

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

Ali Kudamba (✉ alikudamba@gmail.com)

Makerere University

Josephine N. Kasolo

Makerere University

Godfrey S. Bbosa

Makerere University

Allan Lugaajju

Makerere University

Henry Wabinga

Makerere University

Nixon Niyonzima

Makerere University

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: Cancer, Ethnobotanical survey, herbalists, Elgon sub-region, medicinal plants

Posted Date: September 22nd, 2023

DOI: <https://doi.org/10.21203/rs.3.rs-3294875/v1>

Abstract

Background: In Uganda, medicinal plants have been utilized to treat a variety of ailments, including cancer. The anticancer medicinal herbs employed in the Elgon sub-region, however, have only been the subject of a relatively small number of investigations. This study's major objective was to document the anticancer medicinal plants used to treat cancer in the Elgon sub-region of eastern Uganda, with a focus on prostate cancer.

Methods: A semi-structured questionnaire that was administered by the researcher, interview guides, and guided field trips were used to collect ethnobotanical data. A number of quantitative indices were assessed, including informant consensus factor (ICF), fidelity level (FL), and preference ranking. A descriptive statistical analysis and graphs were produced using SPSS version 21.0 and GraphPad Prism version 8.125 respectively. The narratives were then interpreted using major theories and hypotheses in ethnobotany.

Results: A total of 50 plant species from 36 families were documented and herbal knowledge was mainly acquired through inheritance. Most of the plant species revealed in this study belonged to the Fabaceae and Asteraceae families. *Hydnora abyssinica* A. Br. was mostly recommended by herbalists for prostate, cervical, and breast malignancies. *Tylosema fassoglensis* was the most favored in regard to its ability to treat all known cancers in the area. The majority were collected from forest reserves (63%); herbal therapies were made from herbs (45%); and were primarily decocted (43%) from leaves (40%).

Conclusions: The first 10 most often used plants all had FLI (71), ICF (0.8), and PV (60), values that were quite high, indicating that they are believed to be the most effective in treating the known cancers in this area. Therefore, further study is required to determine the phytochemistry, toxicity, and efficacy of these plants in order to develop a newer anticancer drug.

Introduction

Cancer is the world's most serious public health problem[1]. Over the previous decades, it was responsible for 18.1 million cases and almost 10 million deaths[1]. Cancer cases will be more than double over the next two decades from 2018, reaching 43.5 million as per recent statistics on cancer from GLOBOCAN[2]. According to the WHO, cancer is the first or second leading cause of deaths before the age of 70 years in 112 countries and third or fourth in the further 23 countries[2]. According to African Cancer Statistics, Africa has the greatest cancer mortality rate, but with the lowest incidence rates[3]. This is due to late diagnosis, exorbitant expenditures, and, most critically, the difficulty in accessing cancer care[3]. Some fatalities occur as a result of cancer cells' resistance to antitumor drugs[3] and given these shortcomings, search for medicinal plants as alternative remedies including use of medicinal plants remains among the viable options. In 2020, the Global Cancer Observatory recorded 1,414,259 new cases of prostate cancer and 375,305 deaths[4]. Prostate cancer cases increased from 10200 in 1990 to 21900 in 2010, with fatalities ranging from 5600 to 12300 during the same period[5]. In 2020, a total of 77,300 cases were reported in Sub-Saharan Africa [6]. Around 1329 deaths from prostate cancer-related causes and over 2375 new cases were reported in Uganda in 2017[7]. In Uganda, the prevalence of prostate cancer was estimated to be 6.4% in 2018, and by 2030, it is expected to reach 33.4% [8]. The possibility that the reported number of cancer cases is underestimated cannot be ruled out because Uganda lacks sufficient resources for cancer diagnostics[9][7]. Despite the lack of well-documented prostate cancer cases in the Elgon sub-region, health professionals interviewed at Mbale Regional Referral Hospital report an increase in the disease. The lack of a cancer registry and the remoteness present study area makes it likely that there aren't enough diagnostic and therapeutic choices so use of plant remedies cannot be ruled out.

Chemotherapy, radiotherapy, surgery, hormone therapy, and gene therapy are only a few of the cancer treatment options available on a global scale[10]. However, in Africa, and Uganda in particular, these treatments are costly, have serious adverse effects on patients, are scarce due to a lack of specialized clinics and knowledge in the nation, have failed to treat advanced cancer stages, and are easily capable of causing the emergence of secondary malignancies[10]. Due to these shortcomings, there is a global increase in the use of medicinal plants, attributed to cultural acceptance, safety, ready availability, and most importantly, requiring less technical expertise[6]. Medicinal plants are key sources of cancer drugs because they provide around 91% of the licensed and authorized cancer treatments[10]. In Sub-Sahara Africa, more than 80% of the population, particularly in developing countries where Uganda, relies on herbs directly to meet their primary healthcare needs[13, 14, 15]. More than 80% of natives in East African countries especially in underdeveloped nations like Tanzania, Burundi, and Uganda, directly relies on herbs to cover their basic medical needs[14]. However, it is likely that different plant species and use of medicinal plants vary across the different regions of Uganda due to variation in the ecological setup and cultural variability. As a result, it's probable that the cancer-treating plants used in the Elgon sub-region are distinct from those used in other parts of Uganda and so, require thorough documentation.

Uganda is home to more than 6,000 different species of medicinal plants. Medicinal plants were becoming more important in the ethnobotanical approach to treating a range of illnesses, including cancer[15&16]. More than 3000 anticancer medicinal plants exist, and these plants include more than 5000 phytochemicals, such as phenolics, carotenoids, glucosinolates, terpenoids, and alkaloids, which are crucial components of cancer treatment. Moreover, Ugandans are increasingly turning to medicinal plants to treat cancer and other diseases of a similar nature[11]. The Elgon sub-region is home to some of the richest plant species in the world, some of which could have anticancer properties[17]. Traditional medicine knowledge is preserved through documentation, which ultimately results in its conservation[16]. However, 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[18]. Based on this, the objective of the current ethnobotanical survey was to identify the anticancer plant species that the residents of Elgon use in the treatment of cancer, with an emphasis on prostate cancer.

Materials and Methods

Study area

The research study was conducted in the Sironko and Bulambuli districts, are rural areas in the Elgon sub-region of eastern Uganda and are thought to have a range of plant species[17]. The distances between Sironko and Bulambuli districts and Mbale city, respectively, are 24.7 km and 55.4 km, and 275.9 km and 306.8 km, respectively, from Kampala, the capital of Uganda (Google Map, 2020). The Uganda Cancer Institute, which is located in Kampala, where most patients referred to as far away from these this area. The Sironko district is bordered to the north by the Bulambuli district, the northeast by the Kapchorwa and Kween districts, the east by Kenya, the southeast by the Bududa district, and the southwest by the Mbale and Bukedea districts. To the north, east, and west, respectively, of Bulambuli district are Nakapiripirit, Kapchorwa, and Bukedea districts. The average elevation of these districts is 3996 feet (1,218 meters), and they are situated at latitudes 1°17' and 1°24' North and longitudes 1°15' E and 1°45' E East (Google Map, 2020). According to [19], the average annual temperature is 24.4 °C. While there is between 920 and 1650 millimeters of rain per year on average [18]. A large range of plants are available throughout the due to favorable environmental conditions, some of which may have anticancer qualities. The precise medicinal herbs that are employed in this region to manage and treat malignant diseases like prostate cancer are unknown. The majority of its caretakers are elderly, and the plants used are not properly documented, thus there is a risk that this important

information will be lost [13, 21]. The study was 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, on the advice of local leaders and elders who claimed that these villages had the most knowledgeable and experienced herbalists.

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. A total of 45 herbalists were purposely selected under guidance of local chairpersons and elderly for this study. Key informants (herbalists) 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, route of administration, the daily dosage, and the duration of treatment. Key informants provided non-generic plant names in Lumasaba; and standard protocols were followed in the gathering and creation of vouchers for each of the identified medicinal plant species[21]. The taxonomic classification was conducted and plant were identified at Makerere University Herbarium Laboratory, finally and a comprehensive plant database at plantlist.org. verified the scientific name.

Demographic Characteristics of the Population

The majority of the population is made up of the Gisu, the seventh-largest tribe in Uganda and Lumasaba speakers [22]. The community is characterized by being largely rural with few peri-urban centers and a relatively high level of poverty and illiteracy[22]. This indicates that those who are unable to pay for the costly cancer chemotherapy treatments may turn to plant extracts as an alternative method of treatment, which is still a possibility.

Participants Selection, Sample Size, and Sampling Techniques

A purposefully sampling technique was used to select 45 participants (38 men and 7 women) under the guidance of Local leaders (LCI chairpersons) and elder who served as the ' gatekeepers to community. The participants were questioned until no new ideas could be created (saturation point), at which point the sample size was decided using redundancy criterion approaches as previously outlined by[23]. In purposive sampling participants are selected on basis of specific criteria that are judged to essential. The researcher deliberately selected community members with a long period of resident, in the community, which signified the knowledge of natural environment and use of natural resources to fulfill basic needs.

Research Instruments

Data were collected from herbalists through questionnaires, observational guides, and interviews. Twelve herbalists who were available at the time of the study were surveyed to get information on the identification and use of local plant species. Translators with proficiency in Lumasaba, the local language, translated the interviews. On the basis of the questionnaire given to the herbalists, local medicinal plants knowledge was revealed. These were the inquiries that the questionnaire was created to address: 1. Which plant species do you utilize to treat cancer? 2. What plant parts do you use, specifically? 3. Where are the plants gathered? 4. How are the plant therapies made? When making these treatments, do you use just one plant or a combination of two or more plants? 6. What plant growth forms of the plant do you normally use for cancer treatment? The names of the plants known to herbalists were written down on a checklist with their corresponding plants attached in the vernacular and sent to the Herbarium laboratory at Makerere University for taxonomic classifications.

