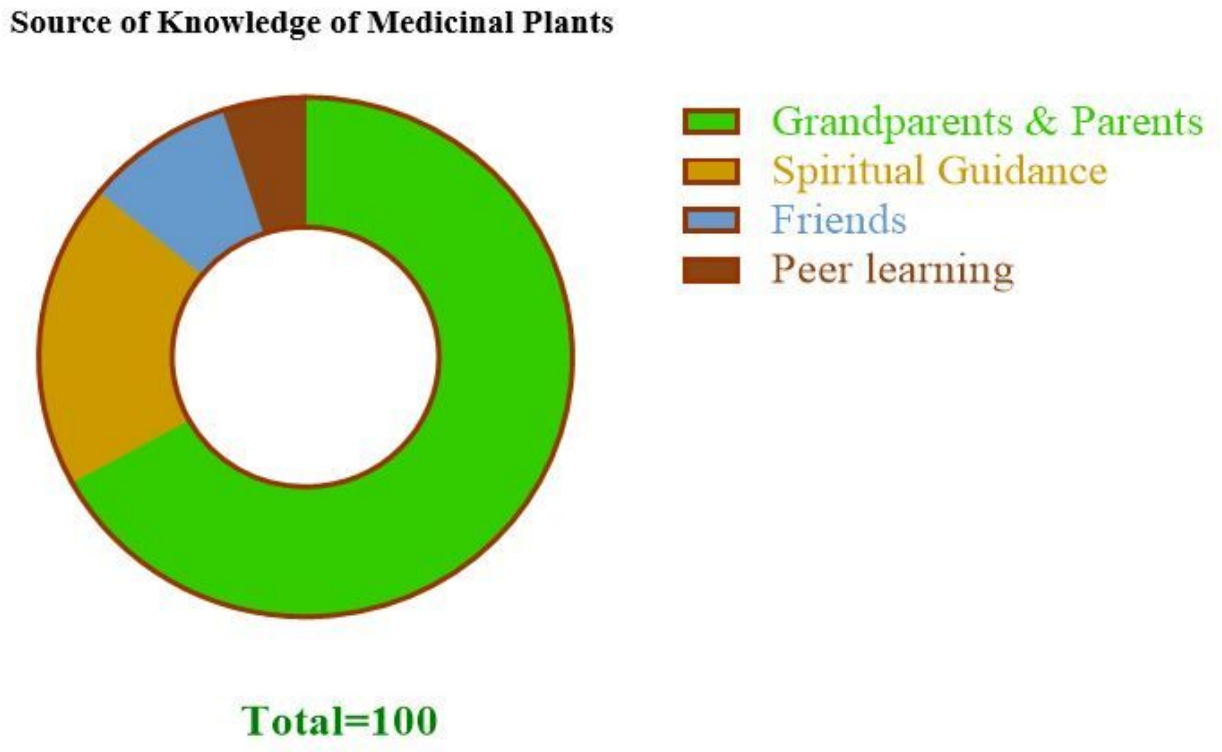

Figure 2

Source of Knowledge of Medicinal Plants

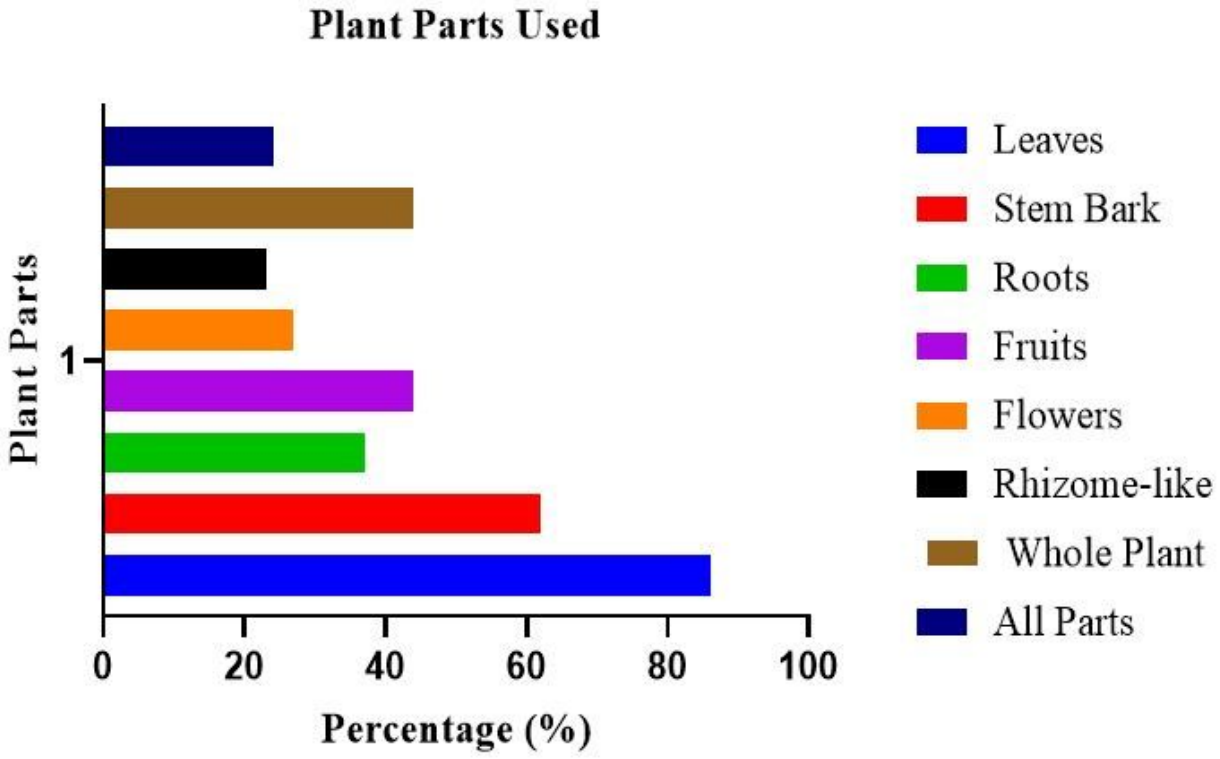

Figure 3

Plant Parts Used