Piloting

A reconnaissance visit was conducted for five days to gain a basic understanding of the potential respondents for the study. After the initial visit, two weeks were spent preparing research instruments another week training research assistant on how to administer the instruments. A translator was employed where necessary. A total of 12 questionnaires and interview guides were piloted. The result of the pilot was used to improve the efficiency of the research instrument for data collection

Validity and Reliability of Research Instrument

To test the validity of the research instrument, a questionnaire was prepared and submitted to an ethnobotany researcher for cross-checking and to assess the reliability of the content.

The reliability of the research instruments were tested during the pilot through the split-half technique and the Cronbach alpha coefficient computed[24]. Here, the instrument was provided by 12 herbalists divided into 2 groups. The reliability of the items was based on estimates of the variability of responses between the two groups. In this study, the reliability coefficient was found to be 0.85, which was very good for analysis.

Inclusion and exclusion criteria

Regardless of their level of experience, the study included all herbalists over the age of 18 years, and had fundamental understanding of the plants used to treat cancer. Additionally, only herbalists who had lived in the area for ten years had a basic grasp of the ecological framework for treating disease and were proficient in the regional language [26, 27]. The study did not include any herbalists who did not match the aforementioned requirements.

Ethnobotanical Data Collection, Plant Identification, and Authentication

The researchers used semi-structured forms of question items, interviews, and observational guidelines to produce a researcher-administered questionnaire. The question items were pretested with non-targeted groups in an area other than the study area prior to data collection. The researchers conducted interviews with the key informants, documenting all pertinent details they observed and, when practical, taking photographs during data collection. All of their comments were swiftly recorded. A plant-based field manual was used by the expert for on-site plant identification. The plant part was further identified by either separating it from the plant or carefully uprooting and wrapping it in old newspapers before putting it in the plant placement and bringing it to the Makerere University Herbarium Laboratory for further scrutiny. The plant names were then verified on plantlists.org[27].

Qualitative Data Analysis

Descriptive statistics method (frequency and percentage) was used to summarize ethnobotanical data was done using Statistical Packages for Social Scientists (SPSS) version 21, and graphs were generated using GraphPad Prism version 8.125. Frequencies and percentages generated by SPSS, plant parts used, growth habits, preparation method, and administration route were all quantified and categorized. The key hypotheses and ethnobotany theories provided support for the narrative analysis that was done on the participant's personal narrations. Fidelity level index (FLI), informant consensus factors (ICF), and preference rankings (PR) were all calculated using the pre-existing formulae.

Quantitative Indices

Preference Ranking

The preference ranking of ten medicinal plants for treating cancer was conducted after selecting ten key informants as earlier guided by Martin's description[28], with modifications. For this, ten key informants were selected to identify the best preferred medicinal plants for treating different cancers. Each informant provided with mentioned medicinal plants reported to treat cancer with leaves or tuber or both of medicinal plant parts used being paper tagged then asked to assign the highest value

(10) for most of the preferred species against the illness and the lowest value (1) for the least preferred plant in accordance to their order. The value given to each plant was summed up and the rank for each species was determined based on the total score.

Informants Consensus Factor (ICF)

The informant consensus factor was calculated using the formula established by[29] and indicates the homogeneity of the information in regards to their use.

$$Fc = \frac{N_{ur} - N_t}{N_{ur} - 1}$$

where N_{ur} is total number of plant use reports (citations) for cancer category, and N_t is number of species used for treatment of that ailment or cancer category. ICF is low when plants are picked at random, when herbalists do not share information about how to use them, or when there are disputes about the species used to treat particular cancer types. ICF is high (very close to 1), if the informants have a good understanding of the species, the community uses a well-designed criterion, and the informants communicate with one another. Consequently, it is believed that a medicinal plant with a high informant consensus value is efficient and frequently utilized in treating specific cancer type in this area.

Fidelity Level (FL) or Level of Trust

Fidelity for each of the ten most preferred plants was calculated to quantify their importance in treating cancer in this area. The formula was used to calculate fidelity level index (FL) $FLI = \frac{L_p \times 100\%}{I_u}$ Where L_p represents the number of informants who suggested using a specific species for the same major use (prostate cancers), and I_u represents the total number of informants who mentioned using the same species for any other use.

Results

The current study enrolled 45 participants, and were mostly males (84%), Ugandan (89%), and married (76%). Most participants (33.3%) were in the age bracket of 51 to 55 years, and were mostly peasants (76%). Furthermore, the vast majority of the participants had only completed primary school (78%) and were generally of low literacy level.

An interview with a senior herbalist and elder from *Jewa village* revealed this information: *"Culturally, in Nakidobo and Zema villages, herbal practice by gender is taken as 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; so I could not go far with formal education and ended in primary three."

Source of Knowledge of Medicinal Plants

According to the research, most herbalists (37%) learned about medicinal plants from their grandparents and parents, with spiritual direction and peer learning coming in second and third, respectively (22%), followed by dreams (12%)

and experimentation (6%). Nobody acquired knowledge of medicinal plants via a technical education.

The herbalist's interview in this regard produced the following responses: *"My father and a grandfather, both of whom lived in a Jewa village, used to take me to a senior herbalist, who began showing me the" herbs he used to treat various maladies. According to Bulaba village's senior herbalist, I started treating individuals with certain ailments between the ages of 10 and 15 years ago. An elderly herbalist who claimed to be 70 years old said, "I learnt to treat different diseases, including cancer, from my family, friends, and peers. Another experienced herbalist claimed that his grandfather taught him about herbs, and that his grandfather had learnt about some of the medicinal plants through dreams and divine direction."*

Medicinal Plants, their habits, Cancer Treated, and Methods of Preparation and Route of Administration.

The herbalists disclosed a total of 50 plant species from 36 families that were allegedly capable of treating cancers known to this area. Fabaceae (6) and Asteraceae (4) were plant families with greater number of species, herbs making up the majority medicinal plants (45%), followed by trees (27%). The results also imply that herbalists in this area employ a range of various techniques for herb preparation and administration. The majority of plants were prepared as decoctions (40%) and concoction (mixtures) (26%) and were primarily administered orally. Plant therapies were more frequently utilized to treat prostate, cervical, and breast cancers than other cancers, indicating that these were the most common cancers in this area.

Table 1
Medicinal Plants, their habits, Cancer Treated, and Methods of Preparation and Route Administration.

Plant Family, Scientific Name & Voucher No.	Local Name	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of Preparation	Route of administration
Alliaceae, <i>Allium sativa</i> , - KA 006	Kachuum	Herb	bulb	Cervical, colon, prostate & skin	Boiled & drunk (decoction); Burnt & applied on infected skin part.	Oral and topical medication
Amaryllidaceae, <i>Allium sepa</i> L - KA 007	Kitungulu	Herb	Bulb	Stomach	Mixed with <i>Mangifera</i> <i>indica</i> , <i>aloe</i> <i>vera</i> & <i>Biden</i> <i>Pilosa</i> , boiled drunk (Concoction)	Oral
Apocynaceae, <i>Rouvoflavia</i> <i>vomitorea</i> Afzel KA 008	Kitondwani	Shrub	Leaves, roots and stems	Colon & cervical cancer	Boiled & drunks (decoction)	Oral
Anacardiaceae, <i>Mangifera</i> <i>indica</i> – KA 009	Kiyembe	Tree	Leaves	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Boiled & drunk (decoction); Burnt & applied on infected skin part	Oral & topical medication
Asphodelaceae, <i>Aloe vera</i> – KA- 010	Kigadi	Herb	Leaves	Prostate, cervical, breast colon, lung, skin intestinal uterine, esophageal bone & bone cancers	Boiled and drunk (decoction) Burnt & applied on infected skin	Oral & topical medication
Asteraceae, <i>Biden Pilosa</i> L –KA 011	Kyikhamama (Tabululu)	Herb	Leaves, stem and roots	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Boiled and drunk (decoction); Burnt & applied on infected skin.	Oral & topical medication

Plant Family, Scientific Name & Voucher No.	Local Name	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of Preparation	Route of administration
Acanthaceae, <i>Amelia caurrhiza</i> Del – KA 012	Nandwasi	Herb	Leaves	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Boiled and drunk (decoction); Burnt & applied on infected skin	Oral & topical medication
Asteraceae, <i>Conyza sumatrensis</i> KA 013	Namagoye	Herb	Leaves	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Mixed <i>Dicrocephala integrifolia</i> , boiled & drunk (concoction) & burnt and applied on infected skin.	Oral & topical medication
Plant Family, Scientific Name & Voucher No.	Local Name	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of Preparation	Route of administration
Asteraceae, <i>Dicrocephala integrifolia</i> KA 014	Lunyabakana	Herb	Leaves	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Mixed with <i>Vernonia adonsis</i> and <i>Mangifera indica</i> , boiled and drunk (concoction). Burnt & applied on infected skin.	Oral & topical medication
Asteraceae, <i>Vernonia adonsis</i> Walp – KA 015	Kisola	Tree	Leaves	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Mixed with <i>Kigelia Africana</i> , <i>Ananasi sativa</i> (Retz) Walker Boiled & drunk (concoction); Burnt and applied on infected skin.	Oral & topical medication

Plant Family, Scientific Name & Voucher No.	Local Name	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of Preparation	Route of administration
Bignoniaceae, <i>Kigelia africana</i> – KA 016	Gufungo/Kifungo	Tree	Leaves, roots and stems	Prostate and breast cancer	Mixed with <i>Hydnora abyssinica</i> A and <i>Hydnora Africana</i> , boiled & drunk (Concoction); Burnt & applied on the infected skin	Oral & topical medication
Bromeliaceae, <i>Ananasi sativa</i> (Retz) Walker – KA 017	Nadanga		Leaves, roots and stems	Oesophageal cancer	Boiled and drunk (decoction) <i>Mixed with Erythrina abyssinica</i> Lam., and <i>Mormordica foetida</i> , boiled & drunk (concoction)	Oral
Celastraceae, <i>Maytnus senegalensis</i> - KA 018	Kikonje	Shrub	Leaves, roots and stems	Cervical cancer	Boiled and drunk (decoction) Mixed with <i>Rinus communis</i> and <i>Dioscaena fragrans</i> , boiled & and drunk (concoction)	Oral
Clusiaceae, <i>Garcinai Buchananii</i> Baker – KA 019	Kikameli	Tree	Leaves & stem	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Boiled and drunk (decoction) Mixed with <i>Rinus communis</i> and <i>Dioscaena fragrans</i> , boiled & drunk (concoction)	Oral

Plant Family, Scientific Name & Voucher No.	Local Name	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of Preparation	Route of administration
Euphorbiaceae, <i>Rinus communis</i> L - KA 021	Mukakale	Herb	Leaves, roots and stems	Uterus cancer	Boiled and drunk (Decoction) Mixed with <i>Entada abyssinica</i> stued & <i>Mangfera indica</i> and boiled & drunk (concoction)	Oral
Dioscoreaceae, <i>Dioscaena bulbifera</i> . Linn - KA022	Liakunyu	Herb	Leaves & tubers	Cervical, breast & prostate cancers	Boiled and drunk (Decoction) Mixed with <i>Dioscaena fragrans</i> (L.) Ker-Gawl and <i>Cajanus Cajan</i> , boiled & drunk (concoction)	Oral
Draceananceae, <i>Dioscaena fragrans</i> (L.) Ker-Gawl - KA 023	Linzi	Shrub	Leaves	Cervical & colon	Boiled and drunk (decoction) Mixed with <i>Hydnora africana</i> & <i>Hydnora abyssinica</i> A. Br and <i>Pseudarthria hookeri</i> Wight, boiled & drunk (concoction)	Oral
Hydnoraceae, <i>Hydnora africana</i> 025	Mwoyogwemutaka	Herbs	Roots	Prostate & cervical cancer	Boiled & drunk (decoction) Mixed with <i>Tamarindus indica</i> and <i>Cajanus Cajan</i> , Boiled & drunk (concoction)	Oral
Plant Family, Scientific Name & Voucher No.	Local Name	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of Preparation	Route of administration

Plant Family, Scientific Name & Voucher No.	Local Name	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of Preparation	Route of administration
Fabaceae, <i>Cajanus cajan</i> - KA 026	Zikolimbo	Herb	Leaves, stem & roots	Breast	Burnt and applied on infected skin	Topical medication
Fabaceae, <i>Erythrina abyssinica</i> Lam. Ex. DC – KA 027	Kitugulu	Tree	Stem & root bark	Cervical & oesophageal cancers	Eaten raw, Boiled & drunk (decoction) Mixed with <i>Rumex usambarensis</i> & <i>Combretum mole</i> G-don and, drunk (concoction)	Oral & topical medication
Fabaceae, <i>Pseudarthria hookeri</i> Wight & Arn KA 028	Nakikofira	Herb	Leaves, stem & roots	Breast	Boiled and drunk (decoction), applied on infected skin	Oral & topical medication
Fabaceae, <i>Tamarindus indica</i> L -KA 032	Mukuwe	Tree	Fruit	GIT & prostate	Crushed and taken raw (infusion) or boiled & drunk (decoction)	Oral
Fabaceae, <i>Entada abyssinica</i> stued – KA 031	Kishembe	Herb	Leaves, stem & roots	GIT & prostate	Boiled and drunk (decoction)	Oral
Fabaceae, Welwe. ex Oliv KA 030	Kiluku	Tree	Root back	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Boiled and drunk (decoction)	Oral
Lamiaceae, <i>Plectranthus cyanneus</i> -KA 033	Wobulaka (Tuliguuye)	Herb	Leaves, stem & roots	Skin cancer	Crushed and taken (infusion) or boiled and drunk (decoction)	Oral & topical medication

Plant Family, Scientific Name & Voucher No.	Local Name	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of Preparation	Route of administration
Lamiaceae, <i>Leonotis nepetifolia</i> (L) R -KA 034	Namusiriri	Herb	Leaves, stem & roots	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Crushed and taken raw (infusion)	Oral
Lauraceae, <i>Persea Americana</i> -KA 035	Pekedo	Tree	Leaves & seeds	Skin cancer	Boiled and drunk (decoction)	Oral
Meliaceae, <i>Azedaracta indica</i> – KA 036	Murabaine	Tree	Leaves, roots and stems	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Boiled and drunk (decoction)	Oral
Primulaceae, <i>Maesa lanceolata</i> Forrsk -KA 037	Kinywabanji	shrub	Leaves, roots and stems	Skin cancer	Boiled and drunk (decoction)	Oral
Rosaceae, <i>Prunus africana</i> (Hook.f). kalk - KA- 040	Gusasa (Kilumati)	Tree	Leaves, roots and stems	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Mixed with <i>Ribia cordifera</i> . <i>Allophylus abyssinicus</i> P. Beauv, boiled & drunk (Concoction)	Oral
Myrtaceae, <i>Syzygium cumini</i> (L) Skeels- KA 038	Jambula	Tree	Leaves, roots and stems	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Boiled and drunk (decoction) & burnt and applied on infected skin	Oral & topical medication

Plant Family, Scientific Name & Voucher No.	Local Name	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of Preparation	Route of administration
Plant Family, Scientific Name & Voucher No.	Local Name	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of Application	Route of administration
Polygonanceae, <i>Rumex usambarensis</i> - KA 039	Nankombi	Herb	Leaves, roots and stems	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Boiled & drunk (decoction)	Oral
Rubiaceae, <i>Ribia cordifera</i> . Linn -KA 041	Kizambazambe	Herb	Leaves, roots and stems	Lung & skin cancer	Mixed with <i>Ribia cordifera</i> . & <i>Gouania longispicata</i> Engl. Linn, boiled & drunk (Concoction)	Oral
Sapindaceae, <i>Allophylus abyssinicus</i> P. Beauv – KA 043	Zipelele	Shrub	Leaves, roots and stems	Lung cancer	Boiled & drunk (decoction)	Oral
Rhmanaceae, <i>Gouania longispicata</i> Engl. (Ait) -KA 042	Namayendeyende	Shrub	Leaves	Skin cancer	Boiled & drunk (decoction) & burn and applied on infected skin	Oral & topical medication
Simaroubaceae, <i>Harrisonia abyssinica</i> Olivia - KA 044	Njetu (Nasambu Or Nefulo	Tree	Leaves, roots and stems	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Mixed with <i>Gouania longispicata</i> a Engl. & <i>Lantana trifolia</i> boiled and drunk (concoction)	Oral
Verbenaceae, <i>Lantana trifolia</i> - KA 045	Namuserera	Shrub	Leaves, roots and stems	Cervical cancer	Boiled and drunk (decoction)	Oral

Plant Family, Scientific Name & Voucher No.	Local Name	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of Preparation	Route of administration
Urticaceae, <i>Urtica dioica</i> L – KA 046	Nettle	Herb	Root tuber	Skin cancer	Crushed & taken raw (infusion) or boiled & drunk (decoction)	Oral
Vitaceae, <i>Cyphosteman adenocaulis</i> (A. Rich -KA 047	Namakajo	Herb	Leaves & roots	Skin cancer	Mixed <i>Hypoxis hemerocallidea</i> Fish C. A. Mey. & Ave-Lall and <i>Psidium guajava</i> boiled and drunk (Concoction) and applied on infected skin	Oral & topical medication
Zingiberaceae, <i>Zingiber officinale</i> -KA 048	Tangawunzi	Herb	Rhizome	Oesophageal cancer	Eaten raw, Mixed with Hypoxidaceae. <i>Hypoxis</i> and <i>Rhoicisuss tridentata</i> , boiled & drunk <i>hemerocallidea</i> Fish C. A. Mey. & Ave-Lall (Concoction)	Oral
Vitaceae, <i>Rhoicisuss tridentata</i> (L.f) Wild & R.B Drumm- KA 051	Nakibondi	Shrub	Leaves & tubers	Prostate and breast	Crushed, and drunk (infusion) boiled & drunk (Decoction)	Oral
Hypoxidaceae. <i>Hypoxis hemerocallidea</i> Fish C. A. Mey. & Ave-Lall - KA 049	Mabondi Gemukyigona	Shrub	Tuber	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Boiled and drunk (decoction) and applied on infected skin	Oral & topical medication
Plant Family, Scientific Name & Voucher No.	Local Name	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of Preparation	Route of administration