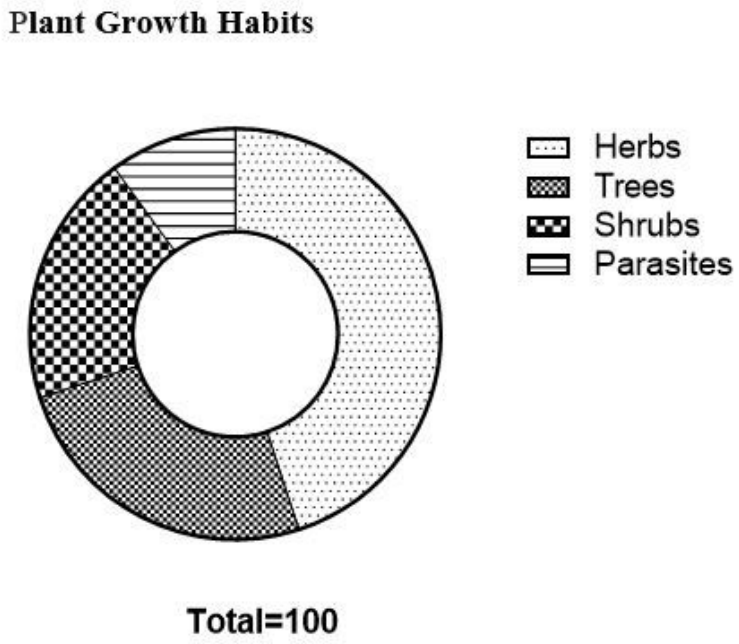

Figure 4

Plant Growth Habits

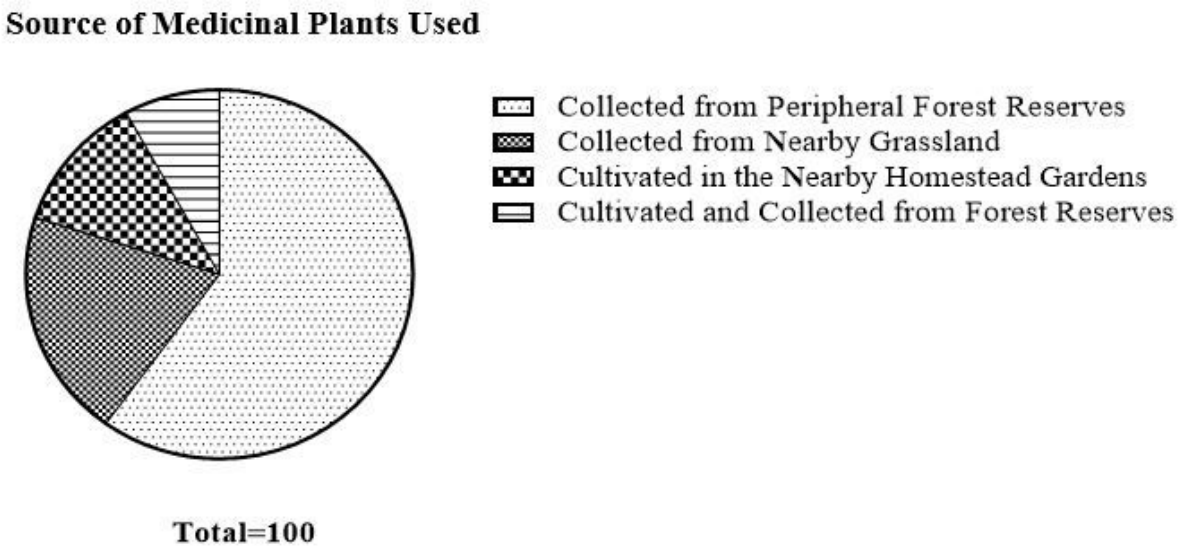

Figure 5

Source of Medicinal Plants