Plant Family, Scientific Name & Voucher No.	Local Name	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of Preparation	Route of administration
Myrtaceae, <i>Psidium guajava</i> L. KA 050	Lipella	Tree	Leaves	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Mixed with <i>Rhoicissus tridentata</i> L.f) Wild & R.B & <i>Combretum mole</i> G-don Drumm boiled and drunk (Concoction)	Oral
Euphorbiaceae, <i>Margaritria discoidea</i> (Baill) Muell. Arg. -KA 052	Gulumati/Kilumati	Tree	Leaves and stem bark	Prostate, colon, cervical and breast	Boiled & drunk (decoction) and applied on infected skin (topical application)	Oral & topical medication
Sapindaceae, <i>Deinbollia fulva</i> <i>-fomentalla</i> Bak.f – KA053	Kifuti	Tree	Fruits, and leaves	Prostate, cervical, breast colon, lung, GIT, skin intestinal uterine, esophageal bone & bone cancers	Boiled & drunk (decoction) and applied on infected skin	Oral & topical medication
Phyllanthaceae, <i>Bridilia micrantha</i> (Hochst.) Bail- KA054	Kigakala	Tree	Leaves, roots and stems	Skin, prostate and cervical cancer	Boiled & drunk (decoction) and applied in infected skin	Oral & topical medication
<i>Combretaceae</i> , <i>Combretum mole</i> G-don- KA 055	Kimwanyimwayi	Shrub	Leaves	Skin, prostate and cervical cancer	Boiled & drunk (decoction) and (applied on infected skin	Oral & topical medication

Plant Family, Scientific Name & Voucher No.	Local Name	Plant Habits	Plant Part(s) Used	Type of Cancer	Method of Preparation	Route of administration
Rubiaceae <i>Coffea arabica</i> - KA056	Emwanyi	Tree	Leaves and fruits	Prostate cancer and cervical cancer	<i>Squeezed and the juice drunk (infusion)</i> <i>Mixed with Mangifera indica and Deinbollia fulva - fomentalla Bak.f boiled & drunk (Concoction)</i> <i>Fruit berries area rooted and added to tea</i>	Oral

Preferred Medicinal Plant Species

Ten (10) medicinal plants that are frequently used to cure cancer were ranked by herbalists according to their preferences. *Tylosema fassoglensis* (PV = 86) was rated as the most effective at treating all known malignancies that locals are aware of. The most effective herb for treating breast, cervical, and prostate cancers was *Hydnora abyssinica* A Br (PV = 84), followed by *Hydnora africana* (PV = 80), and *Rhoicissus tridentata* (L.f.) Wild & R.B. Drumm (PV = 78). *Erythrina abyssinica* Lam was the least preferred species due to its low ranking.

Table 2
Preference Ranking of Medicinal Plants

MPS	PPU	CT	KI (n = 10)											PV/ 100	PR
			A	B	C	D	E	F	H	I	J	K			
<i>Tylosema fassoglensis</i>	Tubers	Prostate, cervical, breast colon, lung, skin, GIT intestinal uterine, esophageal bone & bone cancers	10	9	8	9	7	9	9	8	8	9	86	1st	
<i>Hydnora abyssinica</i> .A. Br	Tuber	Prostate, cervical & breast cancer	9	8	7	8	8	8	7	7	7	7	84	2nd	
<i>Hydnora africana</i>	Tuber	Prostate, cervical, & breast cancer	8	8	8	8	8	9	9	7	8	7	80	3rd	
<i>Rhoicissus tridentata</i> (L.f.) Wild & R.B. Drumm	Leaves, stem and tuber	Prostate, Colon & GIT cancers	6	7	8	7	8	7	7	7	7	7	78	4th	
<i>Albizia coriaria</i>	Tuber	Skin & colon cancer	8	8	8	8	8	7	7	8	7	7	76	5th	
<i>Azadirachta indica</i>		Lung cancer	8	8	8	7	7	8	8	6	7	7	74	6th	
<i>Prunus africana</i>	Bark and leaves	Prostate & cervical,	6	7	8	7	7	8	6	7	7	7	72	7th	
<i>Kigelia africana</i>	Fruit	Prostate & esophageal,	7	7	6	8	7	7	7	6	7	7	69	8th	
<i>Syzygium cumini</i> (L.)Skeel	Leaves	Colon & GIT cancers	7	7	7	6	6	7	6	5	7	7	65	9th	
<i>Erythrina abyssinica</i> Lam. Ex. Dc	Stem & root barks	Colon	5	5	6	6	5	6	6	7	7	7	60	10th	

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

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

Informant Consensus Factor (ICF)

The results showed that the ICF scores for medicinal plant species that are used to treat different cancers were quite high and varied from 0.84 to 0.95. As shown by the highest ICF (0.95) for the medicinal plant species used to treat intestinal cancer and the lowest (0.84) for prostate cancer, the herbalists had a solid comprehension of the species with carefully developed criteria and exchanged knowledge with one another.

Table 3
Informant Consensus Factor (ICF)

Cancer Type	No. of use citation N_{ur}	No. of species N_{taxa}	ICF
Prostate cancer	224	37	0.84
Cervical cancer,	222	35	0.85
Breast cancer	208	21	0.90
Colon cancer	211	24	0.89
Lung cancer	201	14	0.94
Skin cancer	203	16	0.93
Intestinal cancer	198	11	0.95
Uterine cancer	199	12	0.94
Esophageal cancer	201	14	0.94
Bone cancer	198	11	0.94
Gastrointestinal cancers	200	13	0.94

Fidelity Level Index (FLI) of Most Preferred Plants used Plants in Cancer

According to the findings, all ten of the top plant species had fidelity level indices above 70%, indicating their significance to herbalists in this field for the treatment of cancers. The most effective plants for treating prostate cancer were *Hydnora abyssinica* A. Br. (93.9%), *Hydnora africana* (84.8%), *Prunus africana* (82.4%), and finally *Kigelia africana* (79.4%). The most effective herb for treating lung cancer was *Azidarachata indica*, whereas the top two herbs for treating gastrointestinal malignancies were *Syzygium cumini* (L). Skeels, and *Plectranthus cuanneus* (71.4%). For prostate and colon cancer, *Rhoicissus tridentata* (L.f.) Wild & R.B. Drumm scored 89.7%, whereas *Kigelia africana* scored 79.4% prostate & esophageal cancers.

Table 4
Fidelity Level Index (FLI) of Most Commonly Used Plants in Cancer and any other use by key informants

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

Source of Medicinal Plants

According to the results of the current investigation, the majority of medicinal plants were gathered from the periphery of forest reserves. For instance, 63% of the reported medicinal plants were gathered from the outskirts of the Elgon Mountain Forest Reserve. The remainder were collected from Nearby grassland (19%), Nearby homestead (11%) or both homestead and Forest Reserve (8%).

The following statements were made during an in-depth interview with key informants who were males between the ages of 51 and 60 from the villages of Suguta, Jews, and Bulwala: *"We usually use a certain plants that are nearby my homestead as prescribed by our grandparents; some plants are very effective at treating cancer, but honestly speaking, they are mostly far away, and some are in protected areas of the forest and cannot be easily accessed"* *"Another elder from Bulwala village said that all my herb my cancer patient with plants that are readily available and accessible throughout the year".* *"Another village elder from Bulwala said, "All of my herbal plants are readily available and accessible throughout the year for treating my cancer patients."*

Plant Parts used to prepare Herbal Remedies

The outcome suggests that, depending on the plant and cancer type in issue, the utilization of plant parts differed substantially. The leaves were the most often utilized plant portion (40%) followed by the roots and root barks (26%), and then the stems and stem barks (23%). The remaining and least parts were tubers (4%), fruits (3%) seeds & bulbs (2%) and finally rhizomes (1%).

In response to an in-depth interview with key informant, one of elderly from Zema and Suguta and Madaya villages stated, "I normally use leaves to prepare herbal therapies because they are readily available, throughout the year, and are more effective compared to other parts." "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."

Plant Growth Habits

The results showed that herbs were ranked highest (45%), followed by trees (27%), shrubs (19%), and finally parasites, which received the lowest score (9%), as the most frequent plant growth habits.

Another local leaders and elders in villages of Nakidobo, Miwa Jewa, and Bulwala villages during interview with herbalist stated that *"I 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 Suguta village said that some the key plants are collected as far as 30 kilometers from my home because they are very important."*

Modes of Preparation and Administration of Traditional Medicine

The herbalists demonstrated the use of various methods for preparing herbal extracts and administering herbs to their clients. Most of the herbalists used decoction (43%) and concoction (26%). The others were burnt and applied to infected parts (19%), cold infusion (5%), eaten raw (3%), and roasted and added to tea (1.4%).

"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."*

Some Plant Species used in the Treatment of Cancer in Sironko and Bulambuli in the Elgon Sub-region

Discussion

Most participants were Ugandans, and Males outnumbered females in the present study. The dominance of men in the herbal industry was also reported in an earlier study in Butelejja district, located in the Eastern part of Uganda[30] and in rural communities of Dhirkot, Azad Jammu and Kashmir, in Pakistan[31]. The dominance is in line with African beliefs that herbalists are a male-dominated profession. In contrast, earlier studies in the Kurdistan Region, Iraq, and Indonesia revealed a female predominance in the herbal industry. These findings may have been influenced by the cultural contexts of the two studies as well as the nature of the diseases being studied; for instance, their study concentrated on toothpaste herbs, which are more popular among women[33, 34]. According to [34] findings in the Kampala district, the majority of participants elderly(51 to 55), which is older than the ideal and admirable range of 31 to 45 for the continuation, expansion, and sustainability of the herbal business and endangers its existence[35]. The majority of young people who attain formal education underscore this business and migrate to metropolitan areas in search of a brighter future, which leaves the entire industry in a vulnerable position and makes it susceptible to collapse at any moment in the near future. This preponderance of older people could be explained by this trend. The fact that herbalists spend a large portion of their early school years studying more about herbs used to treat various illnesses from their parents and grandparents may be a contributing factor in the high illiteracy rate among this group of people[18].

According to the results of interviews, the majority of herbalists were elderly males who were primarily uneducated. These narratives are best explained by age, gender, and dynamic knowledge, according to the argument that sociocultural and demographic characteristics like age, gender, literacy, and formal education are all dynamic knowledge hypotheses. According to [18] "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 ladies are more knowledgeable about the medicinal flora in their area. Knowledge of medicinal plants is frequently inversely connected to higher levels of literacy and formal education. With the exception of women, who are excluded due to cultural norms in Elgon that restrict their participation in the herbal sector and who are only active to a lesser level under specific conditions, all of the aforementioned responses corroborate this hypothesis [36].

The herbalist in the current area of vicinity revealed varied sources of knowledge about the medicinal plants they use to treat cancer of which inheritance was the most pronounced (Fig. 2). Inheritance had earlier been documented to be predominate source of knowledge among herbalist in Butelejja district in Eastern Uganda and this was seen as survival instinct inculcated across generations [30]. In contrast, the majority of herbalists in Saudi Arabia claimed to have learned this knowledge from their friends; this was likely because their instinct for survival was different from that of our study area. The country also has excellent, state-of-the-art medical facilities and is mostly focused on dealing with oil [37].

Results of interviews with senior herbalists and elders showed that men predominate in the herbal sector and that the majority of this expertise is passed down through heredity. According to this, peer influence and how it affects the spread of knowledge will also depend on a community's family background, age, gender, and whether it is rural or urban. This supports the theory that social networks act as a driver of knowledge dynamics. As a result, societal norms, habits, and levels of development have a significant role in motivating people to learn about using plants as medicine [38].

Tylosema fassoglensis (Schweinf.) Torre & I was commonly used in the treatment of all known cancers in this area because of its multipurpose role (Table 2). Our research indicates that *Hydnora abyssinica* was well-known for its alleged safety and effectiveness in treating prostate cancer. This is in line with the theory that medicinal herbs are extensively utilized because they are accessible, affordable, accepted by society, and most importantly because they are believed to be safe for use [43]. Contrary the review made by [41], which compiled several ethnobotanical surveys in Uganda, showed *Prunus Africana* Hoof.k. (Kalk), *Opuntia species*, *Albizia coriaria* (Welw.ex. Oliver), *Daucus carota* L., *Cyperus alatus* (Nees) F. Muell., *Markharmia lutea* (Benth.) K. schum., and *Oxalis corniculata* L were the dominant species.

According to the current investigation, leaves were the most often employed components for herbal cancer treatments (Fig. 4, Table 1). It is standard practice to employ leaves for herbal remedies because they don't harm the plant and are thought to contain significant amounts of bioactive components [40, 42, 45]. For the treatment of illnesses, people in the Marakwet and Berber communities in Ethiopia and Kenya, respectively, employed roots extensively. This variance may be connected to the sickness focus, ecological conditions, or plant species employed in question [45].

Elders in this region emphasize that because leaves are simple to prepare and are typically seen to be useful in treating illness, the majority of herbs have been prepared from leaves since the beginning of time. The responses can be best understood based on the resource availability hypothesis [38], 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

Most herbalists claimed that they collect their herbs from forest reserves, and this was attributed to the availability of a variety of species in this area (Fig. 3). According to [39], collecting medicinal plants from nearby forests or wild regions is a popular practice in Uganda. The majority of locals living around Mabira Forest region gather their herbs from there. This is consistent with the idea that medicinal plants were historically gathered from the wild [40]. Due to the widespread loss of natural habitats, contrary to the general trend, medicinal plants in the Butelejjja district were reported to be extensively obtained from domestic gardens [11].

Elders in the Sironko and Bulambuli areas claimed that there was no need to domesticate herbal plants because the neighboring forest reserves already had a diversity of species (Fig. 1). In addition, the elders claimed that there was not enough land to support the production of both crops and herbs. In accordance with this, the "resource availability hypothesis" looks at the area where people collect plants and more broadly links local plant abundance or dominance with plant usage. This idea contends that the availability, accessibility, and intended use of plants in the wild all influence how easily they can be domesticated. Herbalists are reluctant to domesticate medicinal plants in these circumstances in order to conceal their usage, especially if there is the assurance of a steady supply from the wild [36].

Findings showed that the bulk of the species thought to provide therapeutic benefits against cancer were found to be members of the Fabaceae family and Asteraceae (Table 2). Since the bulk of the Fabaceae family's members are either herbs or shrubs that grow and reproduce quickly, so these families are commonly employed [41, 42]. Due to the distinct ecological environment and the condition in issue, Apocynaceae was among the families in Morocco with the greatest number of plants used for osteoarthritis treatment [42].

Findings from our investigation, showed that majority of plant species employed in cancer treatment were herbs (Fig. 5). Due to alleged high concentrations of a number of active secondary metabolites, such as flavonoids, alkaloids, phenol, tannin, and anthraquinones, herbs are considered to be utilized extensively [42, 47]. In contrast, as the study was more prospective than the current study region, the use of trees for the preparation of herbal medicines was prevalent in several areas of Matebeleland and Zimbabwe [44]. This was attributed to their high availability throughout the study and assumed efficacy. As opposed to the current study, previous research indicated a high reliance on shrubs for the production of herbal remedies since they are drought-tolerant and unaffected by seasonal variations year-round.

"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.

Most of the herbs used in cancer treatment were decocted and orally administered (Fig. 6). The use of decoction method is widely used as it assumed to be cheapest and easiest way of preparing and extracting active ingredient in most rural settings without much expertise [13, 21]. In contrast concoction is widely reported to be used in herbal preparation and attribute to the embodied belief by most herbalist that no single plant can effectively treat and cure a disease alone [48, 49]. So, effectiveness could be improved through combination with two or more plants [49].

The optimal foraging theory borrowed from ecology and applied to ethnobotany can explain these responses [38]. 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.

According to the current investigation, prostate cancer was the most common type of cancer among people who said they used medicinal herbs to cure it. The prevalence of the most often treated ailment is reflected in a region's high medicine availability, including herbal remedies[41]. Due to the lack of adequate medical facilities, their high cost, their difficulties in being easily accessible, and, most importantly, the idea that they are more expensive than plant therapies, medicinal plants are widely used to treat prostate cancer[50].

ICF values more than 0.80 (very close to 1) were seen in every malignancy treated with plant remedies without exception (Table 3). The high ICF indicates that there was a lot of consensus over the plant species that are utilized to treat cancer in this region. The fact that various plant species are known to be useful in treating cancer in this area is reflected in the high ICF values. The present herbalist association in the region, which has frequent meetings to keep members informed of the association's status and the rising threat of cancer cases in the region, could be responsible for the high ICF. Ethiopia also reported a very high ICF (0.91) for plant species used to treat different malignancies, indicating improved understanding of the plants utilized and sharing of herbal knowledge among herbalists[51]. A low ICF (0.619) was discovered in Butelejja, on the other hand, which might be related to a dearth of diagnostic resources. In light of the fact that cancer can also appear with symptoms including headache, nausea, vomiting, diarrhea, and exhaustion, all of which are also present in other conditions, it is possible that cancer has been misdiagnosed[11].

Tylossema fassoglensis (Schweinf.) Torre & I was favored for its multipurpose role in treating all known cancers in this area whereas *Hydnora abyssinica* A. Br was preferred for treatment of prostate cancer (Table 2 & Table 4). All the plants scored high fidelity level index (above 70) and plant value (above 60). Our earlier study[52], also revealed that *Tylosema fassoglensis*, harvested from Elgon region had high concentration of tannin, alkaloids, polyphenols, and flavonoids than when it is grown elsewhere in the world [41].

The herbalists said that some plants have been trusted and tested on several patients with different conditions. To every herbal preparation, such plant be part of the therapies must be included in the mixture or, in most cases, used alone. These responses are best understood by applying the "Plant Values Hypothesis" 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[38].

Conclusions and recommendations

The study revealed that residents of Sironko and Bulambuli frequently rely on a variety of plant species for treating various cancers. These plant species are extremely beneficial to those who cannot afford modern therapeutic cancer medications or whose cancer healthcare facilities are difficult to reach due to the area's distance from the Uganda Cancer Institute (UCI). The locals still have a tradition of using medicinal plants to treat cancer, and because of this, it is important to maintain the integrity of the forest and indigenous knowledge of herbal medicine use. The majority of medicinal plant species are members of the Fabaceae and Asteraceae families, and it is commonly known that these plants are utilized throughout the world to treat a variety of illnesses. There was no herbalist who claimed to have learned this information through technical training, which indicated that the herbal sector was not at all integrated into the established healthcare system. There was broad agreement over the plant species utilized to treat various cancers,

which is a definite sign that these species are thought to be efficient and deserving of further research for their bioactive chemicals and related pharmacological activities. This could serve as the cornerstone for the discovery of new anticancer drug and will be crucial in determining the dosage, toxicity, and efficacy levels of various herbal preparations.

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 (UNCST), also registered this study (HS3007ES). 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 data, the participants were not required to submit their names in any way.