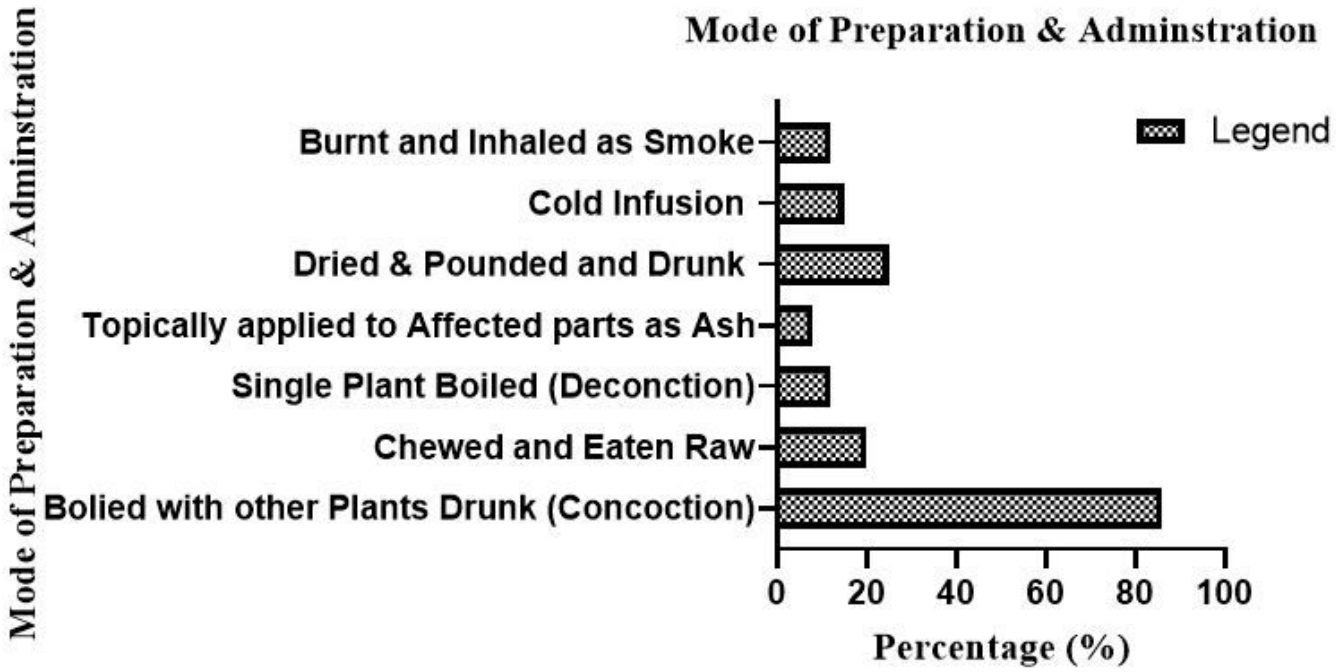

Figure 6

Modes of Preparation and Administration of Traditional Medicine

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Plates.docx