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 partially funded under the research and innovation grant awarded to the Islamic University of Uganda (IUIU) by the Islamic Development Bank (IUIU-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 have 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. 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. Feng RM, Zong YN, Cao SM, Xu RH. Current cancer situation in China: Good or bad news from the 2018 Global Cancer Statistics? *Cancer Commun.* Apr. 2019;39(1). 10.1186/s40880-019-0368-6.
2. Sung H, "Global Cancer Statistics. 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries," *CA. Cancer J. Clin.*, vol. 71, no. 3, pp. 209–249, 2021, 10.3322/caac.21660.
3. Benarba B. Medicinal plants used by traditional healers from South-West Algeria: An ethnobotanical study. *J Intercult Ethnopharmacol.* 2016;5(4):320.
4. Singh D, Vaccarella S, Gini A, De Paula Silva N, Steliarova-Foucher E, Bray F. Global patterns of Hodgkin lymphoma incidence and mortality in 2020 and a prediction of the future burden in 2040. *Int J Cancer.* 2022;150(12):1941–7.
5. Adeloye D, et al. An estimate of the incidence of prostate cancer in Africa: a systematic review and meta-analysis. *PLoS ONE.* 2016;11(4):e0153496.
6. Bray F, 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.* 2022;23(6):719–28. [https://doi.org/10.1016/S1470-2045\(22\)00270-4](https://doi.org/10.1016/S1470-2045(22)00270-4).
7. Katongole P, Sande OJ, Joloba M, Reynolds SJ, Niyonzima N. The human microbiome and its link in prostate cancer risk and pathogenesis. *Infect Agent Cancer.* 2020;15:1–8.
8. Asasira J, et al. Infection-related and lifestyle-related cancer burden in Kampala, Uganda: projection of the future cancer incidence up to 2030. *BMJ Open.* 2022;12(3):e056722.
9. Zhai Z et al. "Incidence and disease burden of prostate cancer from 1990 to 2017: Results from the Global Burden of Disease Study 2017," *Cancer*, vol. 126, no. 9, pp. 1969–1978, Jan. 2020, 10.1002/cncr.32733.
10. London W, Petrick J, McGlynn K, Lindsey A. *Cancer Epidemiology and Prevention*. Oxford: Oxford University Press; 2018.
11. Ssenku JE, et al. Medicinal plant use, conservation, and the associated traditional knowledge in rural communities in Eastern Uganda. *Trop Med Health.* 2022;50(1):1–10.
12. Tugume P, Nyakoojo C. Ethno-pharmacological survey of herbal remedies used in the treatment of paediatric diseases in Buhunga parish, Rukungiri District, Uganda. *BMC Complement Altern Med.* 2019;19(1). 10.1186/s12906-019-2763-6.
13. Tugume P, et al. Ethnobotanical survey of medicinal plant species used by communities around Mabira Central Forest Reserve, Uganda. *J Ethnobiol Ethnomed.* 2016;12(1). 10.1186/s13002-015-0077-4.
14. Abebe BA, Chane Teferi S. "Ethnobotanical study of medicinal plants used to treat human and livestock ailments in Hulet Eju Enese Woreda, east Gojjam zone of Amhara region, Ethiopia," *Evidence-Based Complement. Altern. Med.*, vol. 2021, 2021.
15. Obakiro SB, 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.* 2020;48(1):1–21.

16. Tugume P, et al. Ethnobotanical survey of medicinal plant species used by communities around Mabira Central Forest Reserve, Uganda. *J Ethnobiol Ethnomed*. 2016;12(1):1–28.
17. Kyazze FB, Mubangizi N, Mukwaya PI, Kyamanywa S. 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.
18. Kudamba A 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.
19. Allan B, Gorettie N, Michael JJNG, Banana A. Perceptions of Climate Variability in the Mt. Elgon sub-region, Eastern Uganda. *Cogent Environmental Science*; 2016.
20. Kudamba A, et al. Assessment of Knowledge, Perception, Attitude, Risk Factors Prevention, and Treatment Options of Cancer among Natives in Elgon Sub-Region, Uganda. *Fortune J Heal Sci*. 2022;5:472–87.
21. Martin GJ. "Ethnobotany: a methods manual," 1995.
22. STATISTICS UBOF. "WAVE VII REPORT," 2020.
23. Creswell JW, Shope R, Plano Clark VL, Green DO. How interpretive qualitative research extends mixed methods research. *Res Sch*. 2006;13(1):1–11.
24. Taber KS. The use of Cronbach's alpha when developing and reporting research instruments in science education. *Res Sci Educ*. 2018;48:1273–96.
25. Deeb T, Knio K, Shinwari ZK, Kreydiyyeh S, Baydoun E. Survey of medicinal plants currently used by herbalists in Lebanon. *Pak J Bot*. 2013;45(2):543–55.
26. Hedberg I. Botanical methods in ethnopharmacology and the need for conservation of medicinal plants. *J Ethnopharmacol*. 1993;38:2–3.
27. Kipiro D, Robert K. "Laboratory Manual For Collecting and Processing of plant species & Processing of Plant Samples 2017," 2017.
28. Martin GJ. *Ethnobotany: a methods manual*, Chapman y Hall, Nowy Jork, 1995.
29. Raphael E. "Phytochemical constituents of some leaves extract of Aloe vera and Azadirachta indica plant species," *Glob. Adv. Res. J. Environ. Sci. Toxicol.*, vol. 1, no. 2, pp. 14–017, 2012, [Online]. Available: <http://garj.org/garjest/index.htm>.
30. Ssenku JE, et al. Medicinal plant use, conservation, and the associated traditional knowledge in rural communities in Eastern Uganda. *Trop Med Health*. 2022;50(1):1–10. 10.1186/s41182-022-00428-1.
31. Farooq A, Amjad MS, Ahmad K, Altaf M, Umair M, Abbasi AM. Ethnomedicinal knowledge of the rural communities of Dhirkot, Azad Jammu and Kashmir, Pakistan. *J Ethnobiol Ethnomed*. 2019;15(1). 10.1186/s13002-019-0323-2.
32. Hassan D, Omer B, Salih F, Abdulrahman MD. "Medicinal Plants Used for Immune Booster in The Kurdistan Region, Iraq," *NAYREC-2022*, p. 39, 2022.
33. Septiani S, et al. Choosing Herbal Toothpaste: Study on Consumer Behavior and Preferences in The Greater Jakarta Area. *J Apl Bisnis dan Manaj*. 2022;8(3):758.
34. Walusansa A, et al. Herbal medicine used for the treatment of diarrhea and cough in Kampala city, Uganda. *Trop Med Health*. 2022;50(1):1–21.
35. Monteiro CA, Cannon G, Moubarac J-C, Levy RB, Louzada MLC, Jaime PC. The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing. *Public Health Nutr*. 2018;21(1):5–17. 10.1017/S1368980017000234.

36. Gaoue OG, Coe MA, Bond M, Hart G, Seyler BC, McMillen H. Theories and major hypotheses in ethnobotany. *Econ Bot.* 2017;71:269–87.
37. Akeel MMA, Ghamdi WMA, Habib SA, Koshm M, Otaibi FA. Herbal medicines: Saudi population knowledge, attitude, and practice at a glance, *J Fam Med Prim Care*, vol. 7, no. 5, p. 865.
38. Orou G, Michael A, Mathew B, Georgia H, Barnabas C, Heather M. Theories and Major Hypotheses in Ethnobotany. New York: New York Botanical Garden Press, Bronx,; 2017.
39. Tugume P, et al. Ethnobotanical survey of medicinal plant species used by communities around Mabira Central Forest Reserve, Uganda. *J Ethnobiol Ethnomed.* 2016;12(1). 10.1186/s13002-015-0077-4.
40. Chen S-L, Yu H, Luo H-M, Wu Q, Li C-F, Steinmetz A. Conservation and sustainable use of medicinal plants: problems, progress, and prospects. *Chin Med.* 2016;11:1–10.
41. Omara T 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.
42. Chaachouay N, Benkhniq O, Fadli M, Ayadi RE, Zidane L. Ethnobotanical study of medicinal plants used to treat osteoarticular diseases in the Moroccan Rif, Morocco. *J Pharm Pharmacogn Res.* 2019;7(6):454–70.
43. Farooq A, Amjad MS, Ahmad K, Altaf M, Umair M, Abbasi AM. Ethnomedicinal knowledge of the rural communities of Dhirkot, Azad Jammu and Kashmir, Pakistan. *J Ethnobiol Ethnomed.* Aug. 2019;15(1). 10.1186/s13002-019-0323-2.
44. Mlilo S, Sibanda S. An ethnobotanical survey of the medicinal plants used in the treatment of cancer in some parts of Matebeleland, Zimbabwe. *South Afr J Bot.* 2022;146:401–8. <https://doi.org/10.1016/j.sajb.2021.11.022>.
45. Jima TT, Megersa M. "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.
46. Tugume P, et al. Ethnobotanical survey of medicinal plant species used by communities around Mabira Central Forest Reserve, Uganda. *J Ethnobiol Ethnomed.* 2016;12(1). 10.1186/s13002-015-0077-4.
47. Mohammed AS, Berhanu AT. Ethnobotanical survey of traditional medicinal plants in Tehuledere district, South Wollo, Ethiopia. *J Med Plants Res.* 2011;5(26):6233–42.
48. Calzada F, Bautista E. Plants used for the treatment of diarrhoea from Mexican flora with amoebicidal and giadicial activity, and their phytochemical constituents. *J Ethnopharmacol.* 2020;253:112676.
49. Missoa R-L, Sima-Obinga C., JDL, Ndonga J, Ondo G, Ndong-Atom, and, Abessolo FO, et al. Medcinal Plants Used in the Management of Cancer and Other Related Diseases in In Woleu-Ntem Provice, Gabon. *Eurpoen J Integr Med.* 2019;29:100924.
50. Picking D, Younger N, Mitchell S, Delgoda R. The prevalence of herbal medicine home use and concomitant use with pharmaceutical medicines in Jamaica. *J Ethnopharmacol.* 2011;137(1):305–11. <https://doi.org/10.1016/j.jep.2011.05.025>.
51. Bussa NF, Belayneh A. Traditional medicinal plants used to treat cancer, tumors and inflammatory ailments in Harari Region, Eastern Ethiopia. *South Afr J Bot.* 2019;122:360–8. 10.1016/j.sajb.2019.03.025.
52. Kudamba A, 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.* 2022;5(3):461–71.

Plates

Plates 1 and 2 are available in the Supplementary Files section

Figures

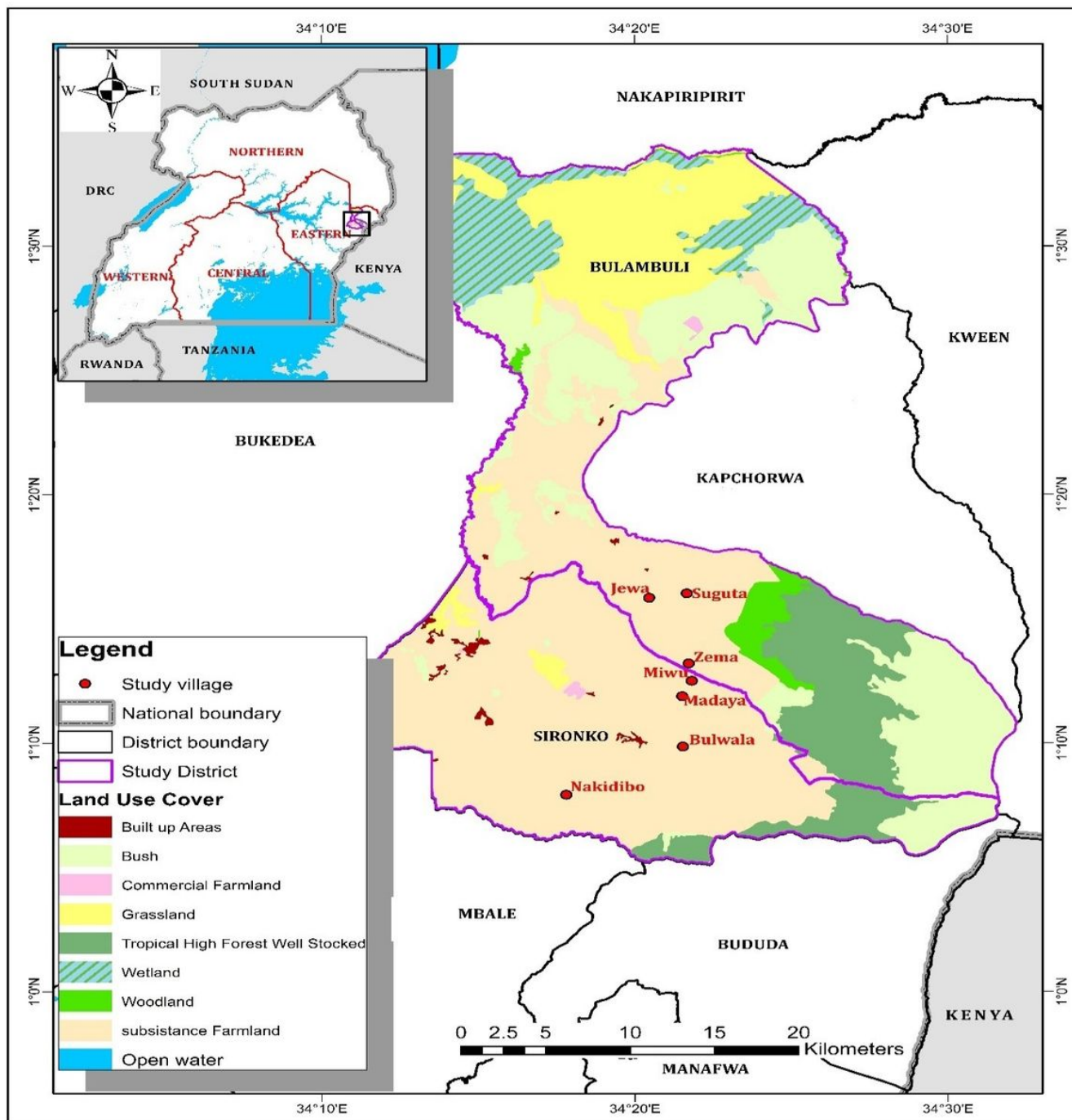


Figure 1

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

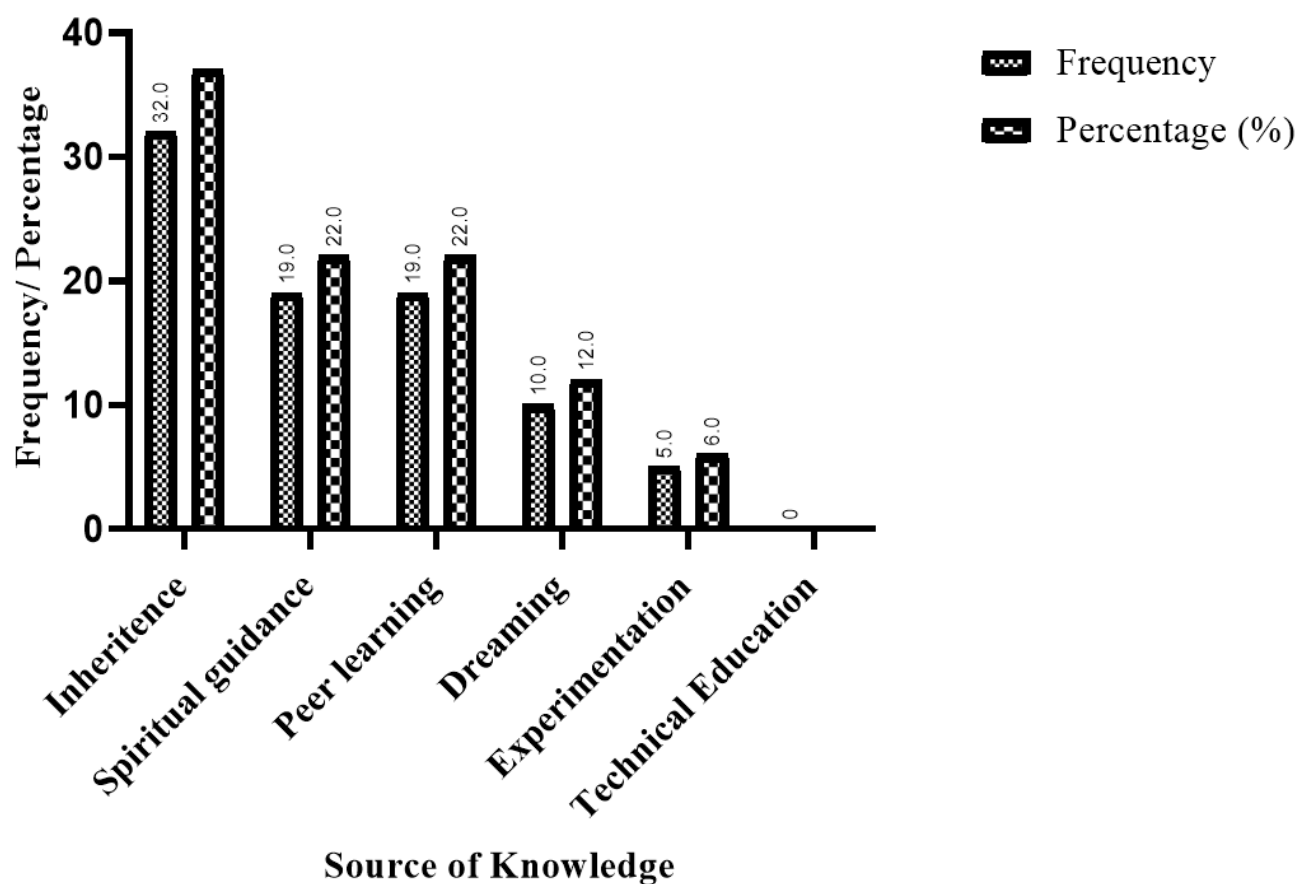


Figure 2

Source of Knowledge of Medicinal Plants

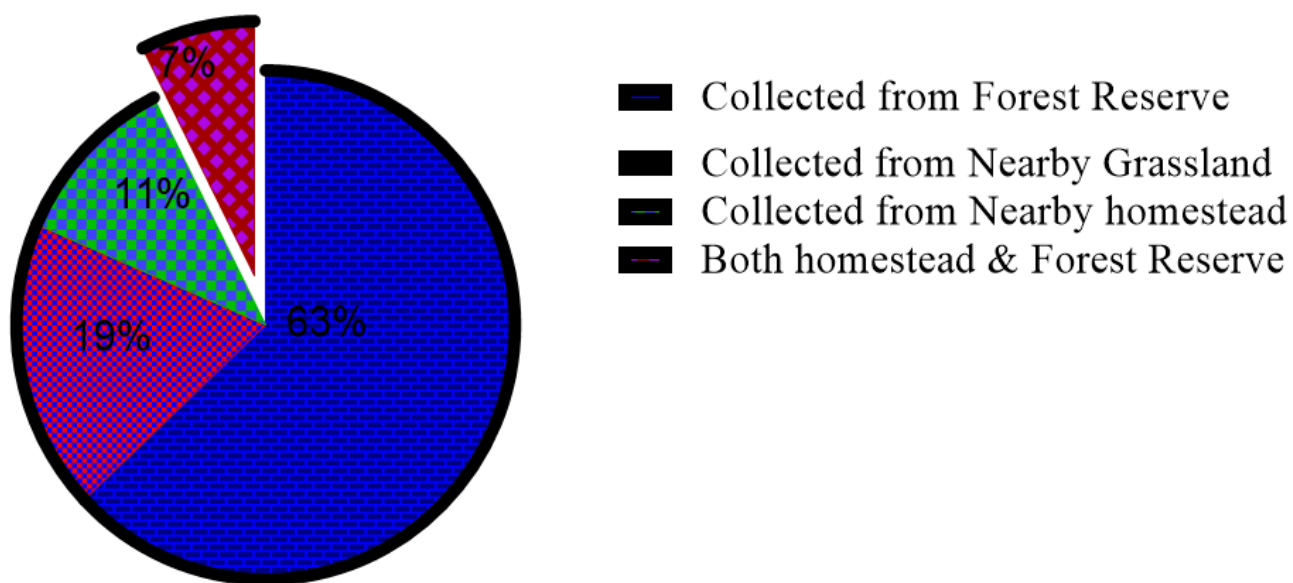


Figure 3

Source of Medicinal Plants

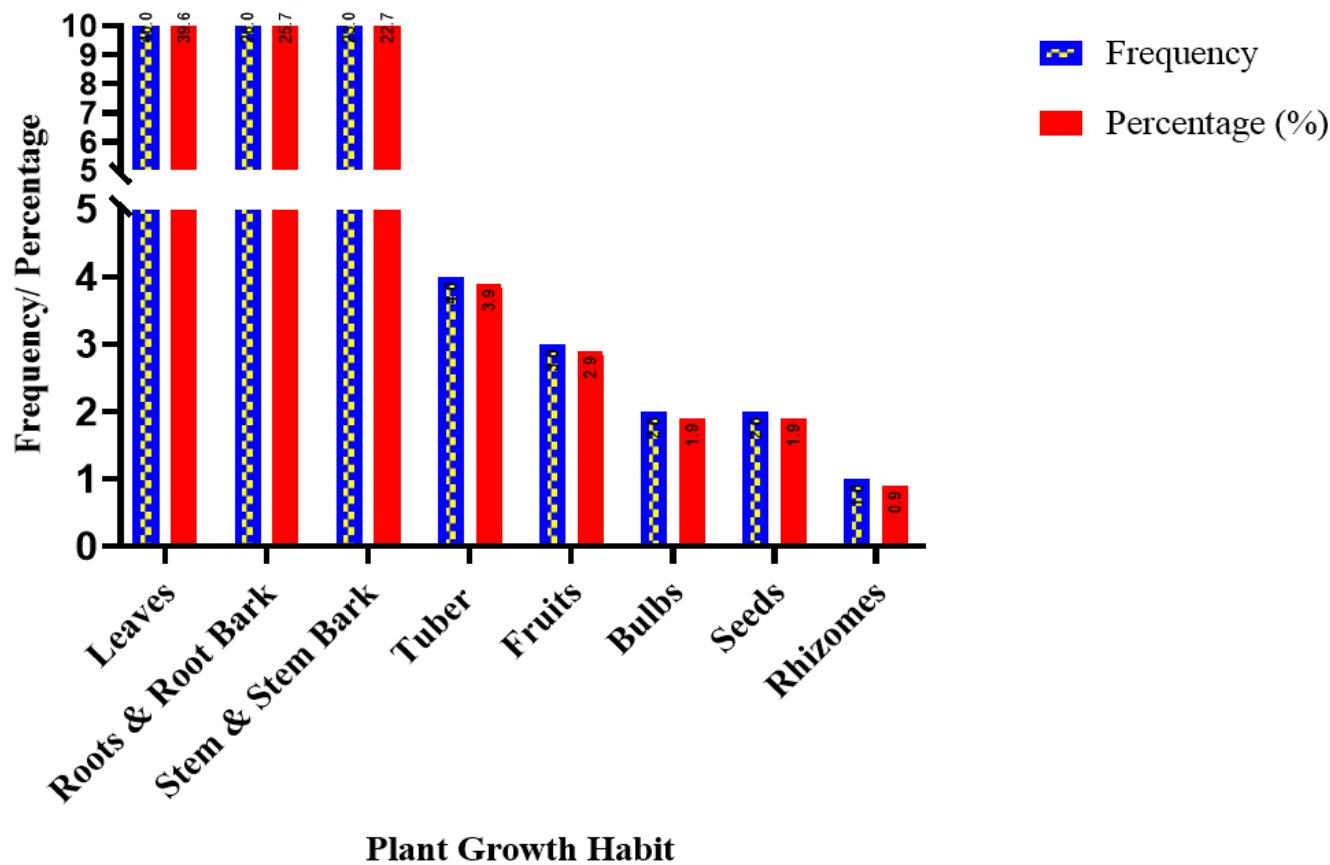


Figure 4

Plant Parts used to prepare Herbal Remedies

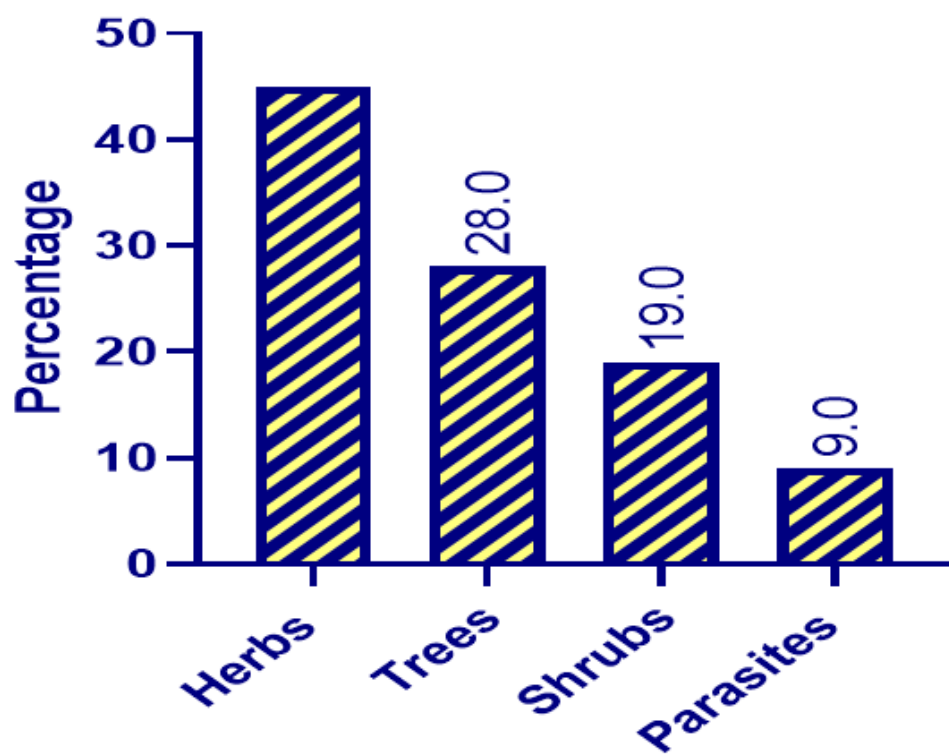


Figure 5

Plant Growth Habits

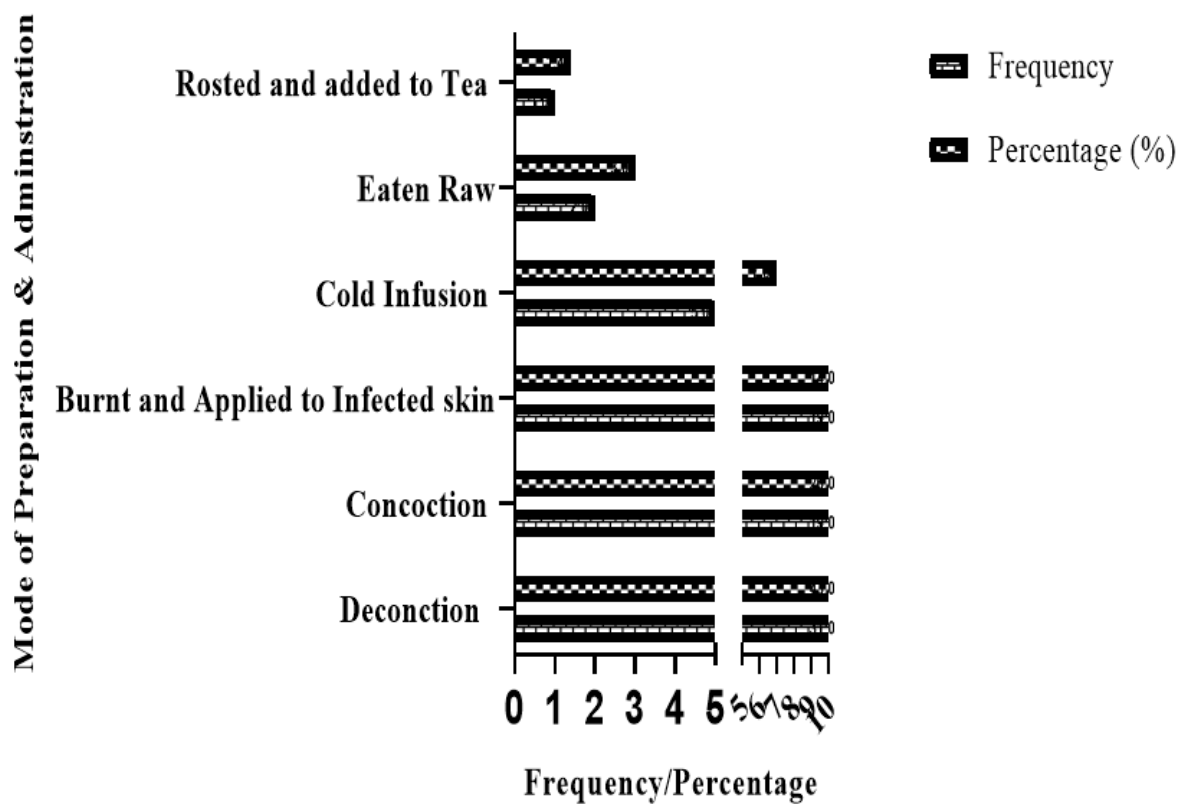


Figure 6

Modes of Preparation and Administration of Traditional Medicine

Supplementary Files

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

- [Plate1.png](#)
- [Plate2.png](#)